18th National Nutrient Databank Conference Proceedings

Food Composition Data:

"Moving Into the Next Century"

May 23-26, 1993
Crown Sterling Suites Hotel
Baton Rouge, Louisiana

Compiled and edited by H. Raymond Allen, Ph.D. and Catherine M. Champage, Ph.D.

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

FOREWORD

The 18th Annual National Nutrient Databank Conference was held in Baton Rouge, LA on May 23-26, 1994. The conference is organized by several committees of volunteers who give of their time and skills generously to assure a successful and informative meeting for all attendees. Chairs of the 1993 conference committees were: Steering Committee, Al Riley of Campbell Soup Company; Program Committee, Carol Windham of Utah State University; Database Committee, Jack Smith of the University of Delaware; Ad Hoc Committee on Citing Nutrient Databases, Suzanne Murphy; and Arrangements Committee, Catherine Champagne of Pennington Biomedical Research Center. Special thanks go to the rest of the Arrangements Committee: Ray Allen, Mary Boudreau, Kevin Gilley, Pat Marquette, Jeanette Noble, Donna Ryan, Janice Walker, Pennington Biomedical Research Center; Steele Burden, Burden Research Plantation, Louisiana State University; and Pat Pillow, M.D. Anderson Cancer Center. A note of thanks to Eileen DeLeeuw of Utah State University for her help in assisting the Program Committee.

Special thanks go to The International Life Sciences Institute, who donated the cost of printing and distributing the proceedings of this conference. The conference organizers would also like to express thanks to Jack Smith of the University of Delaware and Suzanne Murphy of the University of California, Berkeley for providing notebooks from the previous two conferences to assist in developing a successful conference. The organizational and computer skills of Ray Allen of Pennington Biomedical Research Center were invaluable in helping to plan the conference (registration and other organizational details) and for help in preparing this publication.

The NNDC organizers extend sincere appreciation to the following Federal agencies for their support: Human Nutrition Information Service, United States Department of Agriculture; National Center for Health Statistics, Center for Disease Control, Department of Health and Human Services; and Human Nutrition, United States Department of Agriculture and Agricultural Research Service. The following national corporations are also thanked for their support: Campbell Soup Company, The Coca-Cola Company, CPC International-Best Foods Division, Frito Lay-Pepsico Foods International, General Mills-Nutrition Department, Hershey Foods, Kellogg's, Kraft General Foods, Merck & Co., Inc., Nabisco Foods Group, and Training Table Systems. In addition, the following local companies extended financial assistance: Associated Grocers, Inc., Franklin Press, LouAna Foods, and Silo.

ACKNOWLEDGEMENTS

Major funding for The 18th National Nutrient Databank Conference was provided by the following United States Government agencies:

Human Nutrition Information Service
United States Department of Agriculture

National Center for Health Statistics
Center for Disease Control,
Department of Health and Human Services

Human Nutrition
United States Department of Agriculture and Agricultural Research Service

The NNDC extends sincere appreciation to the individuals representing these agencies that have made this support possible.

ACKNOWLEDGEMENTS

The 18th National Nutrient Databank Conference wishes to thank the following groups, listed in alphabetical order, for their generous and enthusiastic support:

ASSOCIATED GROCERS, INC.
P.O. Box 261748 • Baton Rouge, LA 70826-1748

Frito Lay PEPSICO FOODS INTERNATIONAL

LOUISIANA
Opelousas, Louisiana

Campbell SOUP Company
CAMDEN, N.J. 08103-1799

General Mills, Inc.
NUTRITION DEPARTMENT

MERCK & CO., INC.

The Coca-Cola Company
COCA-COLA PLAZA
ATLANTA, GEORGIA

NABISCO FOODS GROUP

Hershey Foods

CPC International Best Foods Division

Silo
A Subsidiary of Dixons Group plc

Kellogg's of Battle Creek

FRANKLIN PRESS

KRAFT GENERAL FOODS

Training Table Systems

18TH NATIONAL NUTRIENT DATABANK CONFERENCE

NNDC

FOOD COMPOSITION DATA: "MOVING INTO THE NEXT CENTURY"

Sunday May 23, 1993

12 noon - 6:00 pm **Registration** *Hotel Lobby*

5:30 - 7:30 pm **Welcoming Reception** *Hotel Atrium*

Monday Morning May 24, 1993

7:30 - 8:15 am **Registration** *Ballroom Foyer*

Opening Session *Assembly-Caucus Rooms*

8:15 am **Welcome**

George Bray, Executive Director, Pennington Biomedical Research Center, LSU
Al Riley, Steering Committee Chair, Campbell Soup Company
Catherine Champagne, Host, Pennington Biomedical Research Center, LSU

8:45-9:30 am **Keynote Address: "Facets of the Crystal Ball"**

Introduction: Carol Windham, Program Chair, Utah State University
Keynote Speaker: Kristen W. McNutt, PhD, JD, President, Consumer Choices, Inc.

9:30-10:30 am **Panel: Moving Into the Next Century**

Moderator: Kristen W. McNutt, PhD, JD
Analytical Methods Challenges: Gary Beecher, Nutrient Composition Lab
Databases: Loretta Hoover, University of Missouri
Industry Issues: Ann C. Grandjean, Center for Human Nutrition, Omaha, NE

10:30-10:45 am **Break/Exhibits/Posters** *Ballroom Foyer/Senate Room*

10:45-12:15 **Ethnic Diversity and Nutrient Databases**

Moderator: Catherine Champagne, Pennington Biomedical Research Center, LSU
Hispanic Foods: Mary Elena Martinez, University of Texas
Asian American Foods: The Need of a Nutrient Composition System for International Use, Rose Tseng, San Jose State University
Capturing Ethnic Diversity in the Database: Suzanne Murphy, University of California, Berkeley

12:15-12:30 pm **Committee Reports**

Moderator: Catherine Champagne, Pennington Biomedical Research Center, LSU
Citing Nutrient Databases: Suzanne Murphy, University of California, Berkeley
Database Committee: Jack Smith, University of Delaware
1994 Arrangements: Loretta Hoover, University of Missouri

12:30-2:00 pm **Lunch and Vendor Presentations** ***Monet Room***

Moderator: Phyllis Stumbo, University of Iowa

Exhibits/Posters Open - *Senate Room*

Monday Afternoon May 24, 1993

2:00-3:00 pm **Concurrent Sessions**

A) **Current Issues in Analytical Methodologies** ***Caucus Room***
Moderator: Joanne Holden, Nutrient Composition Laboratory, USDA
Total Genistein, Diadzein & Glycitein Content of Soyfoods:
Patricia A. Murphy, Iowa State University
Determination of Trans Fatty Acids in Dietary Fats,
W.M. Nimal Ratnayake, Health and Welfare, Canada
The Impact of the Nutrition Labeling and Education Act (NLEA) on Fat Analysis:
Donald E. Carpenter, Kraft General Foods
From Clinical Chemistry to Food Chemistry: The Pennington Experience,
Richard Tulley and Fatemah Ramezanzadeh, Pennington Biomedical Research Center

B) **Collecting Brand Names in National Surveys** ***Assembly Room***
Moderator: Ruth H. Matthews, HNIS, USDA
What are the Issues? Margaret McDowell, NCHS, CDC, DHHS
Brand Names in the USDA Survey Food Coding Data Base,
Linda Ingwersen, HNIS, USDA
Issues Related to Increasing Brand Names in the Survey Nutrient Data Base,
Sue Gebhardt, HNIS, USDA

3:30 - 3:45 pm **Break/Exhibits/Posters** ***Ballroom Foyer/Senate Room***

3:45-5:15 pm **Concurrent Sessions**

A) **Recipes: Methods, Problems, and Issues** ***Assembly Room***
Moderator: Loretta Hoover, University of Missouri

I. Recipe Calculation Methods

Yield Factor and Summation Methods,
Grace J. Petot, Case Western Reserve University
Recipe Calculations: Nutrient Retention Factor Method,
Kristin Marcoe, USDA, HNIS

II. Problems and Issues Associated with Recipes

Recipe Information Obtained During Dietary Survey Interviews–The NHANES III Experience,
Margaret McDowell, DHHS, CDC, NCHS

Coding Recipes: Dilemmas and Decisions,
Betty Perloff, USDA, HNIS

Problems and Issues Related to Calculating Recipes in Several Settings,
Grace J. Petot, Case Western Reserve University

Questions and Answers

B) Nutrition at Either End of the Life Cycle *Caucus Room*

Moderator: Helaine Rockett, Channing Labs/Harvard Medical School

Patterns of Food and Nutrient Intake Among the Elderly,
Katherine Tucker, Tufts University Center on Aging

Development and Reproducibility of a Young Adult's Food Frequency Questionnaire,
Helaine Rockett, Channing Labs/Harvard Medical School

The Relationship Between Nutrients and Foods in Children's Diets,
Pat Crawford, University of California, Berkeley

Nutrient Intakes of American Children Ages 2 to 10 Years,
Ann Albertson, General Mills, Inc.

6:00 – 10:00 pm Cajun Night (Cocktails, Cajun Cuisine, and Music)
Pennington Biomedical Research Center (with small group tours)

Tuesday Morning May 25, 1993

7:30-8:00 am Posters Open *Senate Room*

8:00-9:40 am Updates *Assembly-Caucus Rooms*

Moderator: Jack L. Smith, University of Delaware
USDA Nationwide Food Surveys, Ellen W. Harris, Director, Nutrition Monitoring Division, HNIS, USDA
USDA Nutrient Data, Ruth H. Matthews, HNIS, USDA
NHANES III, Margaret McDowell, NCHS, CDC, DHHS

Total Diet Study & Nutrition Labeling,
Jean Pennington, Center for Food Safety & Applied Nutrition, FDA

International Interface Standard and LANGUAL,
Jean Pennington, Center for Food Safety & Applied Nutrition, FDA

USDA Nutrient Composition Laboratory Update,
Gary R. Beecher, Leader, Nutrient Composition Laboratory, USDA

9:30-10:30 am Food Analysis 101: How to Get Good Data
Assembly-Caucus Rooms

Introduction: Jack L. Smith, University of Delaware
Speaker: JoAnne M. Holden, Nutrient Composition Laboratory, USDA

10:30-10:45 am Break/Exhibits/Posters *Ballroom Foyer/Senate Room*

10:45-12:15 **Database Quality and Variability** *Assembly-Caucus Rooms*

Moderator: Jack L. Smith, University of Delaware

Criteria of Quality and Sources of Variability,
Jack L. Smith, University of Delaware

Database Accuracy - Strengths, Weaknesses, and Quality Control,
Elizabeth Hands, ESHA Research

Nutrient Variability, Jean Pennington, Center for Food Safety and Applied Nutrition, FDA

12:15-1:45 pm **Lunch and Vendor Presentations** *Monet Room*

Moderator: Phyllis Stumbo, University of Iowa

Exhibits/Posters open *Senate Room*

Tuesday Afternoon May 25, 1993

1:45-3:15 pm **Concurrent Sessions**

A) **Carbohydrates: Beyond Proximate Analysis** *Caucus Room*

Moderator: Joanne Holden, Nutrient Composition Laboratory, USDA

Nutrition Labeling of Carbohydrates: Definition, Analyses, and Caloric Calculations,
Betty Wang Li, Nutrient Composition Laboratory, USDA

Carbohydrate Data: Present and Future Needs,
Karen W. Andrews, HNIS, USDA

Carbohydrate Based Food Ingredients: Use, Energy Value, and Analysis,
John S. White, A.E. Staley Manufacturing Co.

B) **Nutrition Monitoring in the States: Experiences, Benefits, and Outcomes** - *Assembly Room*

Moderator: Alanna J. Moshfegh, HNIS, USDA

Daily Fruit and Vegetable Consumption Among Vermonters,
Alison Gardner, Vermont Department of Health

Knowledge, Attitudes and Beliefs about Diet and Cancer in Appalachian Ohio
Barbara Pryor, Ohio Department of Public Health

Developing a State Nutrition Surveillance Monitoring Program: Problems and Possibilities,
Tom Melnik, New York State Health Department

Methodological Issues in Analyzing School Menus,
Pat McKinney, FNS, USDA

Reactor: Colette Zyrkowski, NCCDPHP, CDC, HNIS

3:15-3:30 pm **Break/Exhibits/Posters** *Ballroom Foyer/Senate Room*

3:30-5:00 pm **Concurrent Sessions**

A) **USDA Survey Nutrient Data Base System: Workshop on File Formats**–*Caucus Room*

Moderator: Betty Perloff, HNIS, USDA

Development of a New Database Format for USDA's CSFII Food Codes,
Randy LaComb, HNIS, USDA

Recipe and Nutrient File Formats, Nancy Raper, HNIS, USDA

Programmers' Perspective - Use of Formats in Other Systems,
Lois Steinfeldt, University of Texas

B) International & Ethnic Foods Databases *Assembly Room*

Moderator: Suzanne Murphy, University of California, Berkeley

Nutrient Composition of Selected Ethnic Foods,
Lisa Oehrl, Southern Testing and Research Laboratory

The Mexican Database and Its Use in the CRSP Project,
Jeff Backstrand, University of Connecticut

FAO and Food Databases for Developing Countries,
Gustaaf P. Sevenhuysen, University of Manitoba

Collaborations Between INFOODS and FAO to Expand Sources of International Nutrient Data,
John Klensin, INFOODS Secretariat

6:00 - 10:00 pm Annual Banquet, *White Oak Plantation, Baton Rouge, LA*
6:00 - 7:00 pm - Cash Bar
7:00 Dinner
Speaker: Jules d'Hemecourt, the Quintessential Cajun Raconteur
LSU Manship School of Mass Communication

Wednesday Morning May 26, 1993

All Sessions ***Assembly-Caucus Rooms***

8:00-10:30 am Use of Nutrient Databases for Nutrition Labeling

Moderator: Jean Pennington, Center for Food Safety & Applied Nutrition, FDA

USDA and FDA Policies Concerning the Use of Databases for Labeling
Linda Posati, Food Safety and Inspection Service, USDA
Mary M. Bender, Center for Food Safety & Applied Nutrition, FDA

Industry Use of Databases for Nutrition Labeling

AIB's Model System for Nutrition Labeling of Bakery Foods,
James Vetter, American Institute of Baking

Use of a Custom Database for Nutrition Labeling and Consumer Information,
Janet Helm, McDonald's Corporation

Database Considerations for In-Store Nutrition Shelf Labeling,
Karen Falk, Graphic Technology, Inc.

10:30-10:45 am Break/Exhibits ***Ballroom Foyer/Senate Room***

10:45-11:45 am National Nutrition Monitoring Program--From Legislation to Action: First Year Progress and Future Directions. (Ten-Year Plan for Nutrition Monitoring; Publications and Reports; National Nutrition Monitoring Advisory Council)

Introductions: Suzanne Murphy, University of California, Berkeley
Alanna J. Moshfegh, HNIS, USDA
Colette Zyrkowski, NCCDPHP, CDC, DHHS

11:45 am-12:15 pm Capstone: "Current Status, Continuing Challenges"
Carol T. Windham, Utah State University

12:15 **Evaluation/Adjournment**

12:30-2:00 **Ask the Experts over Lunch**

Moderator: Ruth Matthews: Food Composition and Data Issues

Panel: David Haytowitz: Nutrient Data Tapes, Bulletin Board

Betty Perloff: Survey Nutrient Database

Alanna Moshfegh: 10 Year Plan for Nutrition Monitoring, Nutrition Monitoring Advisory Council

Margaret McDowell, NHANES III

Gary Beecher, Nutrient Composition Laboratory

New Users Workshop

Getting Started: An Overview of Nutrient Databases
Suzanne P. Murphy, *University of California, Berkeley*

Nutrient Data Bases and Computerized Diet Analysis Systems: An Annotated Bibliography
Suzanne P. Murphy, *University of California, Berkeley*

Data Sources, Conventions and Terminology
David B. Haytowitz, *USDA-HNIS*

How to Select a Nutrient Database Application
Phyllis Stumbo, *University of Iowa*

What Do I Need and Why?
Loretta White Hoover, *University of Missouri-Columbia*

Now What Do I Do?
R. Sue McPherson, *University of Texas*

Getting Started: An Overview of Nutrient Databases

Suzanne P. Murphy, Ph.D., R.D., University of California, Berkeley

The purpose of this overview is to acquaint new users with the basic concepts and terminology necessary to become knowledgeable about nutrient databases. I will cover some information about the definition, format, terminology, and features of nutrient databases. I realize this will be at least a partial review for many of you, but I hope it will be useful to establish a baseline of knowledge for everyone.

There is increasing awareness of the link between diet and disease, and therefore increasing interest in dietary nutrient data by consumers and nutrition professionals alike. Many consumers are reading the nutrition information on labels, and the upcoming revisions to the labeling standards have certainly increased interest even more. As a result, nutritionists are being called upon as a resource to guide colleagues in the health professions, as well as the public, in determining the nutrient content of the food we eat. We all know this is a complex task. Thus, this conference is held annually and provides a forum for the exchange of ideas and methods for better performing tasks concerned with compiling and using nutrient data.

To begin, I'd like to comment on the distinction between a food composition table and a nutrient database. Generally, we reserve the former term for printed tables showing the nutrient composition of foods (e.g., books such as USDA Handbook No. 8 (1)), and the latter for the same type of data, but in electronic form (e.g., disks and tapes). The amount of data available currently make it impractical for most people to keep paper copies of all the information. Furthermore, it is a tedious and time-consuming task to try to determine the nutrient content of multiple foods (such as in a diet) by looking up all the foods in a printed table. As a result, this conference focuses primarily on electronic nutrient databases although in many cases the data also exist in printed form as well.

Why are nutrient databases so crucial for dietary assessment and dietary design? Primarily because, given the complexity of our food supply, and the expense of chemical analyses, few nutritionists can afford to actually analyze food samples. As a result, we must rely on published and electronic food composition data.

If one is to keep data in electronic form, one must have both computer hardware and software to access it. As for the hardware—the computer itself—you all are very aware that the choice of computers currently available is almost overwhelming, and that it changes daily. Ten years ago, it was necessary to have access to a large (mainframe) computer system to do much with nutrient databases; and since it was very expensive to keep data on the mainframe tapes or disks, you saw people walking around with decks (or boxes) of computer cards in their hands. Today, it is much more common to work with personal computers. Not only has our dependence on cards disappeared, but the use of display screens saves reams of paper. The switch to personal computers (PC's) has had an enormous impact on dietary assessment technology. Most of us have PC's on our desks, so, with the proper programs, we can analyze a subject's diet in a few minutes. Furthermore, many of our subjects can analyze their <u>own</u> diets in an equally short time. Through a modem, we can be in touch with other systems and users, using phone lines. There are many other hardware features we could discuss, but time doesn't permit me give a hardware overview. As you will see from the exhibits at this conference, almost all of the nutrient databases available today use PC's, but there is a wide variety of specific types in use.

What does a typical nutrient database contain? Generally the same information as is in a typical printed food composition table: usually there is a record (line of data) for each food item, and a field (data value) for each nutrient. In addition, there is some kind of identifier for the food item: usually an identifying code, and often a full alphabetic name as well. Thus, at a minimum, the record for each food item will contain the food identifier and the amount of each nutrient in a specified amount of the food. Often the default amount is 100 grams (i.e., the nutrient values are the amounts contained in 100 grams of the food item). This is useful for people compiling nutrient data, but not very useful for people using it; we want to be able to determine how much is in a cup or a tablespoon of the food. Thus, virtually all databases have some information of the weight of a usual "portion". Sometimes, the nutrient data will be for one of these usual portions, rather than for 100 grams (i.e., the vitamin C in a cup of orange juice), sometimes the data will still be for 100 grams, but the weight of a cup will be contained in a separate field on the database; the nutrient calculation program can then multiply all the nutrient values by the appropriate weight. As you can imagine, there are many ways of organizing portion size data on the database. For some databases, the same food is carried multiple times, once for each portion size; there might be an entry for one medium peach, one cup of peach slices, and 3 ounces of peaches. This is somewhat a holdover from printed tables, since computer programs can readily recalculate the nutrient content of differing portions. Duplicate entries for the same food item will inflate the apparent size of a nutrient database; there may be 1000 food records, but only 500 different food items.

Databases often contain other information about the foods and nutrients. Some examples would be: food group codes; the number of dietetic exchanges; flags for allergens like lactose and gluten; codes for the sources of the nutrient data; refuse factors for converting "as purchased" weights to "edible portion" weights.

This leads us to consider the size of a nutrient database. Generally the size is a direct function of the number of food items (rows) and the number of nutrients (columns). With the price of computers, and particularly of disk storage, falling, it is often the case that bigger is better. It's very frustrating not to have the exact food that was in the diet, and have to figure out something close to it as a substitute; furthermore, it can be quite inaccurate. Precision (how closely you can match the food consumed with a food on the database) can be increased by having larger databases. Even more important is having all the nutrients that interest you and your subjects. The key here is to decide if you need to pay for the additional accuracy of a large database, for your application. For some types of research, accuracy is very important; for classroom use, it may be less critical. If your hardware can support a large nutrient database (i.e., it has enough storage space and doesn't take a long time to find each food item), then you may want to invest in a large database, particularly for research projects. However, large databases do have some disadvantages: they usually cost more to purchase and keep current, and the potential for error is much greater. Thus, it is particularly important to select one that is carefully compiled and maintained.

When selecting nutrient databases, it's obviously crucial to find out the sources of the nutrient data. The "core" of most U.S. databases is from data compiled by the U.S. Department of Agriculture. The next speaker will tell us more about these data. Many database compilers also use other sources; commonly, information from the food industry is also incorporated (often called "brand-name" data). Many food manufacturers supply these data directly to database compilers; in other cases, the data are taken from the nutrition labels on the product. Be aware that these may not be the same numbers! The data on the labels are conservative; that is, they somewhat underestimate the "good" nutrients and overestimate the "bad" ones for a variety of regulatory reasons. Thus, a compiler who is obtaining the actual data from the manufacturer will have a more accurate database. There are other sources of nutrient data as well: sometimes data are gathered from published literature such as journal articles; sometimes data will come from other nutrient databases (such as international databases); and sometimes a compiler will have access to unpublished data from analytic laboratories. Whatever the sources of the data, developing and maintaining a database is not a trivial task. Our food supply is constantly changing, so information that is accurate today may be completely incorrect tomorrow (as the manufacturer decides to change the fortification profile of a breakfast cereal, for example). If accuracy is important for your application, then the method of keeping the database current should be carefully examined.

The handling of missing nutrient data is another issue of importance. As the size grows, it is often the case that the number of data points without nutrient values grows; this is especially a problem with brand-name data when the manufacturer only gives information for a few nutrients. If the missing nutrient values are left blank for a food item, then programs that add up the nutrients in a diet will assume there is none of that nutrient in the food (even though the food may actually be a good source of that nutrient). Thus it is key to know what a compiler is doing with missing data; any advantage of having a large database with many food items may be offset by the disadvantage of incorrectly assuming missing nutrient values are zero. It is my opinion that it is always better for compilers to impute (estimate) a value from a similar food, if it is done by an expert and well documented. However, correctly imputing values is a time-consuming task, especially for large databases.

It's important to remember that just because numbers come from a computer, they aren't always right! In addition to errors due to missing values, nutrient values could be incorrect for a variety of reasons, including out-of-date values and data-entry errors.

Most people who work with nutrient databases make a distinction between the database itself and the programs that access it; obviously, it's not very useful to have a nutrient database but no convenient way to summarize dietary totals and compare the results to a standard (often the Recommended Dietary Allowances). The combinations of programs and databases that allow us to do all these things are referred to as nutrient calculation systems (or dietary assessment systems). The range of features available for these systems is astounding, and the time and expertise it takes to develop a flexible system is huge. The method of displaying the results often takes advantage of the excellent graphic capabilities of computers and printers. Evaluating these systems is by no means a trivial task, and guidelines will be offered by several of the other speakers today.

One important feature of a nutrient calculation system is the method by which food items are accessed: how the identifying information entered by the user from the keyboard of the computer is matched to the proper item. The access (or coding) scheme may be dictated by the organization of the nutrient database. Often each food item has a numeric code. In the simplest data entry scheme, you enter this numeric code for each food item. Thus, if you want to specify "white bread", you will have to look up the code for white bread (in some kind of coding manual) and enter the its number (e.g., "346"). This isn't very time-consuming for a small database, but the coding manuals are extensive for a large one. Therefore, many systems now take other approaches. Some access programs will search on the name of the food ("white bread"); but problems can sometimes arise with the format and spelling (e.g., if you are supposed to enter "bread, white"). More elaborate schemes let you search for the first few characters, or for combinations of characters that are anywhere in the food name. The other, more common, approach is to use hierarchical menus. In this case, the access program shows you several options on the screen (typically some broad categories of foods) and you select the proper one (e.g., grain products); the next menu might let you select breads vs. cereals, pasta, rice, etc.; the final menu lets you select the exact type of bread. Sometimes a combination of methods is available—you can enter the code (or part of the code) if you know it, and then use the menus to get to the specific item.

Cost of nutrient databases and nutrient calculation systems vary widely. A few systems are public domain—you may have to pay an initial amount to cover the cost of copying and mailing, but you can then make as many additional copies as you wish; or if you know someone who already has the system, you can make yourself a copy without any payment. For example, there is a very nice system provided by USDA (Diet Analysis Program) that is public domain (2). You can order it for about $60, or you can download it from USDA's bulletin board at no cost. One can expect to pay more for systems with extensive manufacturer data, uncommon nutrients, imputed data, frequent maintenance, a wide variety of nutrient calculation options, and sophisticated data entry and display. Also, when you're thinking about costs, remember to find out the fee for updates. In some cases, your institution may have a site license for a system, so you only pay a small fee (or no additional fee). On our campus, we have developed our own system for classroom use, which has the great advantage that we can supply it to our colleagues and our students without any fee.

I'll conclude with some comments on documentation for nutrient databases. I feel this is a topic that often is ignored when evaluating and selecting systems. Of course, you want a system with a good users manual that explains exactly how to use the system. Sometimes these kinds of instructions are available on the computer by selecting a "help" screen. However, the documentation shouldn't stop with instructions on how to use the system. Be certain you know how to cite the nutrient database: at a minimum you will need to give the database name, version number, date, and the name and address of the vendor. There also should be documentation (either electronic or printed) that gives you details about the database itself: how many foods it contains, the exact definitions of all the nutrients, what were the sources of the data, what was done about missing values, etc. This information isn't always readily available, but I think users should insist that it's necessary.

Attached is an annotated bibliography which I use in the classes that I teach at the University of California. I've listed several comprehensive references that I find most useful, and also a number of journal publications that address methods for evaluating nutrient databases and dietary assessment systems.

I hope these comments have given you some background information to use throughout the rest of this session, as well as throughout the upcoming conference.

References:

1. Human Nutrition Information Service, USDA. Agriculture Handbook No. 8, Composition of Foods...Raw, Processed, Prepared. Springfield VA: National Technical Information Service. 1976-1992.
2. Human Nutrition Information Service, USDA. Dietary Analysis Program. Springfield VA: National Technical Information Service. 1989.

Nutrient Data Bases and Computerized Diet Analysis Systems: An Annotated Bibliography

Suzanne Murphy

January, 1993

Comprehensive references:

Nutrient Data Bank Directory, 8th Edition, 1992. Smith, J.L. (Ed.). Order from: Department of Nutrition and Dietetics, Alison Hall, University of Delaware, Newark, DE 19715-3360. (Lists in detail the features of 51 nutrient data bases.)

International Directory of Food Composition Tables. Rand, W.M. (Ed.) 2nd Edition, June, 1988. Order from: INFOODS Secretariat, UNU, P.O. Box 500, Charles Street Station, Boston, MA 02114-0500. (List of 200 food composition tables from Africa, Asia, Europe, Middle East, Oceania, North and South America.)

The 1988 Annual Journal of Dietetic Software. P.O. Box 2565, Norman, OK. (Reviews programs of interest to dietitians; descriptions of software from approximately 75 organizations.)

Computer Programs and Databases in the Field of Nutrition. 1989. 6th Edition. Seattle, WA: Computing Information Center, University of Washington. (Abstracts of over 200 diet analysis systems.)

Food Composition Data: A User's Perspective. Rand, W.M., Windham, C.T., Wyse, B.W. & Young, V.R. (Eds.). 1987. The United Nations University. Order from: UNIPUB, 4611-F Assembly Drive, Lanham, MD 20706-4391. (21 papers on experiences, uses, and management of food composition data.)

Proceedings of the National Nutrient Data Bank Conference. This annual conference brings together users (both current and potential) and developers of nutrient data banks. The proceedings from many of the 18 conferences have been published.

Compiling Data for Food Composition Data Bases. Rand WM, Pennington JAT, Murphy SP, Klensin JC. 1991. Tokyo: United Nations University Press. A comprehensive discussion of the process of compiling nutrient composition data.

Microcomputer Software Collection. Food and Nutrition Information Center, National Agricultural Library, USDA. 1991. Lists cost and brief description of 58 diet analysis/diet planning programs, plus many other programs for food service management, nutrition education, and recipe analysis. All are available for demonstration at the NAL in Beltsville MD. To order, call 301-344-3719.

Other helpful references:

Buzzard IM, Price KS, Warren RA. 1991. Considerations for selecting nutrient-calculation software: evaluation of the nutrient database. American Journal of Clinical Nutrition 54:7-9.

Dare D, Al-Bander SY. 1987. A computerized diet analysis system for the research nutritionist. Journal of the American Dietetic Association 87:629-632.

Eck LH, Klesges RC, Hanson CL, Baranowski T, Henske J. 1988. A comparison of commonly used nutrient database programs. Journal of the American Dietetic Association 88:602-4. (Compares DINE, U. Texas, NCC, Short Report.)

Frank GC, Pelican S. 1986. Guidelines for selecting a dietary analysis system. Journal of the American Dietetic Association 86:72-75.

LaComb RP, Taylor ML, Noble JM. 1992. Comparative evaluation of four microcomputer nutrient analysis software packages using 24-hour dietary recalls of homeless children. Journal of the American Dietetic Association 92:1391-92. (Compares USDA's Diet Analysis Program, Food Processor II, Nutritionist III, and Univ. of Texas Food Intake Analysis System with USDA's Nutrient Database for Standard Reference).

Mattes RD, Gabriel SJ. 1988. A comparison of results from two microcomputer nutrient analysis software packages and a mainframe system. Journal of Nutrition Education 20:70-75. (Compares U. Mass., Nutritionist III and Nutriquest.)

Nieman DC, Nieman CM. 1987. A comparative study of two microcomputer nutrient data bases with the USDA Nutrient Data Base for Standard Reference. Journal of the American Dietetic Association 87:930-32. (Compares USDA, Nutritionist III, and The Food Processor.)

Nieman DC, Butterworth DE, Nieman CM, Lee KE, Lee RD. Comparison of six microcomputer dietary analysis systems with the USDA Nutrient Data Base for Standard Reference. Journal of the

American Dietetic Association 1992;92:48-56. (Compares DINE, Food Processor II, Minnesota NDS, Nutri-Calc HD, Nutritionist III and Professional Dietitian with USDA.)

Penfield MP, Costello CA. 1988. Microcomputer programs for diet analysis: A comparative evaluation. Journal of the American Dietetic Association 88:209-11. (Compares U. Tenn., Apple Diet, Eat Smart, Nutrichec, and Idaho.)

Ralston CE, Matthews ME. 1988. Software selection: Can a demonstration computer package help? Journal of the American Dietetic Association 88:1087-89.

Schakel SF, Sievert YA, Buzzard IM. 1988. Sources of data for developing and maintaining a nutrient database. Journal of the American Dietetic Association 88:1268-71. An excellent list of references for obtaining nutrient data.

Taylor ML, Kozlowski BW, Baer MT. 1985. Energy and nutrient values from different computerized data bases. Journal of the American Dietetic Association 85:1136-1138.

Windham CT, Helm AA, Wyse BW. 1990. Integrity of small data bases in computer analysis of dietary data. Critical Reviews in Food Science and Nutrition 29:149-66.

Data Sources, Conventions, and Terminology

David B. Haytowitz, Human Nutrition Information Service, U.S. Department of Agriculture, Hyattsville, Maryland

USDA develops a number of different nutrient data bases. Some are generated as machine-readable counterparts of published food composition tables. Some data bases are generated for use in the Department's food consumption surveys. Others are generated for special purposes as needed. With a number of different data bases to choose from, it is frequently difficult to determine which is best suited for one's own projects. This paper will attempt to sort out the information on the various data bases so that the user can make an informed choice of the data base that will best meet his needs. A report describing these data bases, along with price and ordering information, is available from our office (1).

USDA Nutrient Data Base for Standard Reference

The USDA Nutrient Data Base for Standard Reference is the machine-readable version of Agriculture Handbook No. 8 (AH-8). The current version available is release 10, which includes all AH-8 sections 1-21, data from the first three supplements (1989, 1990, and 1991), and the new data on fresh pork (AH-8-10) The complete data set is available on both the Nutrient Data Bank Bulletin Board and Internet.

Future releases will contain data from future supplements to AH-8 and from those sections which are completely revised. Each year a new supplement is produced containing updated data on foods in the 21 sections plus new data not previously published. The 1992 supplement will be available shortly. A data set containing the information in the 1992 supplement will also be placed on the bulletin board. Work has begun on revising the Nutrient Data Bank System, our in-house system for developing the Standard Reference Data Base. We are also looking into ways to speed up the release of new data though the bulletin board and other means.

When possible, values are supplied for those nutrients where blanks appear in the printed handbook. In future handbook revisions, the values once included only in the machine-readable versions will also be available on the printed page. The Standard Reference Data Base uses the NDB (Nutrient Data Bank) numbers that appear at the bottom of each page of AH-8 to identify food items. The first two digits denote the food group (1-21), while the last three digits indicate a specific food item within the group. These numbers are not necessarily in numerical order in the printed volumes of AH-8.

This data base is available on both diskettes and magnetic tape. Diskettes are formatted for IBM-compatible PC's and are available in both double and high density for both 3-1/2" and 5-1/4" diskettes. An update, containing all of the new information, is available for those users who wish to update an earlier release they have on their systems. For example, the update to release 10 will contain those data added to release 9 to create release 10.

Release 10 of the Standard Reference Data Base contains data on 5,245 foods for the nutrients given in table 1.

The data base contains a 20-character description with nutrient values for each food item on the same file. The coding manual in a separate file has full descriptions. The coding manual also contains weights and descriptions corresponding to the column E, F, and G headings on the AH-8 pages.

An abbreviated version, containing fewer nutrients, but the same number of foods, is also available. The nutrients in this data set are listed in Administrative Report No. 378 (1).

Data Set 72-2

Data set 72-2 contains the data published in Home and Garden Bulletin No. 72, "Nutritive Value of Foods." This publication, originally published in 1965 and revised several times, was last revised in 1991 primarily to incorporate changes in the cholesterol content of eggs. A complete revision of this publication is anticipated within the next couple of years.

The data, which are expressed only in terms of common household units, are based on the USDA Nutrient Data Base for Standard Reference. For sections not published at the time, data were taken from unpublished data in USDA's National Nutrient Data Bank. The data set contains data on 961 food items arranged by food groups. The nutrients included in this data set are shown in table 2. The printed publication includes an index. A description of each item is also included in the data file.

Proximates:

Water, protein, total fat, carbohydrate (by difference), crude fiber, total dietary fiber (when available), ash, and energy (both in kilocalories and kilojoules).

Minerals:

Calcium, iron, magnesium, phosphorus, potassium, sodium, zinc, copper, and manganese.

Vitamins:

Ascorbic acid, thiamin, riboflavin, niacin, pantothenic acid, vitamin B_6, folate, vitamin B_{12}, vitamin A (both IU and RE), and tocopherol (when available).

Lipids:

Total saturated, total monounsaturated, total polyunsaturated, and individual fatty acids, cholesterol, and plant sterols.

Amino acids:

Tryptophan, threonine, isoleucine, leucine, lysine, methionine, cystine, phenylalanine, tyrosine, valine, arginine, histidine, alanine, aspartic acid, glutamic acid, glycine, proline, and serine

Table 1 — Nutrients in USDA Nutrient Data Base for Standard Reference.

Proximates:
Water, protein, total fat, carbohydrate (by difference), and energy
Minerals:
Calcium, iron, phosphorus, potassium, and sodium
Vitamins:
Ascorbic acid, thiamin, riboflavin, niacin, and Vitamin A (IU and RE)
Lipids:
Total saturated fatty acids, total monounsaturated fatty acids, total polyunsaturated fatty acids, and cholesterol

Table 2 — Nutrients in Data Set 72-2.

A unique four-digit number is assigned to each item.

The data set is available on both diskettes and magnetic tape. Diskettes are formatted for IBM compatible PCs. It is also available on the Nutrient Data Bank Bulletin Board.

Other Nutrient Data Sets

HNIS has published a number of summaries of other nutrient and food components of interest to researchers. Data sets for these are all available on the Nutrient Data Bank Bulletin Board. Among these are "Sugar Content of Selected Foods," Home Economics Research Report No. 48. This data set contains data on total sugar, monosaccharides and disaccharides, starch, and carbohydrate for 522 foods. Data sets based on provisional tables include those on vitamins D and K. These data sets contain 165 and 109 items respectively. The vitamin D data set presents data in both micrograms and International Units. A data set on selenium corresponding to the recently published provisional table has recently been added. These data sets also include the appropriate NDB number as a cross-reference. As new provisional tables are produced, data sets will be made available on the bulletin board.

USDA Nutrient Data Base for Food Consumption Surveys

A separate data set is created for each survey. The first data set, Release 1 of the USDA Nutrient Data Base for Food Consumption Surveys was developed for use in the 1977-78 Nationwide Food Consumption Survey. It contains data on 15 nutrients. Releases 2.0 and 2.1 were developed for the 1985 Continuing Survey of Food Intakes by Individuals. Release 2.0 was used for the first set of data collected in the 1985 survey (Wave 1, core monitoring group), while release 2.1 contains about 500 additional food items and covers the complete 1985 survey. These data were also used for Hispanic HANES. Release 3.0 was developed for the 1986 Continuing Survey of Food Intakes by Individuals. It has not been released, but is available to researchers requesting it from our office. Release 2.0 and subsequent releases contain the 30 food components listed in table 3.

Release 4.0 was developed for use in the 1987-88 Nationwide Food Consumption Survey and contains data on 6,237 food items. Release 5, developed for the 1989 continuing survey, is also available and contains data on 6,659 food items. Both are available on the Nutrient Data Bank Bulletin Board. Each food item is identified by a 7-digit code used in USDA food consumption surveys. The nutrient file contains a 51-character description of each item. A separate code book with full description and weights used in survey coding accompanies the nutrient files. One useful part of the code book is the "include" statements, which list those foods items similar in nutrient

Proximates:
Water, protein, total fat, carbohydrate alcohol, total dietary fiber, and energy
Minerals:
Calcium, iron, magnesium, phosphorus, potassium, and sodium, zinc, and copper
Vitamins:
Ascorbic acid, thiamin, riboflavin, niacin, vitamin B_6, vitamin B_{12}, Vitamin A (IU, RE, and carotene), and Vitamin E (alpha-tocopherol equivalents)
Lipids:
Total saturated fatty acids, total monounsaturated fatty acids, total polyunsaturated fatty acids, and cholesterol

Table 3 — Nutrients in USDA Nutrient Data Base for Food Consumption Surveys.

content to the title food for the code.

A "salt in cooking" code is used to distinguish between two records, one for items with salt added and one for the same item with no added salt. The code is used when the meal preparer has a choice of adding salt. On the bulletin board file, to save space, these two records are combined into one that reports both sodium values. The "fat in cooking" code is used to access the nutrient records calculated using fats or oils other than the one designated in the recipe for a particular item. For example, if butter was designated in the recipe, an alternate nutrient profile is calculated for the food cooked in margarine as well as several other cooking fats and oils.

Data Sets Used to Create the USDA Survey Nutrient Data Base Primary Nutrient Data Set for Food Consumption Surveys

The Primary Nutrient Data Set for Food Consumption Surveys (PDS) contains the nutrient data used to create the Survey Nutrient Data Base. The PDS is based primarily on the USDA Nutrient Data Base for Standard Reference. Values are added to the PDS when a food item reported by a survey respondent is either not in the Standard Reference Data Base or is missing nutrients. Future releases of the PDS will contain data from future releases of Standard Reference and other foods as reported by the survey respondents. The PDS contains data on approximately 3,300 foods and uses a 5-digit code to identify them. Food items taken from the Standard Reference use the same NDB numbers as the Standard Reference Data Base, while a unique number is assigned to each food added to the PDS. The PDS contains the same nutrients as the Survey Nutrient Data Base (table 3). A 20-character description is part of the nutrient file, while a longer description is available in a separate file. A code indicating the source of each data record is also part of the nutrient data file. The source codes are given in table 4. The date a value was added to the data base is also part of the nutrient file.

Recipe File for USDA Survey Nutrient Data Base

The recipe file contains the component records and their proportions used to calculate the USDA Survey Nutrient Data Base. It contains recipes for all items on the Survey Nutrient Data Base. Approximately half of these are single item records, while the remainder are of varying complexity.

The recipe file is composed of a header record and a number of component records. The header record contains the name of the food item and the recipe yield. The yield factor indicates, when appropriate, the amount of moisture or fat gained or lost during preparation. If fat is gained or lost, the type of fat is also indicated. The component records contain the name and ID number of each component. The ID numbers refer to the 5-digit ID used in the Primary Nutrient Data Set. The ID number can also refer to another 7-digit code in the Survey Data Base. There is a code to trigger the calculation of additional values for the "fat in cooking" or "salt in cooking" records described above. If needed, a code indicating the appropriate set of retention factors is also part of the component record. The retention factors are described in greater detail below. The weight or proportion of each component is included, along with a household measure for documentation.

USDA Table of Nutrient Retention Factors

The USDA Table of Nutrient Retention Factors contains the retention factors used in recipes to calculate values for the Survey Nutrient Data Base. Additional nutrients and additional food categories were added to this table to match the nutrients and foods in the Survey Nutrient Data Base. These factors are reviewed periodically by NDRB staff. The most recent review was for release 3, which is available on the bulletin board. This file contains retention factors for 16 minerals and vitamins currently used in the Survey Nutrient Data Base. Each set of retention factors is referenced by a four-digit computer code, which is used in the recipe file to access the factors. The relationship between these data sets is shown in figure 1.

Any questions regarding these data bases can be answered by contacting HNIS at (301) 436-8491.

1 — Analytical data from Standard Reference
2 — Analytical data added for Survey
3 — Data from 1963 Handbook (Removed as new sections are added)
4 — Imputed data from Standard Reference
5 — Label claim data from Standard Reference (Primarily Breakfast Cereals, AH-8-8)
6 — Imputed data added for survey
7 — Assumed zero
8 — Label claim data added for survey (Primarily Breakfast Cereals)

Table 4 — Source Codes for Primary Nutrient Data Set.

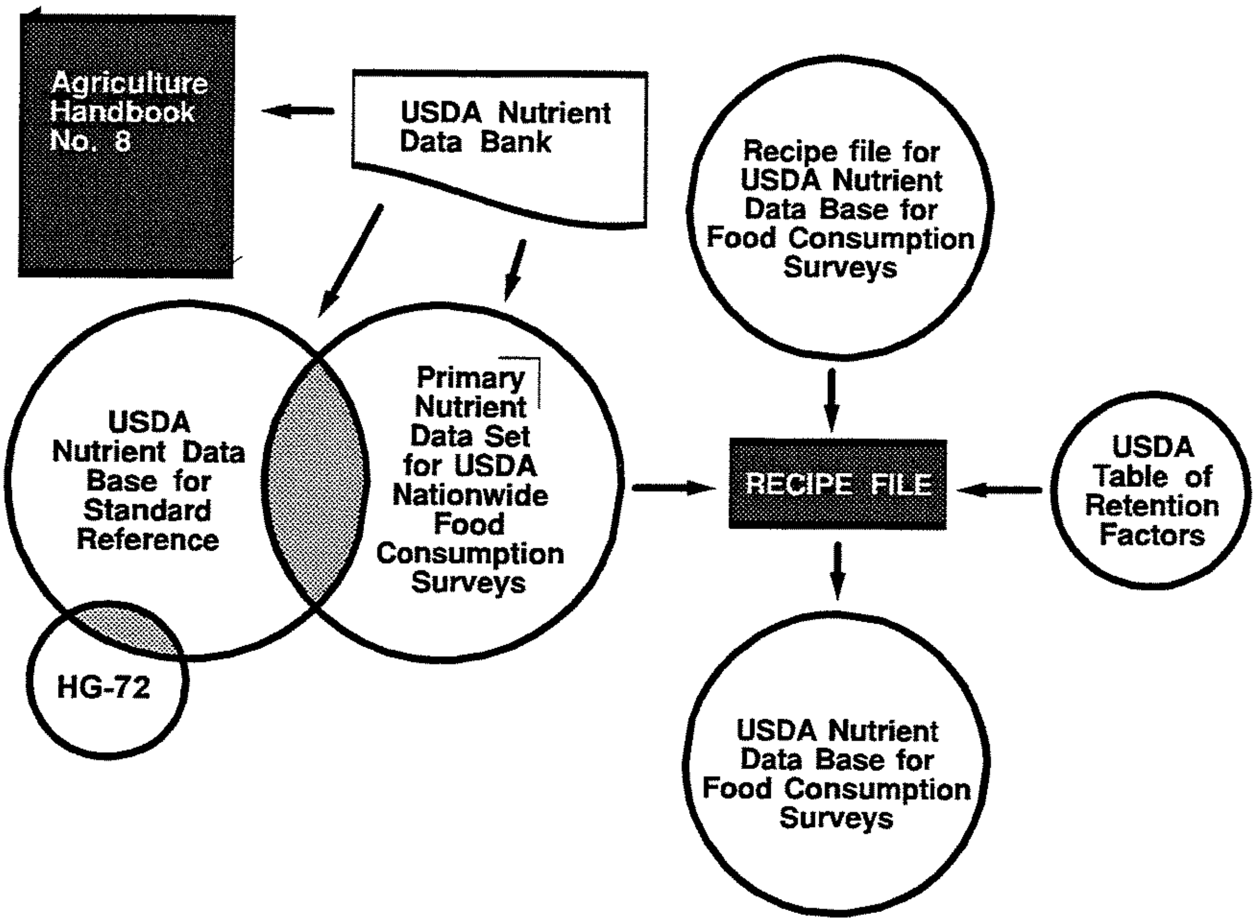


Figure 1 — Relationships Between Data Bases Used to Create the USDA Nutrient Data Base for Food Consumption Surveys

Nutrient Data Bank Bulletin Board

In addition, a number of the data bases described here are available on the Nutrient Data Bank Bulletin Board. The information on the bulletin board is available via telephone and through Internet.

To access the bulletin board directly you will need the following: Computer, modem, communication program, and telephone line. Although the bulletin board can be accessed from any computer, files for downloading are compressed, and made self-extracting using a program that runs on an IBM-compatible PC. Therefore users of other machines will not be able to uncompress the files but will still be able to read all bulletins. Users of other machines, as well as users of IBM-compatible machines, who have access to the Internet will be able to access the data through Internet. The data files on Internet are not compressed. Instructions on accessing the data through the Internet will be described later.

The telephone number for the bulletin board is (301) 436-5078 and operates at either 1200 or 2400 baud. The line settings are N-8-1. Although these line settings are commonly the default values, you may have to change these on your communication program.

First you will be asked to identify yourself. If you have called the bulletin board before, you will be asked to provide your password. If this is your first call you will be asked to select a password and register. The purpose of registering is to obtain some information to be used by the bulletin board program in communicating with you. These include graphics, transfer protocols, etc. If any of the selections don't work correctly, they can always be changed by selecting the utilities option from the main menu. Other functions such as bulletins and file submenu can be accessed from the main menu.

In 1991, HNIS took another step to broaden access to nutrient data. In cooperation with the University of Maryland in College Park, nutrient data were made available through the Internet system. The Internet is a network of regional networks connected by a high-speed "spine" maintained by the National Science Foundation and others and is capable of transferring data at speeds of over 1 megabyte per second. Work is under way to increase the speed of data transfer even more. To access nutrient data over the Internet, type

telnet info.umd.edu

at your system prompt. The logon ID is info. There is no password. In the Info system select Government, then US, followed by NutrientData.

Accessing the bulletin board, either through the telephone or through Internet, was described in greater detail in the proceedings of last year's conference (2).

References

1. U.S. Department of Agriculture. 1993. Machine-Readable Data Sets on Composition of Foods and Results from Food Consumption Surveys. Administrative Report No. 378. Hyattsville, MD. 48pp.
2. Haytowitz, D.B. and Klensin, J.C. 1993. Electronic Dissemination of Nutrient Data via Bulletin Boards and Internet. 17th National Nutrient Data Bank Conference Proceedings. In press.

How to Select A Nutrient Database Application

Phyllis Stumbo University of Iowa

Important selection criteria for nutrient calculation applications begin with how the software will be used: for *training*, assessment, counseling, food service, research, product development or marketing. General purpose nutrient calculation programs are often designed for the clinical user where important features (in addition to calculations) are comparison to dietary standards, printing menus, adjusting menus to specified goals, calculating exchanges, and generating reports. The nutrient database is central to all functions and comprises the most important, and most difficult, evaluation. This session provided the participant with a tool for evaluating database applications.

"What Do I Need and Why?"

Recognizing Required Features For A Nutrient Analysis System

Loretta White Hoover, Ph.D., R.D., University of Missouri-Columbia

The reason for needing a nutrient database is associated with the work that one wishes to accomplish. Thus, the required features for a system that utilizes a nutrient database depends on the specific tasks that one wishes to perform with a system. For instance, the tasks may range from analysis of dietary records or recipes to determination of the adequacy of food procurement for the delivery of nutritious meals in a nursing home. Automation of the diet record acquisition process, comparison of the nutrient intake with stipulated standards, and generation of nutrition education reports for a client are examples of other tasks that might be accomplished by a system. As enumerated on Figure 1, a wide variety of different tasks rely on a nutrient database as an aspect of the system. While the reliability and integrity of the nutrient database are paramount, appropriate systems features are essential to accomplish specific tasks.

Determine Tasks You Wish To Perform

- Dietary Record Analysis
- Menu Analysis
- Food Frequency Analysis
- Tailor Menus
- Monitor Food Procurement
- Client Interviews
- Food Production Support

Figure 1

Once the tasks are identified, the necessary functional requirements for a system can be defined. For example, if one wished to automate the diet record acquisition process, the software should have an interactive component that facilitates the interview with a client and the data coding process. As shown in Slide 2, the functional requirements for dietary record analysis might include: a nutrient database; a recipe database; interactive data entry; comparison with standards; meal, day, and weekly averages; and data export for statistical analysis.

After definition of the functional requirements for a system, the details of the specific features necessary for each functional requirement should be enumerated. On Slides 3 and 4, examples of software features are illustrated for two functional requirements. If a functional requirement were stated as "Comparison with standards", some of the alternative features might be comparison with one or several standards such as the RDA's, user specified standards or targets, child nutrition meal components, or the Dietary Guidelines for Americans; evaluation of intake against modified diet

Define Functional Requirements For a System

- Dietary Record Analysis
  - Nutrient Database
  - Recipe Database
  - Interactive Data Entry
  - Comparison with Standards
  - Meal, Day, and Weekly Averages
  - Data Export for Statistical Analysis

Figure 2

restrictions; or presentation of intake data in graphical displays. In the second example, some alternative features in a recipe database could include: yield factors, nutrient retention factors, ingredient weight as AP or EP amounts, refuse loss factor, link to nutrient database, or link to food inventory system.

In different systems, the same functional requirement may be addressed differently. An example of this is the strategy for coding recipes. In some systems, the amount of refuse associated with a food is not documented in the system because edible portion weights are entered for all foods. However, if one has the task of monitoring the food procurement records of a food service organization or will operate a food production system, that strategy is insufficient because there is no mechanism to convert the edible portion weights for yield adjusted recipes to the amount of food that must be purchased. In this example, the specific feature that would be needed would be either a yield factor that converts from EP to AP weights or documentation of the edible portion weight for some specified purchase weight. Similarly, the detailed features necessary for all functional requirements should be listed to ensure that an appropriate system is selected for a given setting.

The features identified by this process can be used to establish specifications for functional requirements. As illustrated on Slide 5, for dietary record analysis, the specifications for a software product might relate to the eating occasions required, number of foods per eating occasion, number of days per dietary record, number of clients per group, or subject identification codes. One needs this level of understanding of desired features prior to working with a system designer or seeking a system product in the software marketplace.

Comparison of the stated specifications with the features of a system design or the features of various products in the marketplace will help one to recognize if the required features are present. As shown on Slide 6, prioritizing desired features and establishing a checklist of features will facilitate the selection process. Sometimes the required features will not be available in vendor products, and one is forced to decide what features are essential and which can be eliminated. Also, budgetary constraints may preclude acquisition of a system which fully meets the specified features.

Even when the stated features are present in a system, the amount of time and effort that will be

Detail Specific Features For Each Requirement

- Comparison with standards
  - RDAs
  - User Specified Standards
  - Child Nutrition Meal Components
  - Dietary Guidelines for Americans
  - Modified Diet Restrictions

Figure 3

- Recipe Database
  - Yield Factors
  - Retention Factors
  - Ingredient Weight as AP or EP Amounts
  - Refuse Loss Factor
  - Link to Nutrient Database
  - Link to Food Inventory System

Figure 4

required to use the system should be anticipated. The conceptual designs of systems differ; thus, the data organization and capture methods may differ even when the same feature is provided. As shown on Slide 7, two major considerations are data entry and database maintenance requirements.

Because data entry becomes the major cost of using a system,. one needs to project the workload associated with particular systems when making a selection decision. The costs associated with using a system might negate any cost savings anticipated from acquisition of a system with a low purchase price.

Establish Specifications for Functional Requirements

- ❖ Dietary Record Analysis
  - Eating Occasions Required
  - Number of Foods per Eating Occasion
  - Number of Days per Dietary Record
  - Number of Clients per Group
  - Subject Identification Codes

Figure 5

In summary, acquiring a software system for use with a nutrient database is not a simple process. As listed on

Slide 8, recognizing the required features in a system can be facilitated by following a systematic process for designating and specifying aspects of a potential system.

Upon completion of this process, one should be in a good position to make an informed decision when selecting a nutrient analysis system.

Compare Specifications With Software Systems

- Prioritize Desired Features
- Establish a Checklist of Features

Figure 6

Recognizing Required Features for a System

1. Determine what tasks a system should perform
2. Define functional requirements for a system
3. Detail the specific features for each requirement
4. Establish specifications for requirements
5. Compare specifications with software systems
6. Anticipate time and effort requirements

Figure 7

NOW WHAT DO I DO?

R. Sue McPherson PhD, University of Texas School of Public Health, Houston TX

This discussion integrated together the ideas presented by the previous speakers and focused the new users on how to utilize this information at this conference. A self-assessment of nutrient data base needs was discussed and given to each participant. Communication strategies for linking with experts in the nutrient data base field as well as with other nutrient data base users was reviewed. The discussion closed with guidelines for the homework that each user can do to complete their self-assessment and to make decisions about the selection and use of nutrient data bases.

Panel: Moving Into the Next Century

Analytical Methods Challenges

Gary Beecher, *Nutrient Composition Lab*

Databases

Loretta Hoover, *University of Missouri*

Industry Issues

Ann C. Grandjean, *Center for Human Nutrition*

ANALYTICAL METHODS CHALLENGES

Gary R. Beecher, Nutrient Composition Laboratory, BHNRC, ARS, USDA, Beltsville MD

Research on the association of diet and health requires detailed knowledge of nutrients and components of foods. As the impact of food constituents on health is better understood, knowledge of the qualitative and quantitative aspects of these components in foods and diets becomes more important. Thus, the general challenge is to produce, qualitatively and quantitatively, accurate and precise data at reasonable cost for those components related to health in foods that are the major sources of nutrients.

There are several important factors that must be considered during the evaluation or development of any analytical method. These include: 1) separation and/or identification of food component of interest, 2) detection of low levels, often in the range of one part in one-million to one-billion, 3) accurate measurement, including complete extraction and the use of such controls as internal standards and reference materials, 4) reasonable cost which now must consider such items as hazardous waste disposal, cost of solvents, computerized data manipulation, as well as instrument and labor costs, and S) large sample through-put which will make the method attractive to commercial analytical laboratories. Several examples of methods were discussed and food components that present analytical challenges were outlined.

Panel: Moving Into the Next Century: Databases

Loretta White Hoover, Ph.D., R.D., University of Missouri-Columbia

In the next century, computerized databases are likely to be the primary media for tables of food composition with printed tables replaced by alternative media such as optical disks, FAX, or videophone. Already, we have seen that comprehensive printed tables are bulky, expensive to produce and acquire, and difficult to keep up-to-date. Electronic data transfer offers the opportunity for selective retrieval of data of interest from depositories. Is a centralized clearinghouse for nutrient data in our future?

As we envision databases in the future, some of the aspects of databases to consider are their structure, contents, documentation, management, and software. Understanding the factors that are impacting each of these aspects of databases enhances our ability to foresee the characteristics of nutrient databases.

Nutrient Database Structure

From a structural standpoint, nutrient databases will probably have a complex configuration. Many of you will remember when a nutrient database was a deck of computer cards. With enhancements in computer technology, we have begun to separate data according to type of data such as nutrient values and food descriptions.

In addition to familiar files of nutrient values and food descriptions, other types of coordinated data, linked by relational keys, may become integral aspects of nutrient databases. Some of the related data files may include: nutrient descriptions, weights and measures, yield factors, nutrient bioavailability factors, nutrient retention factors, data quality, refuse factors, cross-references, code translation tables, ingredients, recipes/formulations, external link codes, food labels, and portion model images. A more complex configuration has implications for data management and software development. With data in the related files linked by relational keys, data redundancy can be minimized. Coordination of these collections of data will reduce reliance on printed documentation and will support on-line, real-time look-up of pertinent data in a software application.

At some point, we will probably agree that values are needed for only one standard quantity such as 100 grams in our databases. Coordinated records in a weights and measures file will provide the flexibility to process any conceivable portion reported on a dietary record. The computer will assume the role of determining the quantity of each nutrient, and we will have minimized the number of values that must be maintained for each food.

Nutrient Database Contents

The contents of nutrient databases will expand to include new data elements, new foods and modifications of traditional foods, new commercial ingredients, and additional nutrients and non-nutrients. In particular, new data elements will be created to store detailed documentation and pertinent dates, fully qualified with century indicators. Trend analyses, product tracking, and reprocessing of prior data create the need for a variety of dates such as: effective, introduced, expired, departure, or obsolete.

The expanding diversity in foods will result in the addition of many more foods and probably new groups of foods. Growing ethnic minorities and the rise in transnational agribusiness are acquainting us with an array of exotic and imported foods. Similarly, regional variations in food preparation require alternative versions of the same food. For example, chili as I know it from Texas is not the same dish that is served in other regions of the country.

The contents of nutrient databases will be influenced by consumer interest in diet and health and by the dietary requirements of individuals with chronic diseases or genetic disorders of metabolism. The number of foods will multiply as we include low-sodium, low-fat, fat-free, sugar-free, and gluten-free variations for many of our traditional foods.

Tracking the intake of individuals consuming an increasing proportion of their diet from manufactured foods requires that we conquer the brand name challenge. New ingredients such as fat replacers, fibers, gums, and protein components will yield nutrient profiles differing greatly from traditional forms of many foods. Incorporating data for individual products will probably cause us to rethink some of the groupings of foods in nutrient data bases. Also, we may seek ways to form composites of similar foods like granola bars or low-fat crackers. Unique identifiers, appended to existing systems for groupings, will facilitate organization of the overwhelming amount of data records reflecting the burgeoning food marketplace.

Mixed dishes, coded according to recipes, will probably constitute an increasing proportion of the data records in nutrient databases as we attempt to reflect data for foods as consumed. The recipe strategy provides a way to reflect ethnic and regional variations, to estimate values for constituents of interest when laboratory analyses are not feasible, and to recalculate nutrient profiles when ingredients change or the nutrient values of the ingredients are up-dated. Mathematical estimation of formulations for manufactured foods will probably be more prevalent as a technique for approximating values for nutrients not supplied by food processors. The expanding use of these calculation procedures will emphasize the essentiality of better data about cooking losses and gains and nutrient retention.

Nutrient databases will expand to accommodate more constituents linked to concerns about diet and health. Already, data about sugars, starches, alcohol, carotenoids, selenium and other minerals, specific forms of fatty acids, and some non-nutrient constituents are being added to nutrient databases. The amount of imputed values in nutrient databases will probably rise because data for these additional constituents will be available for only a limited number of foods. The problem of missing values will become more acute.

Nutrient Database Documentation

As the need for nutrient data continues to outpace the availability of analytical data, documentation of the types and quality of data will become more prevalent. For example, we will probably employ schemes for identifying if data were analyzed and by what method, normalized and by what basis, calculated and by what method, estimated and with what rationale, or imputed and by what method. In terms of data quality, related data records will provide detail about analytical methods, sampling plan, reference materials, and confidence indicators. Incorporation of documentation into nutrient databases will be facilitated by standard nomenclature and acronyms evolved by consensus.

Nutrient Database Management

Management of nutrient databases will become increasingly more demanding, time consuming, and expensive. Quality control protocols will be essential to insure the integrity of nutrient databases. Incoming data will be screened automatically by diagnostic routines, evaluated against previous data, and subjected to statistical tests. Judgmental actions will be documented and date stamped in the course of transaction processing to provide complete audit trails of data revisions.

Collaboration among the food industry, research organizations, and governmental agencies will facilitate compilation of truly representative databases.

Partnerships will probably be established to achieve a cost-effective strategy for compiling and distributing data for an ever-increasing number of foods and constituents. A clearing house, voluntarily supported by all players, would be a natural product of such coordinated efforts.

Multimedia technology will continue to offer new and different strategies for storage and dissemination of nutrient data. If developments in technology continue at the current pace, we can anticipate many more advances in computing and communications capability that will facilitate accessibility and management of nutrient databases.

Nutrient Database Software

Numerous software options will be standard to support query, data collection and coding, updating and maintenance, recalculation, iterative operations, and diagnostic evaluation. Software will be created or revised to accommodate new nutrient database designs reflecting new field sizes, new data fields, and new data files.

Innovations in software are expected as developers employ extensive use of graphics for portion models and results of analyses. Mathematical models will be used more extensively. Some examples of the use of mathematical models are linear programming for determining the proportions of ingredients in formulations, materials requirements planning (MRP) to determine food usage or requirements, and statistical models for testing outliers or forecasting data needs.

Multimedia technology such as optical disks, FAX, and videophone offer new possibilities for software development and enhancement. Data acquisition and communication will be facilitated by electronic data interchange and electronic file transfer.

Predictions About Databases

Even though my crystal ball is a bit hazy, I offer the following predictions about nutrient databases in the next century. In my opinion, the trends that we can anticipate relative to these aspects of nutrient databases are:

Structure	→	More Complexity
Contents	→	More Extensive
Documentation	→	More Specificity
Management	→	More Expensive
Software	→	More Capable.

In summary, nutrient databases will become even more integral to professional activities related to nutrition, diet, and health. The increased complexity of nutrient databases will require more sophisticated users. Assuring the desired contents in nutrient databases will require a strong sense of collaboration among data generators, compilers, and users.

INDUSTRY ISSUES

Ann C. Grandjean, Center for Human Nutrition, Omaha NE

The Center for Human Nutrition is a nonprofit institute located on the University of Nebraska Medical Center campus in Omaha, Nebraska. Our operating budget is derived from grants, contracts and contributions. Grants and contracts are received from federal and state agencies, trade organizations, foundations and corporations. We consult to the U.S. Olympic Committee and, in that capacity, work with the food and beverage companies which are USOC corporate sponsors.

We also work with several companies on health and wellness activities, and we provide nutrition services for the athletic departments of three universities and a sports medicine center. As part of these services, we conduct dietary analysis. Therefore, one obstacle we encounter is the universal problems related to the shortcomings and limitations of nutrient data bases.

One of the Center's major areas of research is determining dietary patterns of athletes, especially elite athletes. These research activities are a primary reason USOC corporate sponsors contract with us, and they are primarily interested in what athletes eat and how that compares to the general population. Comparing nutrient intake data is difficult; comparing patterns and use of specific foods is impossible.

Ethnic Diversity and Nutrient Databases

Hispanic Foods
Mary Elena Martinez, *University of Texas*

Asian American Foods: The Need of a Nutrient Composition System for International Use
Rose Tseng and Jee-In Mao, *San Jose State University*

Capturing Ethnic Diversity in the Database
Suzanne Murphy, *University of California, Berkeley*

HISPANIC FOODS

Mary Elena Martinez MPH, University of Texas School of Public Health, Houston TX

The rapid rise in the number of Hispanics in the United States has led to an increased interest in the dietary intake and nutritional status of this ethnic group. There is a need to describe the nutritional status of Hispanics to evaluate associations between nutrient and food intake and disease status. Assessment of dietary intake among Hispanics can be problematic due to difficulties in dietary data collection methodology and limited information regarding the nutrient composition of foods commonly consumed by Hispanics. Validity of dietary intake may be sacrificed, particularly among Hispanic individuals who consume more traditional or home cooked meals for which available nutrient data may be lacking. Examples were given of how the variability in dietary intake may not be captured when specific Hispanic foods and recipe ingredients are not accurately analyzed for nutrient amounts. Uncontrolled variability can result in misclassification of individual nutrient intakes, thus the ability to detect nutrient differences between population groups can be lost and crucial associations between diet and disease may not be ascertained.

ASIAN AMERICAN FOODS: THE NEED OF A NUTRIENT COMPOSITION SYSTEM FOR INTERNATIONAL USE

Rose Tseng PhD & Jee-In Mao PhD, RD College of Applied Sciences & Arts, San Jose State Universitv, San Jose CA

Asia, the world's largest continent, is of infinite diversity. As the result of thousands of years of migrations, invasions, conquests and intermingling, the people of Asia belong to numerous cultural groups. This paper discusses the nutrient composition systems in three cultural regions of Asia, East Asia (China, Japan, etc.), South Asia (India), and Southeast Asia (Thailand, Philippine, etc.).

In addition to the Food Composition Table For Use in East Asia (FAO, 1972), many of the Oriental countries have recently developed food composition tables for the comparison of common food sources within individual countries (e.g. Nutritive Value of Indian Foods, Indian Council of Medical Research, 1985; and Standard Tables of Food Composition in Japan, Institute of Nutrition in Japan, 1985). These regional nutrient data base normally provide valuable information for one specific population. However, in recent years immigrants from China, Korean, Japan, India, Philippines, Vietnam, Cambodia, etc. have settled in the United States (Kittler and Sucher, 1989), and created many multi-Oriental communities. Many difficulties have been associated with the evaluation of dietary intake in these communities by using single source of nutrient composition table. Therefore, a nutrient composition system for international use is necessary to solve the problems including data availability (e.g. the data may not exist or are not readily accessible in English), food nomenclature (e.g. one food may have many different names, one name could represent many different foods, etc.) and data interpretation (e.g. serving sizes, recipes, etc.).

Capturing Ethnic Diversity in the Database

Suzanne P. Murphy, Ph.D., R.D., Department of Nutritional Sciences, University of California, Berkeley

Food choices in the United States are expanding. This is partly because of new products introduced by U.S. growers and manufacturers, but it is also because of increased consumer interest in foods from other countries, combined with increased trade with other countries. Capturing ethnic diversity in a nutrient database is certainly an appropriate topic to consider for the next century; we are going to increasingly be living an a global community, and food exchange is no exception.

One indicator of the interest in foreign foods is the number of restaurants serving ethnic cuisine in a community. For example, the yellow pages for the Berkeley/Oakland area in 1993 list 183 restaurants by self-defined ethnic classification: there are 45 Chinese restaurants, 39 Mexican, 22 Japanese, but only 5 consider themselves American. I'm sure most of you share my dismay when a subject in a nutrition study reports that she ate dinner in a Chinese restaurant. Not only is she unlikely to remember, or even know, the ingredients in the dishes, but even if she did, we may not have those ingredients on our nutrient database. Much of the time we must compromise with a limited number of Chinese "mixed dishes", which we assume/hope will be close to the actual item.

Another source of ethnic foods in U.S. diets occurs as a result of the expanding interest in ethnic cooking at home. A recipe for risotto in a recent popular magazine, for example, calls for rapini (broccoli rabe), Chinese broccoli (gai laan), and arborio rice (medium grain). I couldn't find any of these items in USDA's Handbook No. 8 (1), so would probably use regular broccoli and regular white rice if a subject reported these foods. However, I'm uncomfortable doing that without knowing what kinds of errors may be incurred.

We also need ethnic foods, of course, when surveys include persons from various ethnic origins, especially those who have come to the United States recently. In California, we have an ongoing challenge to correctly identify ethnic food items from our large populations of persons from other countries: Mexico, China, Japan, Vietnam, Cambodia, and so forth.

Thus, nutrient data from other countries may be needed for imported food items, for foods from ethnic restaurants, and for foods prepared by immigrant population. The question then becomes, where can these values be found, so that ethnic diversity can be captured on the data base?

Certainly the biggest initial problem is that of obtaining accurate food descriptions, both of the food reported, and of foods on the various nutrient databases that are potential matches for the food reported. We've been very pleased with the concept of using Langual (2) to describe foods in a uniform manner, although for our purposes, a subset of the full Langual descriptors is adequate. In spite of several inquiries, however, we have not found any examples of forms that are used to collect food descriptors for ethnic foods. I'm in the process of developing a form of this sort, and would appreciate talking with any of you who have also gone thorough this process. Some of the descriptors that I think need to be included are: local food name, English food name, scientific name, color, maturity, part consumed, processing applied, fortification or enrichment, and method of preparation. These descriptors are subsets of those used by Langual, or by the faceted INFOODS description system (3). It is my hope to develop a form that is simple enough to be used by field personnel.

The next step is to find some actual nutrient data for the food item of interest. First, I'd like to assume the item is a "basic" food (that is, not a mixed dish). There are several standard sources of nutrient data for ethnic foods. Printed or published tables remain the main source of ethnic nutrient data; however, electronic databases are being used more and more frequently. Journal articles and written communications are also sources of useful data, of course, but tend to be used less often than printed or electronic tables.

To be most accurate, it's desirable to find data from the specific country of origin. How much variation might one expect? That depends, of course, on the food and nutrient of interest. For example, if we were interested in the vitamin A (RE of carotene) content of peppers, we would have a wide choice of values to use, depending on the country or region of origin. Table 1 summarizes values from four countries/regions: United States, Great Britain, China, and Latin America (1, 4-6). Even within a country, there would be a range of appropriate values, depending on the type of pepper (red vs. green; sweet vs. hot, cooked vs. raw, etc.). These are often difficult choices to make, especially if the food item is not completely described. At shown in Table 1, carotene values are generally higher for red peppers than for green, and for hot versus sweet peppers, but there is considerable variation within the categories.

One issue that is often debated is whether to use a U.S. value for foods from other countries. For example, are canned chili peppers imported from Mexico the same as chili peppers canned in the U.S.? It is certainly possible to argue that the U.S. values are more current, and use more modern methods, since many of the published analyses from Mexico are now 30 years old. However, the variety of chilies, and thus their nutrient values, may be very different in Mexico. In this particular case, we would choose to use the U.S. values for the green peppers, but probably the Mexican values for the red peppers. If more data bases carried confidence codes for the nutrient values (as was done in the recent publication by Mangels et al. (7)), these decisions would be easier.

This brings up some concerns when merging data from multiple nutrient databases; in particular, merging U.S. data and data from other countries. First, there are concerns about analytic methods. For example, older methods of analyzing carotenoids overestimated vitamin A activity by including non-vitamin A precursors. Nutrient definition also can vary across nutrient databases. Differences in factors used to convert carotene to retinol illustrate this concern—the Latin American database (6) uses a conversion factor that is three times higher than the one used by the U.S. tables. Finally, sampling can drastically affect the values, particularly if comparing values for a national sample (as is often the case in the U.S.) and samples from a specific location (as may be the case in smaller databases).

Better documentation on the sources of nutrient data would help users of ethnic data. This is a challenging task if done properly. I would suggest that complete documentation of sources, either on paper or (preferably) in electronic form, includes: (a) primary source of the data for a food item, (b) supplemental sources for specific nutrients, (c) sources consulted but not used, and (d) identification of imputed or calculated values, plus a description of the method used.

Some of the published tables that I have consulted frequently when looking for ethnic or international data are: Africa, 1968 (8); Latin America, 1961 (6); Near East, 1982 (9); East Asia, 1972 (10), and India (11); but the usefulness of some of these data is limited by out-of-date methods. I'd like to make an urgent request at this point—we desperately need better data on foods from other countries. I know USDA's Human Nutrition Information Service (HNIS) and the Nutrient Composition Laboratory are very aware of this issue, and are working on gathering data for common foods in the U.S. supply. However, in addition, we also need better data from the countries of origin.

The preceding discussion has addressed primarily issues when trying to match basic food items. The problems with mixed dishes are even greater, of course, since one needs information on the proportions as well as the identity of each ingredient. In some cases it may be possible to find published information on the nutrient content. Let's take salsa as an example. This is a traditional Mexican dish that has become very popular in the U.S. (I understand sales for salsa now exceed those of catsup). Table 2 shows two recipes for typical homemade salsas; these recipes were developed by HNIS for the Nutrient Database for Individual Intake Surveys (12). If the ingredients match those that my population uses for salsa, the chances are good that I can not only use their recipe, I can also use the nutrient totals on the survey data base. Of course, I need to check the proportions as well as the preparation method. I also should check that the moisture loss is about the same (7%) if I use the cooked salsa, and that nutrient retention factors have been applied (which is the case for the HNIS recipe). Table 3 shows the importance of choosing an appropriate recipe—the two illustrated here have very different nutrient profiles. But what are the chances that either of these salsas will match those prepared by a Mexican-American homemaker in central California? Perhaps not very high. What most users will need is a system that allows either new recipes to be entered, or better yet, some way to modify existing ones; e.g., I could take out the fat; change red peppers to green; alter the proportion of tomatoes, etc. These are not trivial undertakings, but systems like the one developed by the University of Texas (13) can prove very useful when trying to adopt typical U.S. recipes to those reported by ethnic communities.

In an effort to simplify a very complex problem, Dr. Doris Calloway and I are consolidating food composition data from multiple developing countries into a single data base. Three years ago at this conference, I talked about an international nutrient database, the International Minilist (IML), that contained foods for the three study sites of the Nutrition Collaborative Research Support Program (NCRSP) (14). The IML is a <u>single</u> nutrient database which can be used in different locations. When we calculated nutrient totals for local diets of village populations in the three countries (Egypt, Kenya, and Mexico) using the consolidated nutrient database, we found they were very similar to those calculated using country-specific nutrient databases. Although the IML was developed for assessing diets in other countries, we have since found that the same approach has been very useful for ethnic populations in California—in particular, we have used this concept for diets of Hispanics and of Native Americans. After working on these projects for several years, we concluded that it should be possible to index foods in any country or ethnic culture to a relatively small number of basic food commodities. Thus, with funding from USAID's Office of Nutrition, we are in the process of broadening this concept to three additional countries: India, Indonesia, and Senegal. The full system, including a dietary assessment program, in now called the WorldFood System. Again, we will evaluate our methods by comparing nutrient totals for local diets using both the IML and the country-specific nutrient databases. The guiding principles for this ethnic/international nutrient database are that a minimum number of foods on the IML is desirable for accuracy and maintainability; a valid substitute should exist on the IML for every country-specific food (and if it doesn't, then one should be added); and no nutrient values should be missing.

The core of the WorldFood System is the IML nutrient database with approximately 200 foods that represent basic foods consumed world-wide. Foods reported in diets are indexed in three ways to the IML foods: (a) directly; (b) using adjustment factors for differences in moisture content (e.g., dry rice may be indexed to cooked rice); (c) using recipes, which allow for multiple ingredients, differing fat levels, and nutrient fortification. Care is also taken to index cooked foods so that nutrient losses during cooking are considered. Thus, although the IML has only 200 foods, the list of country-specific foods is approaching 2000. With this indexing approach, the system can be expanded almost indefinitely with minimal addition of nutrient data.

Thus, we can estimate intakes of a wide variety of nutrients (with no missing values), while maintaining a relatively small nutrient database. This approach allows us to capture ethnic diversity, at least for initial estimates of likely nutrient adequacy for a population. However, users would wish to consider the precision of these estimates before undertaking specific intervention programs in an ethnic population. Chemical analysis of frequently consumed foods and of typical diets is often advisable.

The accuracy of our substitution scheme is greatly dependent on the availability and accuracy of published nutrient data for ethnic/international foods. As previously mentioned, these data are often limited. Nutrient databases from the U.S. Department of Agriculture contain the more common ethnic foods consumed in the United States, but it clearly is an almost insurmountable task to keep up with the expanding number of imported food items. Yet we need these data not only for local and regional research projects, but also for National Nutrition Monitoring efforts. Thus, for a variety of uses, we need to promote expanded analyses of international food items, and better ways of exchanging the results.

References

1. Human Nutrition Information Service, USDA. Agriculture Handbook No. 8, Composition of Foods...Raw, Processed, Prepared. Springfield VA: National Technical Information Service. 1976-1992.
2. Smith EC. Langual for database users. 16th National Nutrient Databank Conference Proceedings, SP Murphy, editor. Ithaca NY: The CBORD Group, 1991.
3. Truswell AS, Bateson DJ, Madafiglio KC, Pennington JAT, Rand WM, Klensin JC. INFOODS guidelines for describing foods: a systematic approach to describing foods to facilitate international exchange of food composition data. J Food Comp Anal 1991;4:18-38.
4. Holland B, Welch AA, Unwin ID, Buss DH, Paul AA, Southgate DAT. McCance and Widdowson's: The Composition of Foods, Fifth Edition. Letchworth, United Kingdom: The Royal Society of Chemistry Distribution Center, 1991.
5. Ershow AG, Wong-Chen K. Chinese food composition tables. J Food Comp Anal 1990;3:191-434.
6. Leung WW, Flores M. Food Composition Table for Use in Latin America. Guatemala City: The Institute of Nutrition of Central America and Panama, and Bethesda, MD: Interdepartmental Committee on Nutrition for National Defense, National Institutes of Health, 1961.
7. Mangels AR, Holden JM, Beecher GR, Forman MR, Lanza E. Carotenoid content of fruits and vegetables: An evaluation of analytic data. J Amer Diet Assoc. 1993;93: 284-296.
8. Leung WW, Busson F, Jardin C. Food Composition Table for Use in Africa. Rome: Food and Agricultural Organization of the United Nations, and Bethesda, Maryland: U.S. Dept. of Health, Education, and Welfare, 1968.
9. Polacci W, McHargue JS, Perloff BP. Food Composition Tables for the Near East. Rome: Food and Agricultural Organization of the United Nations, and Hyattsville, MD: Consumer Nutrition Center, U. S. Department of Agriculture, 1982.
10. Leung WW, Butrum RR, Chang FH. Food Composition Table for Use in East Asia. Rome: Food and Agricultural Organization of the United Nations, and Bethesda MD: U.S. Dept. of Health, Education, and Welfare, 1972.
11. Gopalan C, Rama Sastri BV, Balasubramanian SC, Narasinga Rao BS, Deosthale YG, Pant KC. Nutritive Value of Indian Foods. Hyderabad, India: Siddamsetty Press, 1989.

12. Human Nutrition Information Service, U.S. Department of Agriculture. Nutrient Database for Individual Intake Surveys, Release 5. Hyattsville MD: U.S. Department of Agriculture, 1993.

13. University of Texas Health Science Center. Food Intake Analysis System, Version 2. Houston TX: University of Texas, 1992.

14. Murphy SP, Calloway DH. Development of a database for the Nutrition CRSP project. Proceedings of the Fifteenth National Nutrient Databank Conference, MR Stewart, editor. Ithaca NY: The CBORD Group, 1990.

Committee Reports

Citing Nutrient Databases

Suzanne Murphy, *University of California, Berkeley*

Committee Report: Citing Nutrient Databases

Suzanne P. Murphy, Ph.D., R.D., Department of Nutritional Sciences, University of California, Berkeley

This past year the ad hoc Committee on Citing Nutrient Databases has finalized a one-page document entitled "Recommendations for Describing Nutrient Databases Used in Published Research". A draft copy of these recommendations was presented at last year's meeting; comments from participants were incorporated into a revised version, which was then circulated to all committee members for their comments. A final version was then written, and along with a cover letter, was mailed to the editors of 62 journals which publish human nutrition research results. Feedback from the editors has been uniformly positive. Copies of the recommendations, the cover letter, the committee membership, and the journal list follow. I would like to especially thank the committee members for their helpful comments and timely responses over the past two years.

Current Issues in Analytical Methodologies

Total Genistein, Diadzein & Glycitein Content of Soyfoods
Patricia A. Murphy and Huei-Ju Wang *Iowa State University*

Determination of Trans Fatty Acids in Dietary Fats
W.M. Nimal Ratnayake, *Health and Welfare, Canada*

The Impact of the Nutrition Labeling and Education Act (NLEA) on Fat Analysis
Donald E. Carpenter, *Kraft General Foods*

From Clinical Chemistry to Food Chemistry: The Pennington Experience
Richard Tulley and Fatemah Ramezanzadeh, *Pennington Biomedical Research Center*

Total Genistein, Daidzein & Glycitein Content of Soyfoods

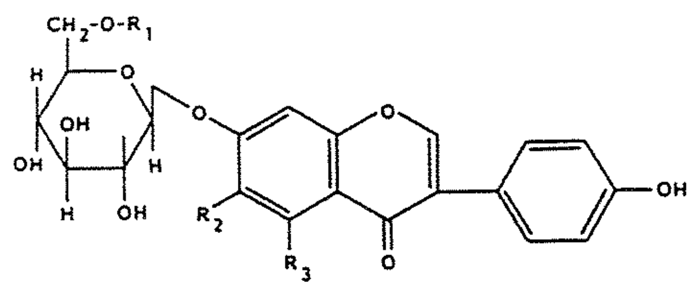
Patricia A. Murphy & Huei-Ju Wang, Iowa State University, Food Science & Human Nutrition, Ames, IA 50010

Introduction

The major soybean isoflavones, genistein and daidzein (figure 1), have been identified for a considerable period (Walter, 1941). Because these compounds appear to act as anticarcinogens by exerting a biological antioxidant effect, their content and bioavailability in foods has been a topic of recent interest (Messina and Barnes, 1991). However, in order to evaluate the potential of the isoflavones as a dietary anticarcinogen, the amounts available in typical soy foods and in soybeans must be quantified.

There have been preliminary reports on genistein and daidzein and their glycosides in a few soybean varieties and in soyfoods (Murphy, 1982; Farmakalidis and Murphy, 1985) as well as discussion of the effects of processing on these chemicals. More recently, the variations in glucoside substitution has been recognized (Farmakalidis and Murphy, 1985, Kudou et al., 1991). Glycitein, a 5-methoxy form, has been reported by some researchers (Eldridge, 1982; Naim et al., 1973) but not all soybeans seem to contain this form. The isoflavones appear to be concentrated in the soybean hypocotyl with low to moderate amount in the cotyledon. Since traditional processing of soybeans into food products will not separate these seed parts, we have evaluated soybean seeds without fractionation.

We have estimated the amount of soyfoods that humans would need to consume to provide an anticarcinogenic dose at 0.6 to 18 mg/kg body weight/day. Some soyfoods have isoflavone contents that will easily supply this amount.



ISOFLAVONE	R_1	R_2	R_3
DAIDZIN	H	H	H
GENISTIN	H	H	OH
GLYCITIN	H	OCH_3	H
6"-O-ACETYLDAIDZIN	$COCH_3$	H	H
6"-O-ACETYLGENISTIN	$COCH_3$	H	OH
6"-O-ACETYLGLYCITIN	$COCH_3$	OCH_3	H
6"-O-MALONYLDAIDZIN	$COCH_2COOH$	H	H
6"-O-MALONYLGENISTIN	$COCH_2COOH$	H	OH
6"-O-MALONYLGLYCITIN	$COCH_2COOH$	OCH_3	H

Figure 1. Chemical structures of soybean isoflavone glycones. Soy aglycone isoflavones, genistein, daidzein and glycitein, are free phenols without a glucose moiety.

Materials and Methods

Soybeans were obtained from our collection of food (tofu) soybeans. Commercial soyfoods were purchased locally. Soy ingredients were purchased locally and made into "homecooked" soyfoods in departmental test kitchens.

Isoflavone standards for HPLC analysis were isolated by methods of Farmakalidis and Murphy (1985) and Kudou et al. (1991). Only genistein and daidzein can be purchased commercially (ICN; CalBiochem, Inc.).

Isoflavones in "homecooked" soyfoods were measured as free isoflavones after acid hydrolysis in 1N HCl (Wang et al. 1990). All other soy products were evaluated as acetonitrile/0.1N HCl extracts (Murphy, 1981). Isoflavones were separated by gradient (A: H_2O with 0.1% acetic acid; B: acetonitrile with 0.1% acetic acid) on a YMC-PACK ODS-AM-303 C_{18} column (Kudou et al., 1991). The gradient is developed for 15 to 35% B over 50 min followed by a 10 min hold at 35% B. The peaks were evaluated with a Waters 990 photodiode array detector between 200-350 nm.

Statistical analysis of differences between means was performed by ANOVA with the SAS package of the ISU computation system.

Results and Discussion

The analysis protocol used can evaluate the 12 isoflavones found in soybeans and soyfoods. Figure 1 presents the chemical structures of the 3 isoflavonoids, genistein, daidzein and glycitein. Additionally, these isoflavonoids occur as the glycosides, genistin, daidzin and glycitin, as the 6"-O-acetylglucosides, and as the 6"-O-malonylglucosides.

Figure 2 represents typical chromatographic profiles for two soy samples. Vinton 81 soybeans show the typical distribution for whole soybeans. Most of the isoflavones were present as glucosides. There were little 6"-O-acetyl forms reflecting minimal heat treatment. The distribution of genistein and daidzein forms was roughly equivalent, however, this ratio varies with crop year and growth environment within a variety. Glycitein and its glucosides were 5% of total isoflavone content. Soybeans from the north-central region of the U.S. appear to have much lower levels of this methoxylated isoflavone than those grown in more southern regions of the U.S. Tofu isoflavones yielded a different chromatographic profile typical of food products were the soy was fully hydrated. The glucosides are reduced while the aglycones and the 6"-O-acetyl forms increased. This reflected the action of the native glycosidases and the effect of heat processing, respectively.

Prior to isolation of glycone isoflavone standards, soyfoods were evaluated for their total isoflavone content by assaying the acid hydrolysates. These data are presented in figure 3. The graph shows that as soy products or soybeans were diluted into foods, the effective dose decreases rapidly compared to whole soybeans alone. Soymilk, fried tempeh, tempeh pizza and soybean casserole were judged to contain isoflavones at levels high enough to provide an isoflavonoid dose in the range required.

Food-use soybeans were evaluated for all isoflavonoid moieties but contained almost no acetyl forms. Total isoflavonoid, total genistein and total daidzein are presented in Table I. The distribution of the isoforms are presented in figure 4 for Vinton 81, Strayer 2233 and Prize varieties, all U.S. tofu beans, and for Keburi, Kurodiazu and Raiden, Japanese varieties, from several crop years. The contents of isoflavones show considerable variation by variety, crop year and location. The malonyl forms make up a considerable proportion of total isoflavonoid contents of intact soybeans. Almost no 6"-O-acetyl forms appear in intact beans. The total glycitin content was relatively constant for all varieties evaluated at 135 μg/g.

Commercial soy product isoflavone contents are presented in Table II and in figure 5. As total soy protein content was diluted in soy product formulation, the total isoflavone content was reduced, concomitantly. The effects and extent of heat processing is reflected in the appearance and concentration of the 6"-O-acetyl forms in commercial products. The more extensive the heat treatment, the higher the 6"-O-acetyl isoflavonoid contents. Textured soy protein (TVP) was processed by extrusion, a high intensity heat treatment, and yielded the highest levels of the acetyl derivatives. Processing, by heat or with water addition, decreased the 6"-O-malonyl forms significantly while increasing the respective aglycones and unmodified glycones. The commercial soyfoods evaluated were produced from unknown soybean varieties. We have not performed a mass-balance on specific soybean varieties, thus, we cannot calculate the distribution during processing.

Conclusion

Total isoflavone content of food soybeans ranged from 713 to 2772 ppm total, 311 to 1311 ppm daidzein, 402 to 1461 ppm genistein and 82 to 203 ppm glycitein. Isoflavone content of commercial soyfoods ranged from 7 to 2892 ppm total, 5 to 1539 ppm genistein, 2 to 1537 ppm daidzein and 12 to 202 ppm glycitein. The glycoside variation was effected by heat processing and water content. Careful selection of soy products can yield a desired anticarcinogenic dose of 700 to 2000 ppm.

References

Eldridge, A.C. 1982. J. Agric. Food Chem. 30:353-355.

Farmakalidis, E. and Murphy, P.A. 1985. J. Agric. Food Chem. 33:385-389.

Kudou, S., Fleury, Y., Welt, D. Magnolato, D. Uchida, T., Kitamura, K., Okubo, K. 1991. Agric. Biol. Chem. 55:2227-2233.

Messina. M. and Barnes, S. 1991. J. National Cancer Inst. 83:541-546.

Murphy, P.A. 1981. J. Chromatog. 211:166-169.

Murphy, P.A. 1982. Food Technol. 36:62-64.

Naim, M. Gestetner, B., Zilkah, S. Birk, Y., Bondi, A. 1974. J. Agric. Food Chem. 22:806-810.

Walter, E.D. 1941. J. Amer. Chem. Soc. 63:3273-3275.

Wang, G., Kuan, S.S., Francis, O.J., Ware, G.M. and Carman, A.S. 1990. J. Agric. Food Chem. 38:185-190.

TOTAL ISOFLAVONE CONTENT OF FOOD SOYBEANS

		μg/g			
VARIETY	YEAR	TOTAL	GENISTEIN	DAIDZEIN	GLYCITEIN
PRIZE	1989	2,772^{A}	1,461^{ABCD}	1,311^{A}	110^{GHI}
LS301	1989S	2,747^{A}	1,509^{AB}	1,238^{A}	129^{DEF}
P9111	1989	2,682^{AB}	1,636^{A}	1,046^{BC}	116^{FGHI}
LS301	1990	2,479^{BC}	1,368^{BCDE}	1,111^{BC}	135DE
PRIZE	1990	2,402^{CD}	1,280^{DEFG}	1,122^{B}	122^{EFGHI}
P9202	1989	2,375^{CDE}	1,472^{ABCD}	903DE	131^{DEF}
VINTON 81	1989	2,225^{CDEF}	1,163^{FGH}	1,062^{BC}	122^{EFGHI}
LS301	1989A	2,170^{DEF}	1,300^{CDEF}	870DE	131^{DEF}
P9202	1991	2,132^{FE}	1,481^{ABC}	651^{F}	135DE
P9111	1991	2,065^{F}	1,253^{EFG}	812^{E}	82^{K}
VINTON 81	1990H	2,047^{F}	1,083^{GH}	964^{CD}	122^{EFGHI}
STRAYER 2233	1989	1,443^{G}	837^{JK}	605^{FG}	130^{DEF}
HP204	1989S	1,361^{GH}	854^{JK}	507^{GHI}	132^{DEF}
STRAYER 2233	1991	1,333^{GH}	788^{JK}	545^{FGH}	126^{EFG}
HP204	1990	1,318^{GHI}	840^{JK}	479^{HIJ}	123^{EFGH}
KEBURI	1991	1,278^{GHI}	859^{JK}	419^{IJK}	156^{BC}
XL72	1989	1,242^{GHI}	972^{HIJ}	270^{L}	167^{B}
RAIDEN	1991	1,221^{GHI}	875^{JK}	345^{KL}	203^{A}
HP204	1989A	1,181^{GHIJ}	786^{JK}	394^{IJK}	131^{DEF}
XL72	1990	1,178^{HIJ}	904^{JK}	274^{L}	170^{B}
KURODIAZU	1991	1,138^{HIJ}	820^{JK}	318^{KL}	123^{EFGHI}
VINTON 81	1991I	1,059^{IJ}	732^{KL}	327^{KL}	107^{HIJ}
VINTON 81	1991S	933^{JK}	553^{LM}	380^{JKL}	117^{FGHI}
VINTON 81	1991W	713^{K}	402^{M}	311^{KL}	109^{GHI}

Table 1. Isoflavone values in columns with different letters were significantly different (a=0.05). Isoflavone contents were normalized with respect to glucoside moiety. Crop year with letter code were grown in different locations in Iowa.

Table 2. The total equivalent amounts (µg/g) of daidzein, genistein, and glycitein in soy food products.

Products	Daidzein	Genistein	Glycitein	Total
Soy Ingredients				
Green soybean	546^{a}	729^{c}	79^{de}	1354^{c}
Soy granule	549^{a}	748^{c}	167^{b}	1464^{b}
T.V.P.	473^{b}	707^{cd}	202^{a}	1382^{bc}
Soy flour	226^{f}	810^{b}	88^{d}	1124^{de}
Traditional soy foods				
Soynuts	563^{a}	869^{a}	193^{a}	1625^{a}
Soy beverage^{A}	311^{de}	617^{ef}	109^{c}	1037^{ef}
Soy beverage^{B}	295^{de}	607^{fg}	111^{c}	1014^{f}
Soy beverage^{C}	336^{d}	560^{g}	105^{c}	1001^{f}
Soy beverage^{D}	407^{c}	665^{de}	111^{c}	1183^{d}
Organic tofu	146^{g}	162^{k}	29^{ghij}	337^{hi}
Tempeh	273^{e}	320^{h}	32^{fghij}	625^{g}
Bean paste	272^{ef}	245^{i}	77^{e}	593^{g}
Fermented beancurd	143^{g}	224^{ij}	23^{j}	390^{h}
Honzukuri miso	79^{h}	177^{jk}	38^{fg}	294^{i}
2nd-generation soy foods				
Hot dog	34^{hijk}	82^{lm}	34^{fghi}	150^{jk}
Bacon	28^{ijk}	69^{lm}	24^{ij}	122^{jkl}
Tempeh burger	64^{hi}	196^{ijk}	30^{ghij}	289^{i}
Tofu yogurt	57^{hij}	94^{l}	12^{k}	164^{j}
Soy parmesan	15^{jk}	8^{n}	41^{f}	65^{kl}
Cheddar cheese^{A}	2^{k}	5^{n}	27^{hij}	34^{l}
Cheddar cheese^{B}	34^{hijk}	40^{mn}	35^{fgh}	109^{jkl}
Mozzarella cheese	11^{k}	36^{mn}	30^{ghij}	76^{jkl}
Flat noodle	9^{k}	37^{mn}	39^{fg}	85^{jkl}

List of figures

Figure 1. Chemical structures of soybean isoflavone glycones. Soy aglycone isoflavones, genistein, daidzein and glycitein, are free phenols without a glucose moiety.

Figure 2. HPLC chromatograms of soy isoflavones in A) Vinton 81 soybeans and B) commercial organic tofu.

Figure 3. Total genistein and daidzein content of soyfoods prepared for human feeding study.

Figure 4. Isoflavone distribution in food soybeans. A) Japanese soybeans, Keburi, Kuodiazu and Raiden from 1991. B) Vinton 81 soybeans from 3 crop years. C) Strayer 2233 soybeans from 1989 and 1991. D) Prize soybeans from 1989 and 1990. D, G and Gl = total daidzein, genistein and glycitein normalized for different molecular weights of glucosides. MAL-DIN = malonyldaidzin; MAL-GIN = malonylgenistin; MAL-GLY = malonylglycitin; AC-GLY = acetylglycitin.

Figure 5. Isoflavone distribution in commercial foods containing soy. A) Soynuts, textured soy protein, tofu. B) Soymilk, tempeh and soy bacon. D, G and Gl = total daidzein, genistein and glycitein normalized for different molecular weights of glucosides. MAL-DIN = malonyldaidzin; MAL-GIN = malonylgenistin; MAL-GLY = malonylglycitin; AC-DIN = acetyldaidzin; AC-GIN = acetylgenistin; AC-GLY = acetylglycitin.

Figure 2A VINTON 81 SOYBEANS

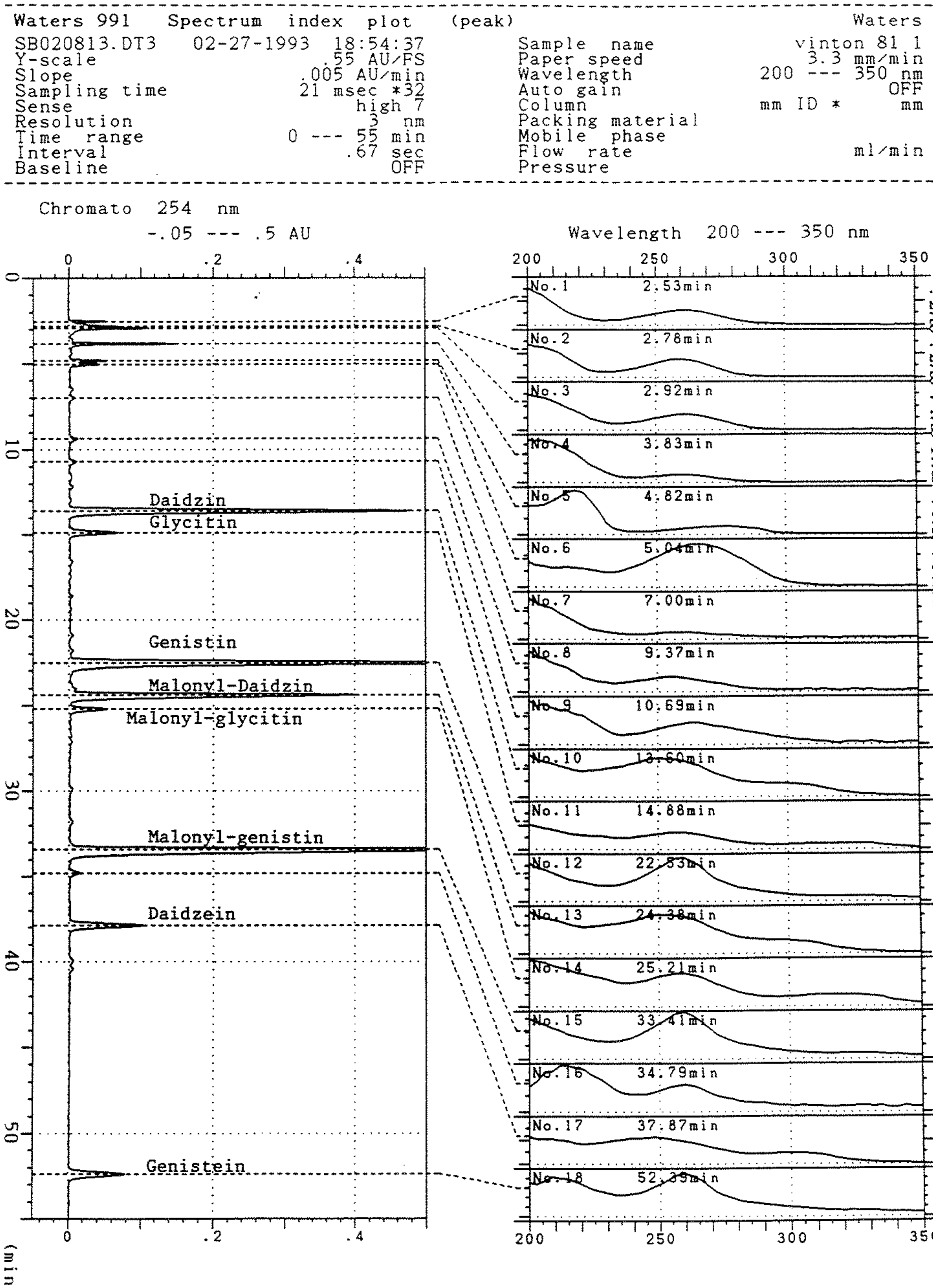


Figure 2B ORGANIC TOFU

Waters 991 Spectrum index plot (peak) Waters

SF10229.DT3	09-25-1992 10:42:07	Sample name	
Y-scale	.55 AU/FS	Paper speed	3.3 mm/mi
Slope	.005 AU/min	Wavelength	200 --- 350 nm
Sampling time	23 msec *160	Auto gain	OFF
Sense	high 7	Column	mm ID * mm
Resolution	3 nm	Packing material	
Time range	0 --- 55 min	Mobile phase	
Interval	3.68 sec	Flow rate	ml/min
Baseline	OFF	Pressure	

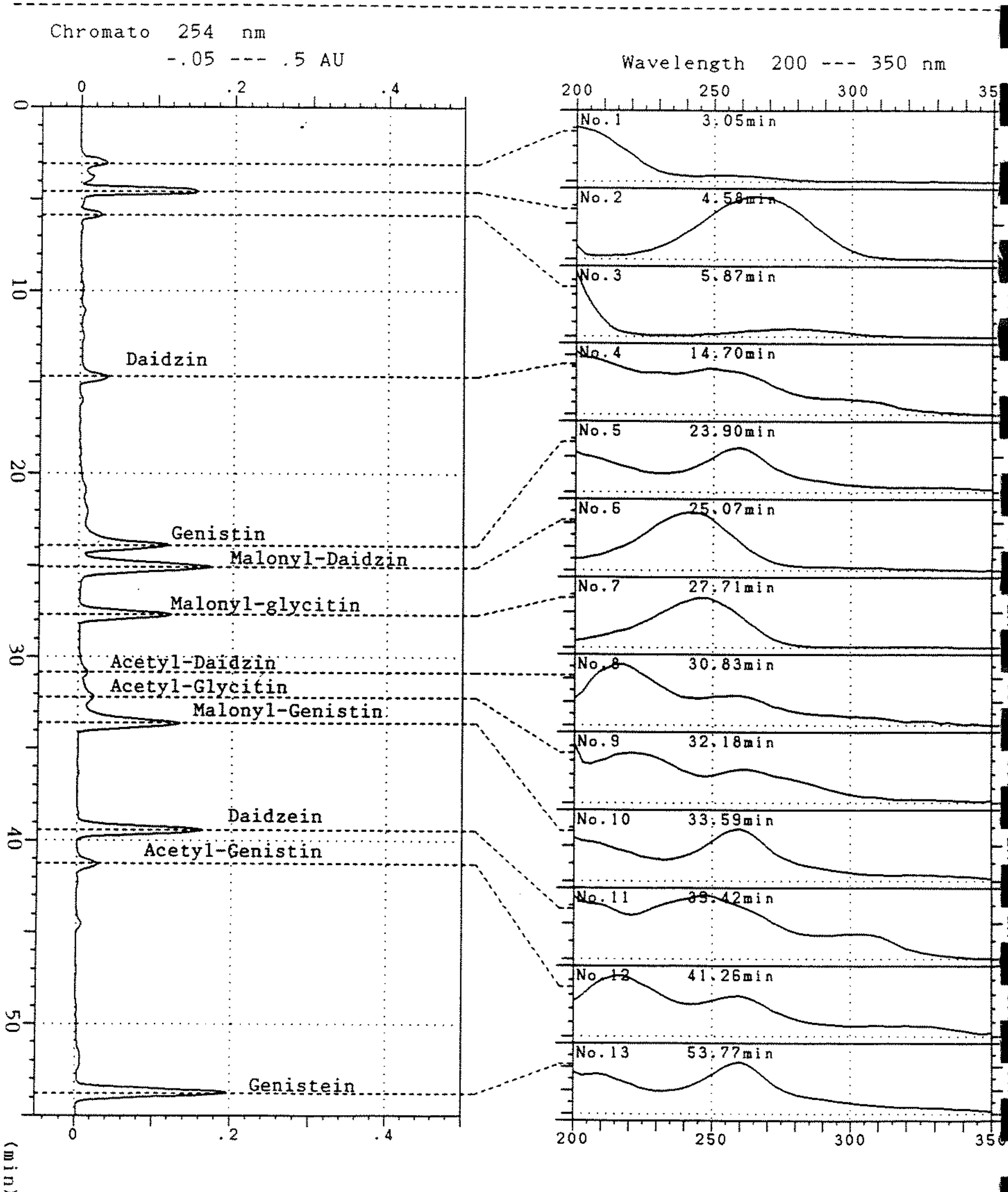
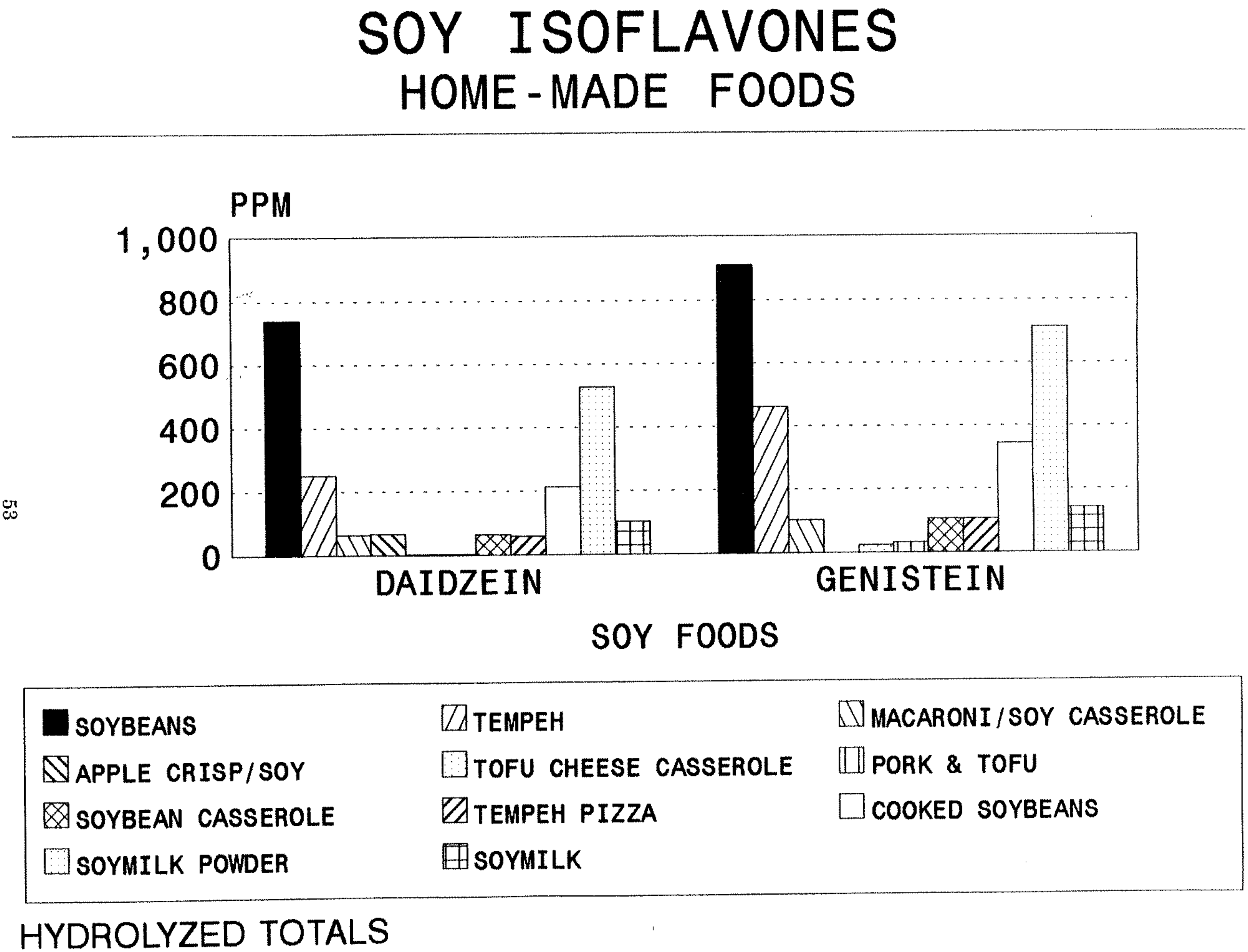


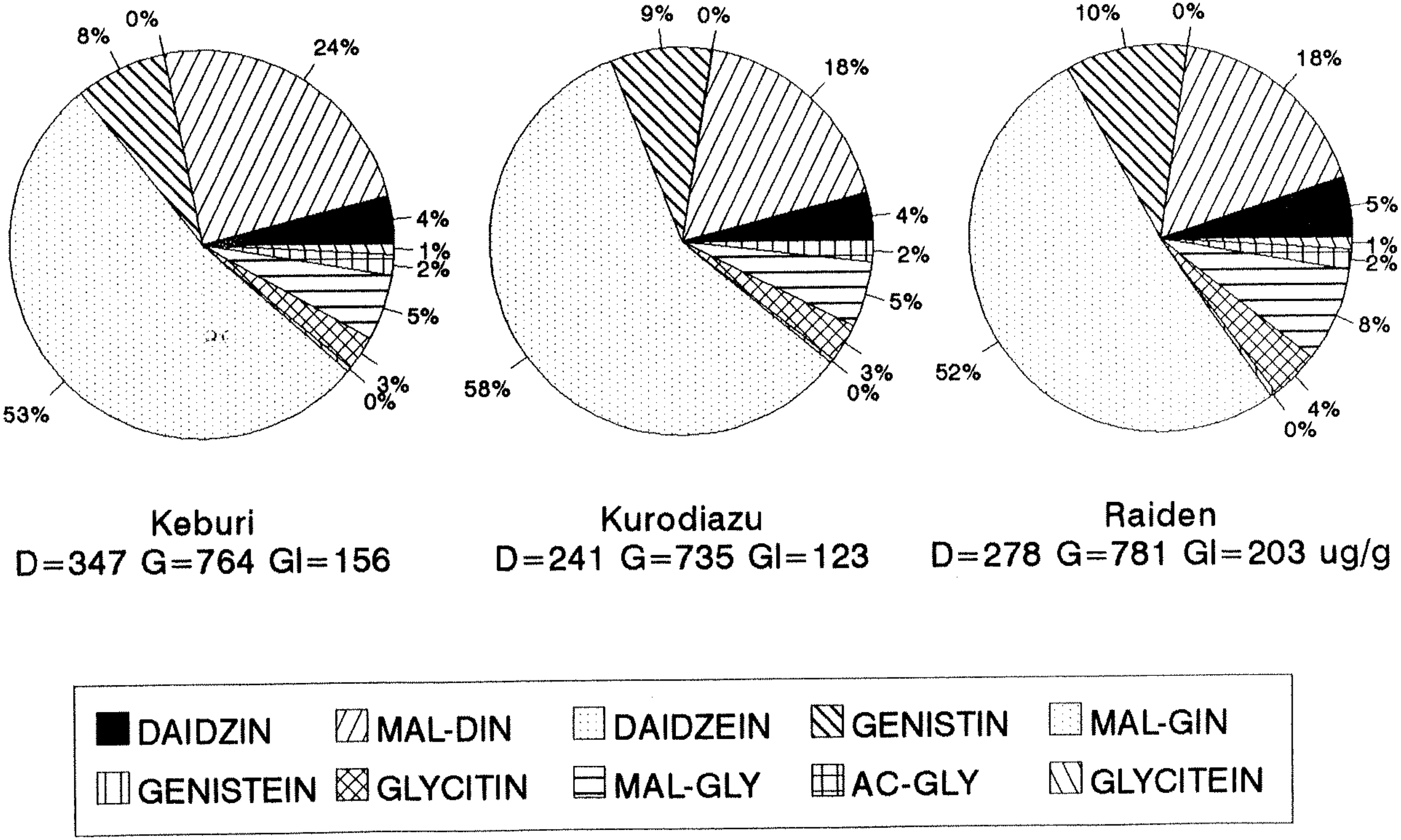
Figure 3



SOY ISOFLAVONES
HOME-MADE FOODS
PPM
1,000
800
600
400
200
0
DAIDZEIN
GENISTEIN
SOY FOODS
SOYBEANS
APPLE CRISP/SOY
SOYBEAN CASSEROLE
SOYMILK POWDER
TEMPEH
TOFU CHEESE CASSEROLE
TEMPEH PIZZA
SOYMILK
MACARONI/SOY CASSEROLE
PORK & TOFU
COOKED SOYBEANS
HYDROLYZED TOTALS

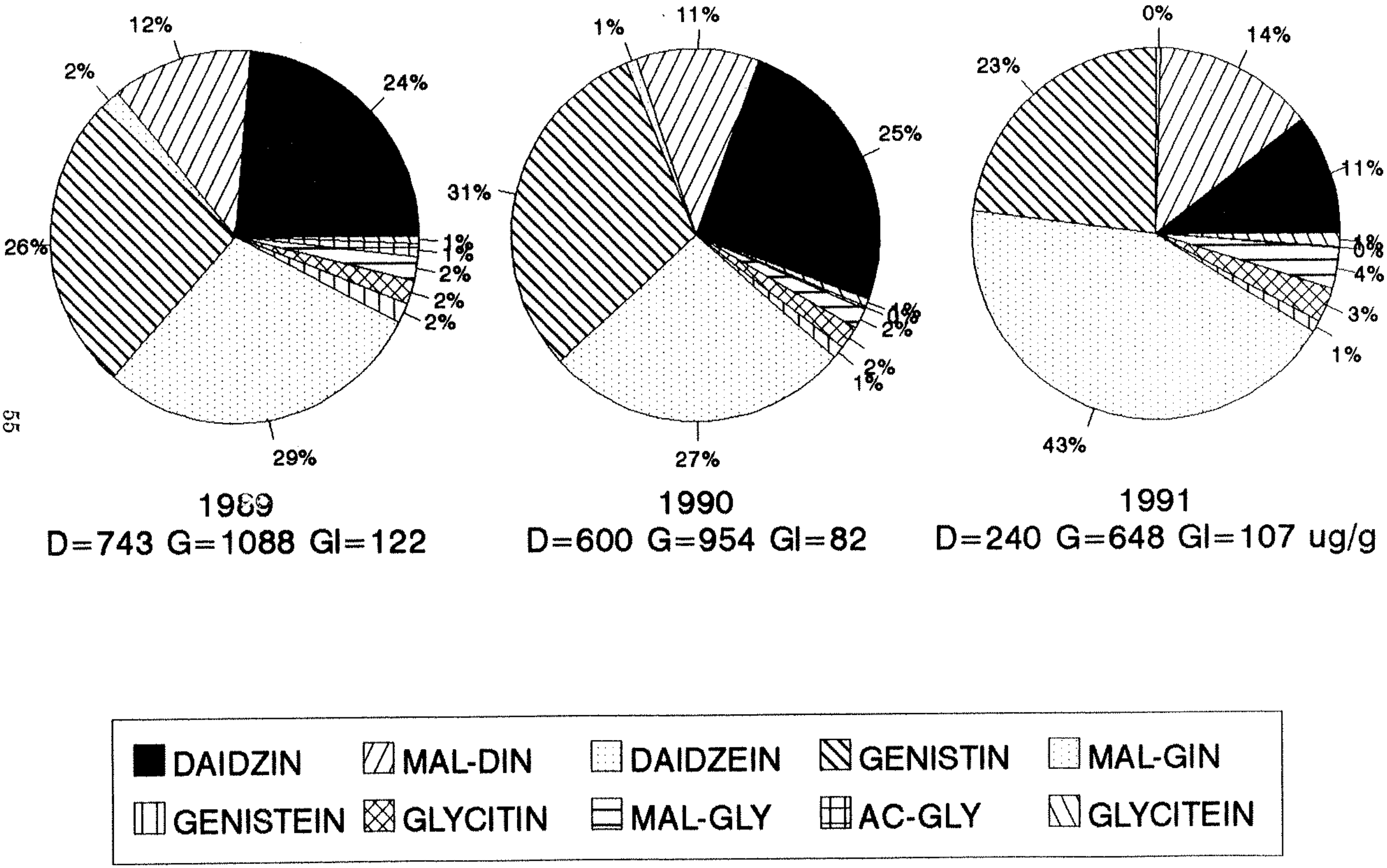
figure 4A

ISOFLAVONES IN FOOD SOYBEANS



1991

Figure 4B



VINTON 81

Figure 4C

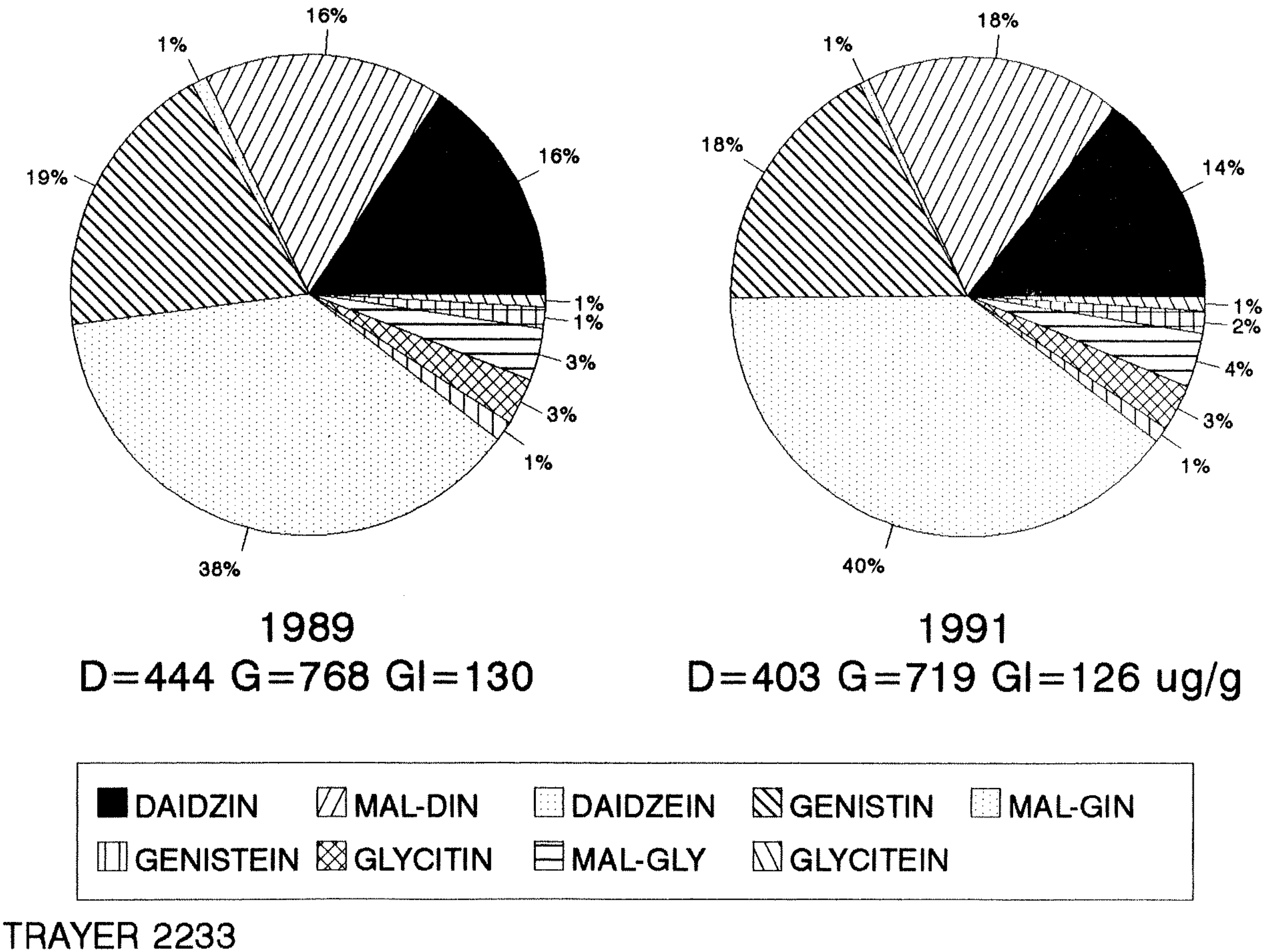
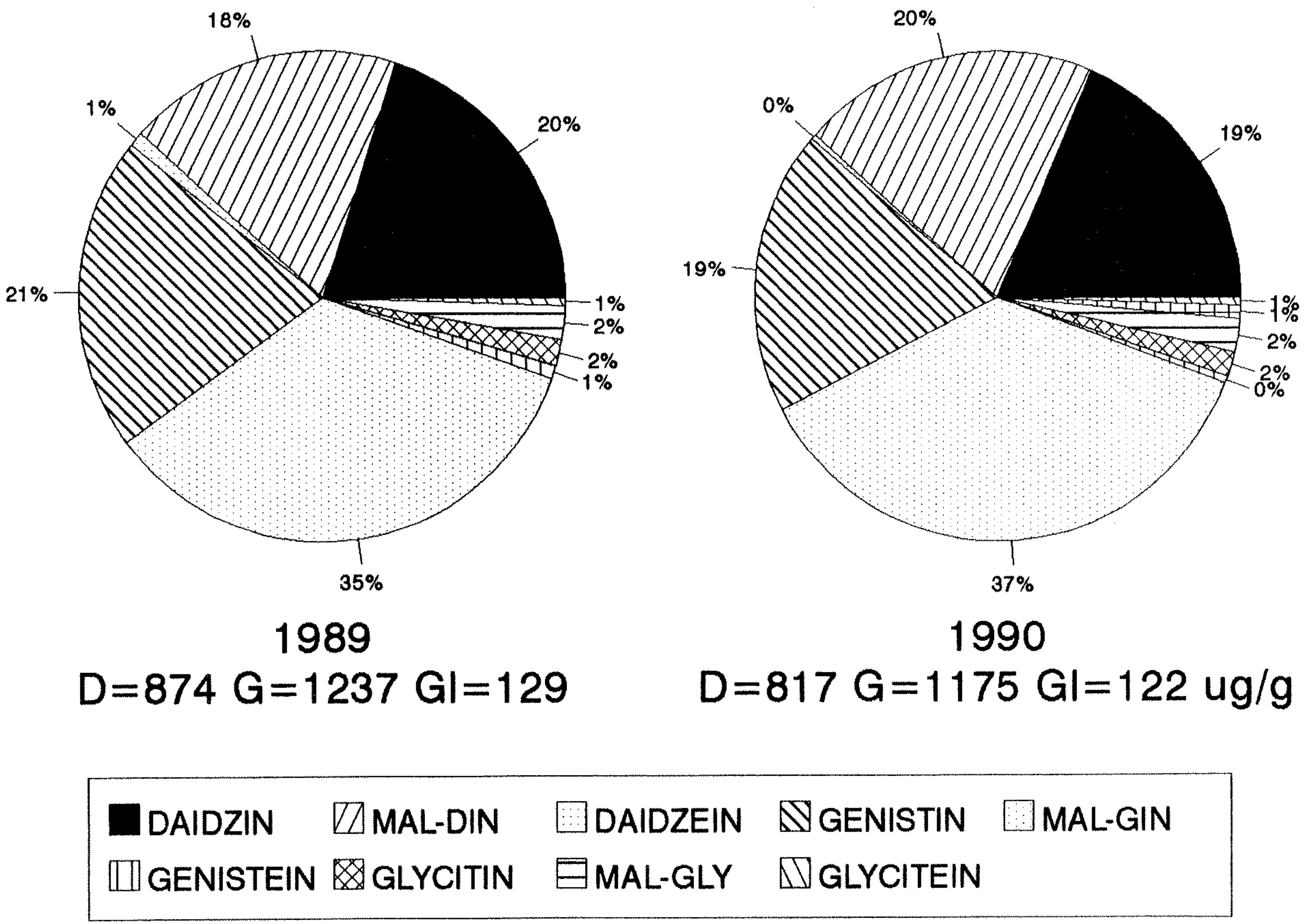
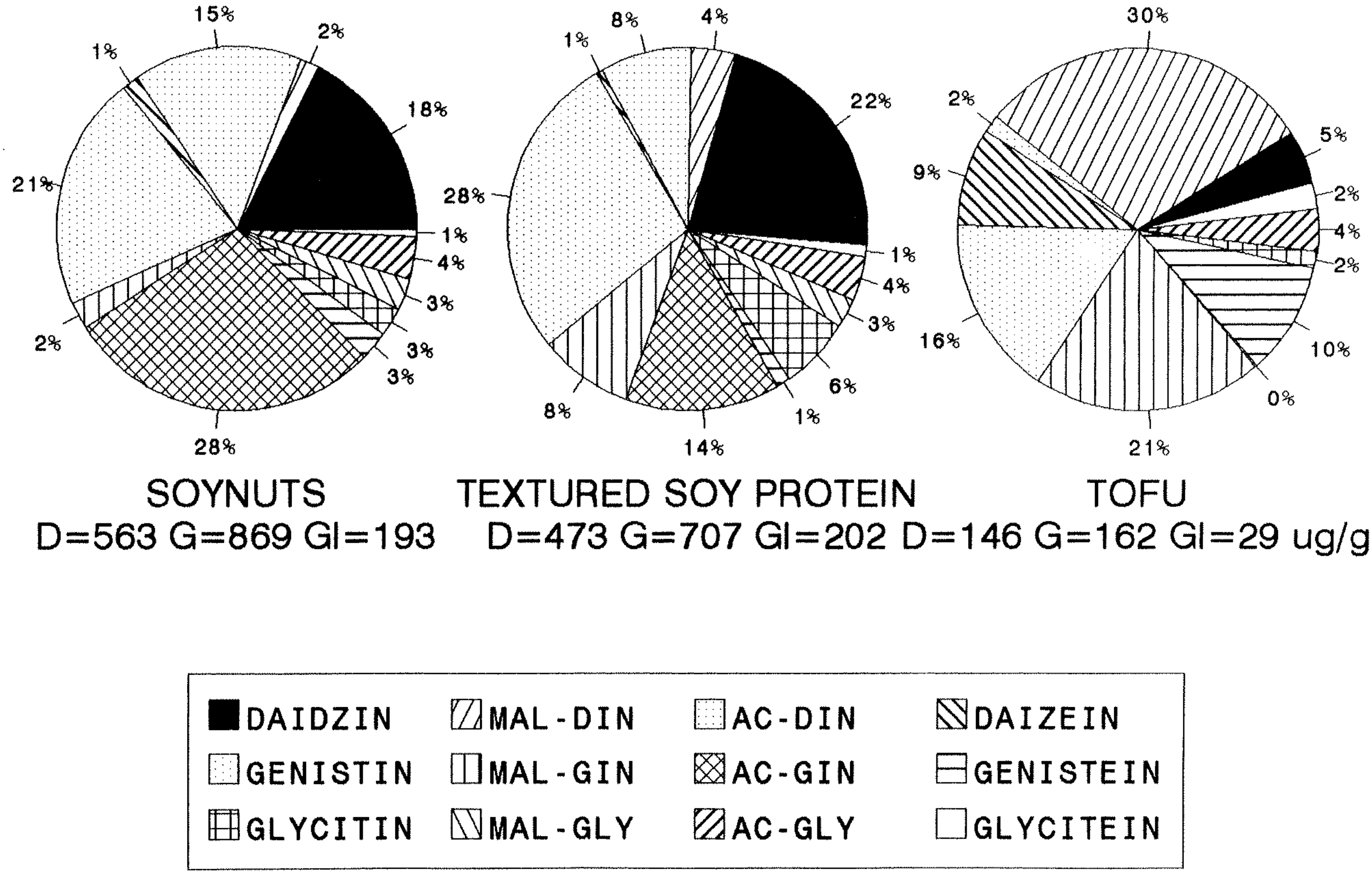

16%
1%
16%
19%
1%
1%
3%
3%
1%
38%
1989
D=444 G=768 Gl=130
18%
1%
18%
14%
1%
2%
4%
3%
1%
40%
1991
D=403 G=719 Gl=126 ug/g
DAIDZIN
MAL-DIN
DAIDZEIN
GENISTIN
MAL-GIN
GENISTEIN
GLYCITIN
MAL-GLY
GLYCITEIN
STRAYER 2233

Figure 4D



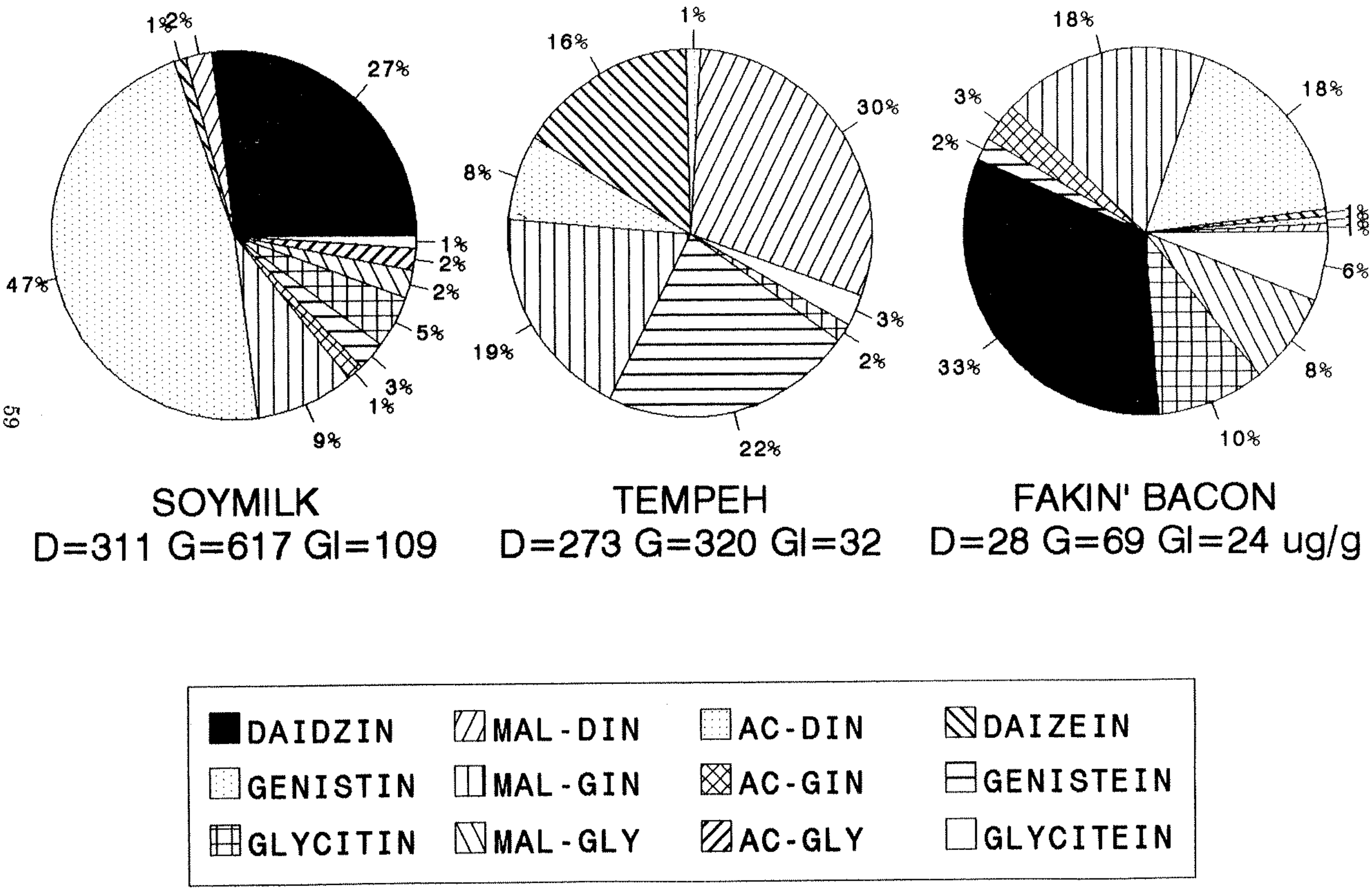
PRIZE

Figure 5A



COMMERCIAL SOYFOODS

Figure 5B



COMMERCIAL SOYFOODS

Determination of *trans* fatty acids in dietary fats

W.M.N. Ratnayake, Nutrition Research Division, Food Directorate, Health Protection Branch, Health and Welfare Canada, Ottawa, Ontario, Canada K1A 0L2

Introduction

Several unusual *cis* and *trans* isomers of naturally occurring unsaturated fatty acids is found in many dietary fats. With partially hydrogenated vegetable oils (PHVO), *cis* and *trans* isomers of oleic acid are the main components with double bond positions located from Δ5 to Δ16 (1). In addition, PHVO contain various positional and geometric isomers of linoleic acid with *trans* or non-methylene interrupted double bonds (2). The isomers of linoleic acid are generally prevalent in mildly hydrogenated vegetable oils. Levels up to 7% have been found in some margarines (2,3). Hydrogenated fish oils contain numerous *cis* and *trans* isomers of mono- and poly-unsaturated fatty acids with a wider range of chain lengths (4). *Trans* fatty acids also occur naturally in dairy products, especially those from ruminant animals. Rumen microorganisms biohydrogenate dietary polyunsaturated fatty acids to *trans* fatty acids with 18:1Δ11*t* being the most prevalent isomer.

The widespread use of PHVO, mainly as a substitute for saturated fats of tropical origin, has raised questions concerning the health consequences of intake of *trans* fatty acids. Recent reports indicate that *trans* fatty acids are hypercholesterolemic as that of saturated fatty acids and adversely affect the LDL/HDL cholesterol ratio (5-7). Furthermore, *trans* fatty acids as compared to oleic and linoleic acids increase serum levels of lipoprotein (a) (8). High Lp(a) is an independent and greater risk factor than is high serum cholesterol for coronary heart disease (9).

Because of these adverse health effects, accurate determination of the *trans* fatty acid content is important. In Canada and some European countries, the voluntary nutritional labeling regulations of foods require that monounsaturates only of the *cis* configuration be declared on the label. Furthermore, according to Canadian regulations, polyunsaturates are restricted to *cis,cis* methylene-interrupted structures. These labeling regulations necessitate, not only the determination of the total *trans* content, but also accurate determination of *cis* and *trans*-monounsaturated fatty acids and the general fatty acid composition of food fats.

Determination of total *trans* content

A number of methods are described in the literature for the determination of total *trans* content, including infrared (IR), Raman and nuclear magnetic spectroscopy (NMR), gas chromatography (GC), GC coupled to Fourier transform (FT) IR spectroscopy (GC/FTIR), reversed-phase and silver ion high-performance liquid chromatography (HPLC), and silver nitrate thin-layer chromatography ($AgNO_3$-TLC) in conjunction with GC (10). Of the various methods, IR spectroscopy has been the method of choice for determination of total *trans* content in food fats. The methods based on TLC and HPLC are generally used for isolation of *trans* fatty acids for subsequent structural identification, while Raman and NMR spectroscopy and, GC/FTIR are more suited for structural elucidation of pure *trans* fatty acids.

An isolated *trans* double bond absorbs in the IR region at a wave number of approximately 967 cm^{-1}, equivalent to a wavelength of 10.3 μm, as a result of the deformation of the C-H bonds adjacent to the *trans* double bond. The measurement of the intensity of this absorption under controlled conditions is the basis of the official methods of AOCS (11), AOAC (12) and IUPAC (13) for the determination of total *trans* unsaturation in fats. The AOCS method is exactly same as that of AOAC and can be used for either triglycerides, methyl esters or unesterified fatty acids. The absorbance or transmittance is recorded by scanning a carbon disulphide solution of the fat sample from 1110 (9 µm) to 910 cm^{-1} (11 µm) against a carbon disulphide blank. A baseline is drawn from 990 (10.10 µm) to 939 cm^{-1} (10.65 µm) for unesterified acids, from 998 (10.02 µm) to 944 cm^{-1} (10.59 µm) for methyl esters or from 995 (10.05 µm) to 937 cm^{-1} (10.67 µm) for triglycerides and the absorptivity is calculated. The *trans* content is calculated by comparing this absorptivity to that of a standard solution of either elaidic acid, methyl elaidate or trielaidin in carbon disulphide. Because, conjugated *trans* bonds absorb near the 10.3 µm band of isolated double, the method is limited to samples containing less than 5% conjugated fatty acids. Further, because of the low intensity of absorption, the accuracy of the AOCS IR method is poor for samples containing less than 5% isolated *trans* unsaturation. Capillary GLC may be the ideal technique for accurate determination of low levels of *trans* unsaturation (discussed below).

The AOCS method gives higher values when fat samples are analyzed as triglycerides, particularly for samples containing less than 15% *trans* unsaturation. Accurate determination of *trans* content in triglycerides require their conversion to methyl esters prior to IR analysis.

The IUPAC (13) method specifies the use of methyl esters and measures the absorption against a blank containing methyl stearate at the same concentration as the sample. The *trans* content is calculated using a calibration curve of absorption versus % isolated *trans* unsaturation developed using a series of carbon disulphide solutions containing different ratios of methyl elaidate and methyl stearate. The use of methyl stearate removes the interference from methyl ester absorption and thus gives greater accuracy down to 1% *trans* content.

Madison *et al.* (14) proposed a 2-component calibration procedure similar to that of IUPAC (13). However, they suggested standard mixtures of methyl elaidate and methyl linoleate for the development of the calibration curve. Calibration and test solutions are scanned from 900 to 1050 cm^{-1} against a carbon disulphide blank. A baseline is drawn between peak minima at about 935 and 1020 cm^{-1}, and the baseline-corrected absorbance of the *trans* peak (967 cm^{-1}) is obtained. The baseline for the test sample spectrum is drawn exactly as the baseline in the standard spectrum, by overlaying the two spectra. This method allows analysis of *trans* contents in the range 0.5 to 36% with increased accuracy. A recent collaborative study organized by Health and Welfare Canada tested a slightly modified procedure of Madison *et al.* (14). Methyl oleate was used instead of methyl linoleate for the development of the calibration curve. A good agreement among the participating laboratories (reproducibility relative standard deviation, RSD_R, ranged between 8.8 to 11.7%) was obtained for samples containing moderate to high content of *trans* unsaturation (15 to 34% *trans*) (see Table 1). However, for sample A (Table 1), that had the lowest *trans* content (5.2%), the agreement among the laboratories was less satisfactory (RSD_R 34.5%). This suggests that accurate measure of low levels of *trans* unsaturation (<5%) by IR is difficult.

Determination of *trans* by FTIR

The newer technique of FTIR offers several advantages over the conventional dispersive IR, including the high signal to noise ratio (S/N) obtained by averaging multitude spectral scans, rapid and comprehensive data collection allowing simple integration of peaks and digital background substraction (15). Use of computerized FTIR eliminates the time consuming tasks encountered with the conventional procedures of manually drawing the baseline and measuring of the peak heights.

Table 1. Statistical Evaluation of GLC-IR Collaborative Study of PHVO Samples

PHVO Sample	IR *trans*			18:1*t*			18:1*c*		
	Mean*	S_R	RSD_R	Mean*	S_R	RSD_R	Mean*	S_R	RSD_R
A	5.17	1.79	34.56	4.88	1.77	36.39	24.93	0.95	3.79
B	15.54	1.76	11.31	14.92	1.41	9.48	24.70	1.75	7.08
C1**	18.92	2.21	11.69	17.37	2.18	12.53	28.11	1.94	6.89
C2**	19.09	1.97	10.32	17.53	1.81	10.34	28.17	2.01	7.14
D	30.06	2.69	8.94	26.64	2.55	9.58	34.38	2.11	6.14
E	34.48	3.90	11.31	32.60	2.53	7.78	34.28	3.61	10.52
R	21.63	1.90	8.79	19.37	1.87	9.65	32.16	2.10	6.53

* Mean for 12 laboratories
S_R = Reproducibility Standard Deviation
RSD_R = Reproducibility Relative Standard Deviation
PHVO = Partially hydrogenated vegetable oil (blend of partially hydrogenated soybean oil and cottonseed oil)
** C1 and C2 are blind duplicates

Lanser and Emken (16) developed a computer assisted procedure for the estimation of isolated *trans* unsaturation in fats, using the peak area of the *trans* absorbance band at 966 cm^{-1} from FTIR spectra of fatty acid methyl esters in carbon disulphide. The area under a peak depends on the baseline chosen. They observed that absorbance minima, more specifically the minimum at the higher wave number, varied with the proportion of *trans* unsaturation. This required adjustment of the baseline according to the *trans* content. Samples with more than 10% *trans* produce an absorption band with minima at 944 and 988 cm^{-1}, whereas at less than 10% *trans*, the peak minima are at 944 and 985 cm^{-1} and below 5% *trans*, the peak minima are at 944 and 973 cm^{-1}. The calculation of *trans* content in hydrogenated oils containing less than 5% was improved by the use of appropriately selected integration limits.

Use of thin cells and neat methyl esters is the basis of the FTIR method proposed by Sleeter and Matlock (15) for determination of *trans* unsaturation in fats. FTIR uses a Michelson Interferometer, which allows all wavelengths of light to pass through the sample simultaneously, whereas with conventional dispersive spectrophotometers, which uses diffraction gratings, only limited amounts of light pass through the sample. Due to this increased amount of light at all wavelengths, FTIR allows analysis of neat products using thin cells with path lengths of ≈0.1 mm, eliminating possible errors due to weighing of sample and dilution with carbon disulphide. Use of carbon disulphide in dispersive instruments frequently leads to stratification, vapor and air bubble formation within the cell. Sleeter and Matlock (15) use neat mixtures of methyl elaidate and methyl linoleate for calibration as proposed by Madison *et al* (14). The area of the *trans* peak was integrated from 945 to 990 cm^{-1}. Quantitation was obtained by fitting measured *trans* areas of the calibration mixtures with a second order polynomial. This provides a correlation coefficient of 0.9998 and standard error of 0.11% over a range of 0 to 50%. *Trans* content can also be determined by measuring peak heights, which give a slightly increased error.

Determination of fatty acid composition

Gas chromatography (GC) of fatty acid methyl esters is undoubtedly the most convenient and widely used analytical method for determining the fatty acid composition (17). Slightly polar stationary phases, such as polyglycol Carbowax-20M, are normally employed for the analysis of fatty acids of natural origin, in which the double bonds of unsaturated fatty acids are almost exclusively of *cis* configuration. However, with these stationary phases, the separation of *cis/trans* isomers is not feasible. With highly polar cyanosilicone stationary phases such as SP-2560, SP-2340, OV-275 or CP-SIL-88 *cis* and *trans* isomers could be separated to a far greater extent than with polar stationary phases.

Based on an interlaboratory study, a 6.1 m x 2 mm (i.d.) column packed with OV-275 has been recommended by both AOCS (18) and AOAC (19) for determination of *trans* unsaturation in partially hydrogenated oils. However, a complete resolution is not feasible with the OV-275 column, since some of the *trans*-monoenes are hidden under the larger *cis* isomer peak (20).

In many lipid laboratories, capillary columns coated with cyanosilicone stationary phases appeared to gain acceptance for *cis/trans* isomer separation (21,22). AOCS (23) and AOAC (24) recently recommended the use of a 60 m x 0.25 mm (i.d.) flexible fused capillary column coated with SP-2340 to determine the general fatty acid composition, including the levels of *cis* and *trans*-octadecenoates of partially hydrogenated oils. This same method is recommended for determination of total *trans* unsaturation. The direct capillary GLC procedure was based on the assumption that 18:1*c* and 18:1*t* isomers are completely separable on the SP-2340 column. However, a complete resolution of 18:1*t* as a group from that of the *cis* isomers is not feasible on SP-2340 (25) or any other cyanosilicone capillary column (2,26). In these columns, the early eluting 18:1*t* isomers with low Δ values are well separated from the 18:1*c* isomers, but the 18:1*t* isomers with high Δ values (i.e. Δ12 and Δ15) overlap with 18:1Δ9*c* (the major 18:1*c* isomer in PHVO). Because of this overlap the direct GLC method greatly underestimates the total 18:1*t* in favor of the *cis* isomers (25). In some margarines, the underestimation in determining the total 18:1*t* can be as high as 32% (26). The levels of 18:1*t* isomers of high Δ values may depend on the hydrogenation conditions and the source oil, and this will result in variation in the extent of overlaps of the isomers from one PHVO to another. The concentration of the methyl esters applied to the GLC could also influence the *cis* and *trans* resolution.

Sampugna *et al* (21) proposed the use of appropriate correction factors to compensate for the *cis* and *trans* overlaps. They found a linear relationship between the correction factors, determined by comparison with results obtained by silver nitrate TLC/GC, for 18:1*t* and 18:1*c* and the proportion of total 18:1 isomers in the sample. GLC combined with other chromatographic techniques (particularly argentation chromatography) has been suggested (20,25,27-29), but these procedures are lengthy and are not suitable for routine analysis of dietary fats.

Combined GLC-IR

Ratnayake et al (26) proposed use of a combined capillary GLC and IR method for the determination of 18:1t and 18:1c isomers and the general fatty acid composition of PHVO. The total trans unsaturation determined by IR was correlated to the capillary GC weight percentages of the component trans fatty acid methyl esters by the mathematical formula: IR *trans* = %18:*t* + 0.84 x %18:2*t* + 1.74 x %18:2*tt* + 0.84 x %18:3*t* where 0.84, 1.74 and 0.84 are the correction factors relating GLC weight percentages to the IR *trans*-equivalents for mono-*trans* octadecadienoic (18:2*t*), *trans,trans*-octadecadienoic (18:2*tt*) and mono-*trans*-octadecatrienoic (18:3*t*) acids, respectively. This formula forms the basis for the determination of 18:1*t* and 18:1*c* in PHVO. GC provides the proportions of 18:2*t*, 18:2*tt* and 18:3*t*, whereas IR yields the total *trans* unsaturation, and 18:1*t* is calculated from the mathematical formula. 18:1*c* is obtained as the difference between total 18:1 and 18:1*t*.

An interlaboratory collaborative study, just concluded, indicated that the GLC-IR method gives reproducible results for PHVO samples containing more than 5% *trans* unsaturation (Table 1). That the GLC-IR method is capable of good precision is demonstrated by the excellent agreement for a pair of duplicate samples (Table 2). For samples with less than 5% *trans* content (sample A in Table 1), the agreement for 18:1*t* between the laboratories was less than satisfactory. This is because, as mentioned previously, the accuracy of measuring *trans* unsaturation by IR is poor with samples containing low levels of *trans* unsaturation. Direct GLC analysis is recommended for such samples, since when *trans* content is <5%, the overlap of 18:1*c* and 18:1*t* in cyanosilcone capillary columns is almost negligible.

Summary

With any of the current official methods a fairly good quantitative estimate of *trans* unsaturation can be obtained by IR spectrophotometry. Whether low levels of *trans* unsaturation would be determined by IR is doubtful. For these, use of direct GC is recommended. Alternatively, accuracy at lower *trans* levels could be improved with the use of FTIR by analyzing neat methyl esters in 0.1 mm IR cells.

The combined GC-IR method should be useful for routine analysis of *cis* and *trans*-octadecenoates and the general fatty acid composition in dietary fats made from PHVO and animal fats, provided the *trans* content is more than 5%. For samples containing less than 5% *trans*, detailed fatty acid composition and the total *trans* unsaturation are conveniently obtained through

Table 2. Statistical Evaluation of GLC-IR Collaborative Study of PHVO
Blind Duplicates – Samples C1 and C2

	Mean	**S_r**	**S_R**	**RSD_r**	**RSD_R**
IR *trans*	19.04	1.22	2.04	6.42	10.72
18:1*t*	17.45	1.26	1.92	7.24	11.00
18:1*c*	28.16	1.12	1.87	3.97	6.05

* n = 12 laboratories
S_r = Repeatability Standard Deviation
S_R = Reproducibility Standard Deviation
RDS_r= Repeatability Relative Standard Deviation
RSD_R = Reproducibility Relative Standard Deviation

GC analysis alone, without resorting to the use of IR. The GC-IR procedure, however, is not applicable to partially hydrogenated fish oils, because these fats contain a complex mixture of *cis/trans* isomers of polyunsaturated fatty acids with a wider range of chain lengths.

References

1. Dutton, H.J. Hydrogenation of fats and its significance. In "Geometrical and Positional Fatty Acid Isomers", Emken, E.A. and Dutton, H.J. (eds.). Champaign, IL. The American Oil Chemists' Society, pp. 1-16, 1979.
2. Ratnayake, W.M.N. and Pelletier, G. (1992). Positional and Geometrical isomers of linoleic acid in partially hydrogenated oils. J. Am. Oil Chem. Soc. 69:95-105
3. Ratnayake, W.M.N., Hollywood, R. and O'Grady, E. (1991). Fatty acids in Canadian margarines. Can. Inst. Food Sci. Technol. J. 24:81-86
4. Ackman, R.G. Fatty acid composition of fish oils. In "Nutritional Evaluation of Long-chain Fatty Acids in Fish Oils", Barlow, S.M. and Stansby, M.E. (eds.), Academic Press, London, England, pp 25-88 (1982)
5. Mensink, R.P. and Katan, M.B. (1990). Effect of dietary *trans* fatty acids on high-density and low-density lipoprotein cholesterol levels in healthy subjects. N. Engl. J. Med. 323:439-445
6. Zock, P.L. and Katan, M.B. (1992). Hydrogenation alternatives: effects of *trans* fatty acids and stearic acid versus linoleic acid on serum lipids and lipoproteins in humans. J. Lipid Res. 33:399-410
7. Troisi, R., Willett, W.C. and Weiss, S.T. (1992). *Trans*-fatty acid intake in relation to serum lipid concentrations in adult men. Am. J. Clin. Nutr. 56:1019-1024
8. Mensink, R.P., Zock, P.L., Katan, M.B. & Hornstra, G. (1992). Effect of dietary *cis* & *trans* fatty acids on serum lipoprotein (a) levels in humans. J. Lipid Res. 33:1493-1501
9. Sandkamp, M., Funke, H., Schute, H., Kohler, E., and Assmann, G. (1990). Lipoprotein (a) is an independent risk factor for myocardial infarction at a young age. Clin. Chem. 36:20-23
10. Firestone, D. and Sheppard, A. (1992). Determination of *trans* fatty acids. In Advances in lipid Methodology-One, W.W. Christie (ed.), The Oily Press Ltd, Ayr, Scotland, pp 273-322.
11. Official Methods and recommended Practices of the American Oil Chemists' Society, Fourth edition, 1989, Edited by D. Firestone, Method 14-61, American Oil Chemists' Society, Champaign, IL.
12. Official Methods of Analysis of the Association of Official Analytical Chemists, 15th edition, 1990, K. Helrich, (ed.), Method 965.34, Association of Official Analytical Chemists, Arlington, VA.
13. International Union of Pure and Applied Chemistry, Commission on Oils, Fats and Derivatives. Standard Methods for the Analysis of Oils, Fats and Derivatives, 7th Edition, C. Paquot & A. Hautfenne (eds.), 1987, Method 2.207. Blackwell Scientific Publications, London, England.

14. B.L. Madison, R.A. Depalma and R.P. D'Alonzo (1982). Accurate determination of *trans* isomers in shortenings and edible oils by infrared spectrophotometry. J. Am. Oil Chem. Soc. 59:178-181

15. Sletter, R.T. and Matlock, M.G. (1989). Automated quantitative analysis of isolated (nonconjugated) *trans* isomers using Fourier Transform Infrared Spectroscopy incorporating improvements in the procedure. J. Am. Oil Chem. Soc. 66:121-129

16. Lanser, A.C. and Emken, E.A. (1988). Comparison of FTIR and capillary gas chromatographic methods for quantitation of *trans* unsaturation of fatty acid methyl esters. J. Am. Oil chem. Soc. 65:1483-1487

17. Ackman, R.G. and Ratnayake, W.M.N. Lipid Analyses: Part 1. Properties of fats, oils and lipids: recovery and basic compositional studies with GLC and TLC. In "The role Fats in Human Nutrition", Vergroesen, A.J. and Crawford, M. Academic Press, London. pp. 441-514 (1989)

18. Official Methods and Recommended Practices of the American Oil Chemists' Society, 4th edition, 1989. Edited by D. Firestone, Method Cd 17-85. American Oil Chemists' Society, Champaign, IL.

19. Official Methods of Analysis of the Association of Official Analytical Chemists. 15th edition, edited by K. Helrich, Method 985.21, Association of Official Analytical Chemists, Arlington, VA.

20. Smith, L.M., Dunkley, W.L., Franke, A. and Dairiki, T. (1978). Measurement of *trans* and other isomeric unsaturated fatty acids in butter and margarine. J. Am. Oil Chem. Soc. 55:257-261.

21. Sampugna, J., Pallansch, L.A., Enig, M.G. and Keeney, M. (1982). Rapid analysis of *trans* fatty acids on SP-2340 glass capillary columns. J. Chromatogr. 249:245-255

22. Heckers, H., Melcher, F.W. and Schloeder (1977). SP-2340 in the glass capillary chromatography of fatty acid methyl esters. J. Chromatogr. 136:311-317

23. Official Methods and Recommended Practices of the American Oil Chemists' Society, 4th edition, 1990. Edited by Firestone, D. Method Ce 1c-89. American Oil Chemists' Society, Champaign, IL.

24. General Referee Report on Oils and Fats (1990). J. Assoc. Off. Anal. Chem. 73:105

25. Ratnayake, W.M.N. and Beare-Rogers, J.L. (1990). Problems of analyzing C_{18} *cis*- and *trans*-fatty acids of margarine on the SP-2340 capillary column. J. Chromatog. Sci. 28:633-639

26. Ratnayake, W.M.N., Hollywood, R., O'Grady, E. and Beare-Rogers, J.L. (1990). Determination of *cis* and *trans*-octadecenoic acids in margarines by gas liquid chromatography-infrared spectrophotometry. J. Am. Oil Chem. Soc. 67:804-810

27. Conacher, H.B.S. (1976). Chromatographic determination of *cis-trans* monoethylenic unsaturation in fats and oils. J. Chromatog. Sci. 14:405-411

28. Sebedio, J-L., Farquharson, T.E. and Ackman, R.G. (1982) Improved methods for the isolation and study of the C_{18}, C_{20} and C_{22} monoethylenic fatty acid isomers of biological samples: Hg adducts, HPLC, $AgNO_3$-TLC/FID and ozonolysis. Lipids 17:469-475

29. International Union of Pure and Applied Chemistry, Commission on Oils, Fats and Derivatives. Standard Methods for the Analysis of Oils, Fats and Derivatives, 7th edition (1987). Edited by Paquot, C. and Hautfenne, A. Method 2.208. Blackwell Scientific Publications, London, England.

The Impact of the Nutrition Labeling and Education Act (NLEA) on Fat Analysis

D. E. Carpenter, Kraft General Foods, Glenview IL

In response to the nutrition labeling regulations proposed in November 1991, AOAC International formed a task force to assess the adequacy of Official Methods of Analyses for nutrient labeling. A subcommittee was formed to address concerns regarding fat methodology including the absence of a clear definition of fat for labeling purposes, the appropriateness of methods for various food matrices, and the lack of official methods for some matrices. The Task Force proposed a chemical definition of fat as the sum of fatty acids expressed as triglycerides. FDA published the final regulations on January 6, 1993 and defined fat as the total lipid fatty acids express as triglycerides. In view of the published regulations, validated methods were assessed for adequacy. In addition, AOAC is looking to validate methodologies where adequate methods do not exist such as for the sum of fatty acids.

The Impact of NLEA on Fat Analysis

Subcommittee Charter

- Recommend chemical definition for fat
- Identify suitability of official validated fat methods for food matrices
- Recommend matrices/ methods needing further study

However,

Nonfat material such as flavor compounds, fat soluble vitamins, etc. may also be extracted

AOAC Fat Methodology Subcommittee

Sandy Bailey
Donald Carpenter
Henry Chin
Jonathan Devries
Norman Fraley
William Hummer
Ann Kistler
Sungsoo Lee
Jerry Ngeh-Ngwainbi
Philip Oles
Darryl Sullivan

Issue • What is Fat?

- Fat has been interchangeably described as lipids
- Crude fat is defined as an ether extract
- Fat now accepted as a sublcass of lipids

Lipid Classes

- Mono-, Di, & Triglycerides
- Phospholipids
- Glycolipids
- Sphingolipids
- Steroids and Sterols (and their esters)
- Waxes
- Free Fatty Acids

Source of Fatty Acids

- Mono-, Di, & Triglycerides
- Phospholipids
- Glycolipids
- Sterol Esters
- Vitamin A Esters
- Free Fatty Acids

Bread Crumbs

Fat Analysis by Various Methods

METHOD	AOAC #	%FAT	S.D.
Soxhlet, Pet	945.16	1.39	0.10
Soxhlet, Diethyl	920.39	1.88	0.16
General Mojonnier	989.05	2.24	0.005
Acid Hydrolysis - Re-extraction	945.44	3.46	0.01
Chloroform - Methanol	983.23	4.03	0.04
Acid Hydrolysis - Flour	922.06	4.41	0.06
Acid Hydrolysis	925.32	5.13	0.10

Other Lipid Methodologies

- Fatty Acid Distribution
- Cholesterol
- Cis/trans

Variations in Fat Methodologies

- Sample pre-treatment
- Sample digestion
- Extraction solvent
- Re-extraction procedures

Nutritional significance of fat value on label

- Calories from fat

Subcommittee recommended a single concise definition for fat

- Sum of the fatty acids expressed as triglycerides

Issues

- Study of methods
- Solvents - chlorinated hydrocarbons
- Ether soluble nondigestible fat substitutes

List Of Total Fat Methodologies Which Are Adequate To Meet NLEA Regulations

AOAC #	TITLE	BRIEF DESCRIPTION	APPLICABLE MATRICES	COMMENTS
960.39	Crude Fat in Meat	(Pet or diethyl ether) extraction	Baby food-meats, meats	Mono-, di- and triglycerides and traces of other lipid components
976.21	Crude Fat in Meat	Rapid specific gravity method. Tetrachloro-ethylene extraction	Baby food-meats, meats	Mono-, di- and triglycerides, and most of the sterols, glycolipids, phospholipids and waxes
985.15	Crude Fat in Meat & Poultry Products	Rapid microwave-methylene chloride solvent extraction	Baby food-meats, meats	Mono-, di- and triglycerides, glycolipids phospholipids, and waxes, yield of sterols may be depressed
920.39B	Crude Fat in Animal Feed	Diethyl ether extraction	Cereal & products; not adequate if product was heat processed, extruded	Mono-, di-, and triglycerides and traces of other lipid

			or has sugar added	components
920.39C	Crude Fat in Animal Feed	Diethyl ether extraction; water prewash if high in sugar	Cereals & products, sweet mixes (cakes & pies) Not adequate if heat processed	Mono-, di-, and triglycerides; may not quantitatively extract total lipids; recommend further review or study of method
945.18A	Fat in Cereal Adjuncts	Pet ether extraction	Cereals & products, sweet mixes (cakes & pies) Not adequate if heat processed	Mono-, di-, and triglycerides; may not quantitatively extract total lipids; recommend further review or study of method
945.38F	Fat in Grains	Refers to 920.39C	Cereals & products Adequate if not heat processed	Mono-, di- and triglycerides and traces of other lipid components
933.05	Fat in Cheese	Acid hydrolysis, pet and diethyl ether extraction; re-extraction	Cheese	Mono-, di- and triglycerides and traces of other lipid components; yield of sterols greatly reduced

905.02	Fat in Milk	Alkaline treatment pet and diethyl ether extraction; re-extraction	Dairy	Mono-, di- and triglycerides and traces of other lipid components
989.05	Fat in Milk	Alkaline treatment, pet and diethyl ether extraction	Dairy	Mono-, di- and triglycerides and traces of other lipid components
938.06	Fat in Butter	Diethyl or pet ether extraction	Butter	Mono-, di- and triglycerides and traces of other lipid components
920.111A	Fat in Cream	Alkaline treatment, pet and diethyl ether extraction; re-extraction	Dairy	Mono-, di-, and triglycerides and traces of other lipid components
920.111B	Fat in Cream	Babcock, acid hydrolyses, volumetric analysis	Dairy	Mono-, di- and triglycerides, phospholipids and reduced sterol yield
952.06	Fat in Ice Cream & Frozen Desserts	Alkaline treatment, pet and diethyl ether extraction re-extraction	Dairy	Mono-, di- and triglycerides and traces of other lipid

				components
945.48G	Fat in Evaporated Milk	Alkaline treatment, pet and diethyl ether extraction; re-extraction (refers to 905.02)	Dairy	Mono-, di- and triglycerides and traces of other lipid components
932.06	Fat in Dried Milk	Alkaline treatment, pet and diethyl ether extraction	Dairy	Mono-, di-, and triglycerides and traces of other lipid components
948.15	Crude Fat in Seafood	Acid hydrolysis, pet and diethyl ether extraction	Fish, shellfish	Mono-, di-, and triglycerides, fatty acid portion of phospholipids and glycolipids; in some products with high sugar content, may overestimate fat; may reduce yield of sterols
964.12	Crude Fat in Seafood	Babcock, acid hydrolysis, volumetric analysis	Fish, shellfish	Mono-, di- and triglycerides, phospholipids; yield of sterols

986.25	Fat in Milk-Based Infant Formula	Alkaline treatment, pet and diethyl ether extraction; re-extraction (refers to 945.48G)	Infant formula/ medical	Mono-, di- and triglycerides and traces of other lipid components
925.32	Fat in Eggs	Acid hydrolysis, pet and diethyl ether extraction	Eggs/egg products May not be adequate for containing sugar	Mono-, di- and triglycerides, fatty acid portion of and glycolipids; may reduce yield of sterols
948.22	Crude Fat in Nuts and Nut Products	Diethyl ether extraction	Nuts; not adequate for nuts containing sugar	Mono-, di-, and triglycerides and traces of other lipid components
950.54	Total Fat in Food Dressings	Acid hydrolysis pet and diethyl ether extraction	Oils/fats (dressings)	Mono-, di- and triglycerides, fatty acid portion of phospholipids and glycolipids
945.44	Fat in Fig Bars & Raisin filled cookies	Acid hydrolysis, pet and diethyl ether; re-extraction	Sweet mixes (cakes & pies) and baked cereal products	Mono-, di- and triglycerides and fatty acid portion of phospholipids and glycolipids; may

				reduce yield of sterols re-extraction may not remove all sugars recommend further study
963.15	Fat in Cacao Products	Pet ether extraction	Chocolate products	Mono-, di, and triglycerides and traces of other lipid components
925.07	Fat in Cacao Products	Pet and diethyl ether extraction	Candy	Mono-, di, and triglycerides and traces of other lipid components
920.177	Ether Extract of Confectionary	Pet & diethyl ether extraction; re-extraction	Candy	Mono-, di, and triglycerides and traces of other lipid components
920.172	Ether Extract of Prepared Mustard	Diethyl ether extraction	Mustard	Mono-, di, and triglycerides and traces of other lipid components

Fatty Acid Methodology and Cis-Cis Methylene Interrupted Procedures

963.22	Methyl Esters of Fatty Acids in Oils and Fats	Gas Chromatographic method following preparation of methyl esters (according to 969.33)	All	Fatty Acid profile; recommend further review or study of method to make method adequate for quantitative analysis of fatty acids
979.19	Cis, Cis-Methylene Interrupted Polyunsaturated Fatty Acids in Oils	Spectrophotometric Method	All	

Total Lipids

AOAC #	TITLE	BRIEF DESCRIPTION	APPLICABLE MATRICES	COMMENTS
983.23	Fat in Foods	Amylase/Protease treatment, chloroform-methanol extraction.	All	Method extracts total lipids including, mono-, di, triglycerides, sterols, glycolipids, phospholipids and waxes; method is *not* for determining total fat. May be used as an extraction method for various lipid fractions.

From Clinical Chemistry to Food Chemistry: the Pennington Experience

Richard Tulley, Ph.D. and Fatemeh Ramezanzadeh, M.S.

Pennington Biomedical Research Center (PBRC) is a relatively new research center dedicated to nutritional research and education with the goal of improving human health. The center was the result of a multimillion dollar gift by C.B. "Doc" Pennington for the purpose of nutritional research. The Center has been open six years and is continuing to grow. It is the goal of the goal of PBRC to become an internationally recognized facility for the performance of nutritional research.

The Clinical Research Laboratory at Pennington opened in 1989 with the purpose of serving as a support laboratory for the clinical and basic research being conducted, as well as for the U.S. Army Institute of Environmental Medicine's nutritional research studies. The laboratory has performed more than 200,000 tests on a least forty different studies. The laboratory operates using the principles of quality control, quality assurance, and good laboratory practice. Modern automated equipment is used to improve precision and accuracy and minimize analyst to analyst variability often found when using manual methods. Quality control procedures include routine checks of refrigerator/freezer temperatures, water purity, pipet accuracy and precision, reagent reliability, and instrument maintenance. Daily monitoring of quality control and periodic checks using interlaboratory comparisons, reference materials, and external quality control surveys help to insure the accuracy of results. The laboratory is in the process of being accredited by the College of American Pathologists.

It was recently determined that the addition of a food analysis laboratory at PBRC would facilitate and support clinical research being conducted at the Center. The establishment of this laboratory gave PBRC the capability to design menus for feeding studies using the in-house MENu (Moore Extended Table of Nutrients) database, and to verify those diets by direct analysis. The lab also gave MENu the capability to verify published data on nutrient content of food and to act as a research tool in support of the Metabolic Kitchen.

In setting up a food analysis laboratory it soon became apparent that some of the principles from the clinical laboratory were less easily transferred than we initially thought. Several problems in food analysis became evident very quickly: 1) sample processing is laborious and time consuming, 2) there are multitudes of sample matrices, and 3) there is a scarcity of reference materials. Despite these problems, we have, we believe, successfully implemented a highly automated, modern laboratory using the principles of quality control and quality assurance.

Equipment, which was generously purchased by the Pennington Medical Foundation, is now operational and includes those instruments listed in Table 1.

Table 1. Equipment Purchased for Food Analysis Laboratory

Instrument	Function
Soxtec	Fat Extraction
Fibertec	Fiber Analysis
CEM Microwave Moisture	Moisture Determination

CEM Microwave Muffle Furnace	Ashing
Perkin Elmer Nitrogen Analyzer	Nitrogen Analysis
two Hewlett Packard GCs	Cholesterol and Fatty Acids
two Waters HPLCs	Vitamins and carbohydrates
UV Visible Spectrophotometer	General Lab Analyses
Hewlett Packard Capillary Electrophoresis System	Anion Analysis & Experimental Studies
Robot Coupe R4	Sample Prep
Robot Coupe R10	Sample Prep
Waring Blender	Sample Prep
Homogenizer	Sample Prep
Perkin Elmer 5100Z Atomic Absorption Spectrophotometer	Trace Elements
Perkin Elmer 1000P ICP	Minerals

The Food Analysis Laboratory at PBRC is located in the main laboratory building in one of the sixteen basic research labs. The lab, which is 700 square feet, is equipped with stainless steel counters and a seamless acid and solvent resistant vinyl floor which is well suited for food analysis. The location of the Food Analysis Laboratory makes it accessible to shared facilities at PBRC. These facilities are the Liquid Scintillation/Gamma Counter lab, walk-in incubator, ultra centrifuge lab, walk-in refrigerators and freezers, the Clinical Research Laboratory, and Central Stores.

Analytical methods that are used in the Food Analysis Laboratory are official methods such as the American Association of Official Analytical Chemists (AOAC), American Association of Cereal Chemists (AACC), American Oil Chemists Society (AOCS), United States Department of Agriculture (USDA), and in-house methods which will be validated accordingly. We will perform the same quality control, quality assurance, and good laboratory practices which are also used in the clinical laboratory.

In addition to supporting the Metabolic Kitchen and the MENu database, we will be able to perform food analysis and research for the U.S. Army. Plans are underway for the lab to serve as a training ground and research facility in conjunction with the graduate program of the Food Science Department at Louisiana State University. Other goals are for this laboratory to obtain external funding, provide quality service, and become a world class laboratory.

Collecting Brand Names in National Surveys

Brand Information Collection in NHANES III: What are the issues to consider?

Margaret A. McDowell, M.P.H., R.D., National Center for Health Statistics, Centers for Disease Control, Hyattsville, MD 20782

Introduction

The Third National Health and Nutrition Examination Survey, (NHANES III) a 6-year national survey of the civilian, non institutionalized U.S. population 2 months of age and older, began in 1988. (1) NHANES III data are obtained by means of interview and examination methods. Of the 40,000 persons who are expected to participate in the NHANES III, approximately 30,000 will be examined in mobile examination centers. All examinees are eligible for the 24-hour dietary recall interview.

NHANES III dietary recalls are obtained using an automated dietary interview and coding system developed by the University of Minnesota's Nutrition Coordinating Center (NCC) with government contract and grant support. The NHANES III Dietary Data Collection or "DDC" system, was described and demonstrated at previous Databank Conferences (2). NCHS specified that the DDC system include brand probes for several food groups. I will summarize the several data base maintenance, respondent, and data reporting issues that have emerged since NHANES III began.

How is brand information collected during NHANES III?

The DDC system features include a standardized interview format and structured probes to obtain detailed information about all foods and beverages consumed during a 24-hour time period (midnight to midnight). (3) Brand probes are included in approximately 30 DDC system food categories--about 6,000 foods in all. The brand probes include many ingredients used in food preparation such as fats and oils. All foods reported during NHANES III, including brands, are coded using the U.S. Department of Agriculture (USDA) Survey Nutrient Data Base (SNDB) system food codes. (4)

Hundreds of new brand name products have been added to the DDC system since the Survey began. The concept of a changing marketplace means changing data bases for the survey community! NCHS is a data base user in this regard. The DDC system is used to collect brand information; the SNDB is used to code and report NHANES III findings. The SNDB has brand-specific food codes for some food categories such as candy and ready-to-eat breakfast cereals. Brand names are also listed in the food code description "include" statements for other SNDB food codes.

New brand name products are added to the DDC system and SNDB as they are reported in NCHS and USDA surveys. NCHS, HNIS, and NCC contact food manufacturers to obtain current information about commercial products. This information is used to update the product names, nutrient profiles, ingredient lists, food code descriptions, and food weights found in the USDA and NCC data bases.

Why is brand specificity important to survey data users?

Survey data users have diverse data requirements. HNIS and NCHS are the co-lead agencies for Activity V-A-4.1 in the Ten-Year Comprehensive Plan for National Nutrition Monitoring and Related Research. (5) The primary objective of the Activity is to evaluate the specificity of food items in the SNDB for describing foods consumed by the general population and ethnic subgroups. In 1992, HNIS and NCHS conducted an informal survey of the government agencies working on this Activity. Government data users were asked to identify their uses of dietary survey data and requirements for specific information about ethnic foods and brand name products. HNIS and NCHS reported the findings of the survey to the National Nutrition Monitoring Advisory Council in September, 1992.

The two primary uses of dietary survey data identified by the agencies surveyed were: 1) to identify foods consumed by the U.S. population and 2) to estimate intakes of nutrients and other food components. With respect to food identity, brand information is used to determine the type, form, and variety of foods consumed. The use of brand-specific food weights and nutrient composition data were used to refine food and nutrient intake estimates.

Collecting brand information during NHANES III respondents

The DDC system features a standardized interview format and structured probes. NHANES III interviewers probe for brand names when a brand option is presented during the interview. For example, when a respondent reports consuming soda, the dietary interviewer probes for the brand of soda. If the reported brand is found in the DDC system soda brand list, the soda is entered by brand name; non-brand sodas are entered using the DDC system's generic soda descriptors which include information about the flavor type, calorie content, i.e. low calorie vs. regular calorie, caffeine content, etc.

A standardized interview format and structured probes are useful tools for collecting specific information about foods. One element that researchers cannot standardize, however, is the respondent! The "ideal" respondent provides complete, accurate information about all foods consumed. In reality, respondent capabilities vary greatly. For example, during NHANES III, infants and children five years of age and under were oversampled. Proxy respondents were permitted to report for respondents who were unable to report for themselves.

Respondent burden is an important consideration for an examination survey such as NHANES. The NHANES III examination component is requires approximately three hours to complete; dietary recalls are completed in approximately 20 minutes. Brand specificity can reduce respondent and interviewer burden when the respondent is knowledgeable about brands of foods and beverages. For example, reporting ready-to-eat breakfast cereal by brand name eliminates multiple questions which would otherwise be asked to ascertain the form, grain composition, sugar content, and other characteristics of the cereal.

Reporting Brand Information Collected During NHANES III

Are respondents capable of reporting brand names? NCHS will review brand name reporting by food category. NHANES III brand data will be used to design protocols for future dietary surveys and set priorities for data base revisions. For example, brand probes might be added to additional food categories; brand lists for some food categories could be expanded. On the other hand, some food categories may be difficult for respondents to report brand information; some brand probes might be eliminated in future surveys. The NHANES III dietary interviewers provided feedback to NCHS throughout the Survey. Many improvements in the DDC system brand lists, brand probes, and brand product food amount options in the DDC system were based on recommendations from the field staff.

In summary, survey data users have requested specific information about foods consumed by the U.S. population. Brand probes add a dimension of complexity to the survey data collection and data base maintenance effort. A careful evaluation of brand information collected during surveys such as NHANES III is planned to improve data collection methods and survey data bases.

REFERENCES

1. Plan and operation of the third National Health and Nutrition Examination Survey, 1988-94. Series 1, no. 32. DHHS. Hyattsville, MD: National Center for Health Statistics, 1994 (in press).
2. McDowell M, Briefel RR, Warren RA, et al. The NHANES III dietary data collection system: an automated interview and coding system for NHANES III. Paper presented at the Fourteenth National Nutrient Databank Conference, June 19-21, Iowa. 1989.
3. NHANES III Dietary Interviewer's Training Manual. Prepared by the National Center for Health Statistics, Hyattsville, MD and Westat, Inc., Rockville, MD. Revised, September, 1992.
4. U.S. Department of Agriculture. Human Nutrition Information Service: Survey Nutrient Data Base for NHANES III-Phase 1. Hyattsville, MD. 1992.
5. Department of Health and Human Services and United States Department of Agriculture: Ten-Year Comprehensive Plan for the National Nutrition Monitoring and Related Research Program. Federal Register 56:209. pp 55716-55767. October 29, 1991.

Brand Names in the USDA Survey Food Coding Data Base

Linda A. Ingwersen, Human Nutrition Information Service, U.S. Department of Agriculture

How is Data Collected in the CSFII Interview?

For the Continuing Survey of Food Intakes by Individuals (CSFII) 1989-91, interviewers conducted dietary recalls in respondent's homes, usually in the kitchen, using the Food Instruction Booklet, called the FIB. Conducting interviews in the kitchen helped to set the stage for a discussion of food and also made it convenient for respondents to open the refrigerator and cupboards to check for product labeling information, including brand names.

The Food Instruction Booklet contains a series of probes—questions the interviewer asked respondents in order to obtain complete descriptions of foods and amounts of them eaten the previous day. Probes vary according to the particular food reported and reflect the design of the food coding data base.

Respondents were asked about the form of the food (such as fresh, canned, frozen, cooked), the cooking method used (such as baked, broiled, fried), and use of fat in cooking. Respondents were also asked if they ate the skin on chicken or the fat on meats. Other identifying or unique characteristics were probed for, such as type of grain in breads, type of syrup in canned fruit, the presence of low calorie sweetener and type of nutrient modification to lower or increase calories, fat, cholesterol, sodium, or calcium in foods. They were also asked for brand names of many foods.

There are brand name probes for 52 out of 90 food subcategories in the FIB. Of course, brand name probes are not appropriate for many foods, including fresh vegetables, fruits, eggs and meats. And their usefulness is limited for some foods such as milk, sugar, condiments and plain pasta. Their value may be limited for brands from small companies and for generic or store brands.

The descriptive information collected from the respondent is matched to codes in the survey food coding data base used for CSFII and for NHANES III. The data base presently contains 6,700 food codes which fall into nine major food categories. Code descriptions range from very general to very specific. For example, there is the very general code with the description "chicken, NFS" and the very specific code with the description "chicken breast, prepared with skin, battered, fried, skin and coating eaten."

Why Do We Collect Brand Names in the Survey?

One major reason brand names are collected in the survey is simply that it is easier for respondents to give brand names than to describe many foods that are on the market. For example it is easier to give the brand name than to describe frozen desserts such as Simple Pleasures, margarine blends or spreads such as I Can't Believe It's Not Butter or Shedds Spread, and sugar substitutes such as Sugar Twin and Equal. The same is true for meal replacements and protein supplements such as Slim Fast, "fat-free" coffeecake or pastries such as Entenmann's new product line, and soup with one-third less salt such as Campbell's Healthy Request soups.

For many foods, the brand is actually the name of the food. Coke Classic, Rice Krispies, Similac Infant Formula, Cheez-its and Baby Ruth are the names of foods. These brands are easy for respondents to report and helpful in the coding process.

Near the conclusion of data collection for CSFII 1991, interviewers completed a debriefing questionnaire. They were asked to rank the ability of respondents to provide brand names for various foods. Interviewers thought respondents were most able to report brands of breakfast cereals, soft drinks, margarines, baby foods, baby formulas, and soups; and least able to report brands of cookies, rice mixes, snack cakes, popcorn, and lunch meats. They thought women were more likely than men or children to recall brands. Eighty-one percent of the interviewers rated women's ability to give brands as good or very good; 33 percent rated men's ability as good or very good and 22 percent rated children's ability as good or very good. Perhaps this reflects that women still are purchasing most of the groceries for the household. It also shows that respondents are not equally likely to provide brand information.

How Are Brand Names Used in Coding?

The brand name information we collect is useful in several ways. Brand names often assist us in finding a good code match in the existing coding scheme. Brands immediately identify a particular product possessing certain characteristics. Examples of this are breakfast cereals, infant formulas, and frozen meals. Knowing the characteristics of brand name foods enables us to classify them with other similar foods in the data base or to classify them separately in a unique food code.

Brand names can clarify the description of the food given by the respondent. Orange juice might be reported along with the brand name Tang, which identifies the "juice" as a fruit-flavored beverage with vitamin C added. It seems that "beverages" are "juice" to many people. Butter may be reported, but the brand name Smart Beat identifies it as a reduced calorie margarine-like spread. Cream may be reported, but the brand name Cremora identifies it as a cream substitute. These cases do occur and illustrate the importance of brand names for food identification purposes and for nutrient summaries. By using brands, respondents do not have to be knowledgeable about specific food characteristics or classifications in order to have accurate recalls.

And following in this vein, brands may provide insight on features of food of which the respondent may be unaware. Several food components of a food may be modified, but the respondent only may mention the one most important to him. He may describe the beverage as "reduced calorie" but not correctly answer probes that it was also fortified with vitamin C. A processed cheese may be described as low in fat but not as also low in sodium. A new oat flake cereal may be described as having raisins but not as also containing dates, apples and pecans.

Brand names are also useful in that they provide us with a lead we use to contact manufacturers for product descriptions, ingredient listings, and package and unit measure weights. With manufacturer's information, reasonable assumptions can be made about foods reported with brand names but with incomplete descriptions.

Use of Brand Names for Assigning Weights to Quantities

In addition, brand names may assist us in assigning gram weights to quantities of a food eaten when the respondent is unable to give or recall the weight. For example, the respondent may report eating all of a chicken teriyaki with rice Budget Gourmet dinner but not know the weight of the meal. We can, with a measure of confidence, use the package weight, 10 ounces, for that type of Budget Gourmet dinner for the person's intake.

Weights of brand foods may be linked in the data base to packages, to individual items, or to common household measures like cups, fluid ounces, and tablespoons. Package weights are common for dinners; individual item weights are common for cookies, candies, and crackers; and household measures are common for nearly all foods. Information on weights is a definite benefit gained from the use of brand names.

The food laboratory at HNIS is responsible for providing specific gram weights for measures of foods respondents report. Respondents may be able to give household measures for brand name breakfast cereals and beverages, for example, but not know their actual weight in grams. It is sufficient for the respondent to estimate eating ½ cup of cereal—the lab will provide the gram weight of that particular cereal for the data base. Of course, weights in grams of foods eaten are important because these weights are used to obtain estimates of amounts of foods and of nutrients consumed by groups of people.

The usefulness of brand name food information to specialists responsible for calculating nutrient composition of foods in the Nutrient Data Research Branch will be discussed by Sue Gebhardt, our next speaker.

Types of Food Codes in the Data Base

There are different levels of detail and brand name incorporation in codes in the survey coding data base. The following are some classifications of the types of codes:

Codes with a direct one-to-one correspondence to a brand name food—infant formulas, breakfast cereals, some candies. The brand name of the food is the code description. There is no "include" in the code listing other products.

- Codes with very specific descriptions or descriptors relating to one brand name food listed in the "include" statement. An example of a code description is "Chocolate pound cake, very low fat, no cholesterol. Include Entenmann's fat free, cholesterol-free chocolate loaf cake." The "include" usually gives examples of similar foods or brands that belong in the same classification as the code description. This example has only one include. This is not a direct one-to-one correspondence, although there is only one brand listed in the include and the nutritive values are based on the description of that product.
- Codes with general descriptions and several brand names in the "include" statement with gram weights specific to each brand. Some examples are ice cream novelties, fast food sandwiches, frozen meals, hard candies and chocolate bars. Using brand-specific weights is important because respondents may not easily recall the weights of these foods. This is a valuable aspect of brand names.
- Codes with general descriptions, several brand names in the "include" statement, and weights not keyed to brand. Weights for common units of measure apply to all brands. Examples are fruit juices, cheeses, and potato chips. Foods are similar in ingredients, nutrients, and weights.

· Codes with detailed or general descriptions but no brand names in the "include." These may be ethnic foods such as Hispanic and Puerto Rican style dishes, a great variety of cooked meat and mixed dishes, and fresh, unprocessed foods. Many foods do not have brand names. The information collected on all foods is captured in a data base which matches the amount of detail collected.

How Has the Food Coding Data Base Expanded in Recent Years?

There were 1,034 new food codes created for items reported in CSFII 1989-91 and the first phase of NHANES III. We work closely with the National Center for Health Statistics (NCHS) in determining when to create new codes for brand name items and when to include them in existing codes. New codes are created for brand name foods when no code exists for a similar food, when sizable amount of nutrients are present in the food, if the food is modified in some way, if it is likely to be reported again, or if the form or type of food is of interest.

New codes have been created for many ethnic foods, for breakfast cereals, frozen dinners, juice blends, processed cheeses, soups, frozen dairy desserts, fast-food items and new lines of baby foods; as well as for foods low in sodium, cholesterol, fat, and calories. In other cases, brand name foods were incorporated in the "include" statement of existing food codes and were assigned portion size weights specific to these foods.

Possibilities of Identification of Brands in the Future

As we prepare for CSFII 1994, we are considering ways to expand the identification of brands in the survey data base and how this affects the coding data base and the efforts of the staff.

As part of this effort, we can study the food groups most appropriate to the collection of brand name information. NCHS has offered the results of the collection of brand name foods in the first phase of NHANES III when the information is available. These results will show which foods respondents report with brand names. Results will point to the food groups that will benefit from brand name expansion in the code book from an identification point of view.

At HNIS, we have the option of creating subcode numbers for selected foods and brands that are included under the main or generic code. This subcode can be used to capture brand use and also allow for a weight to be keyed to the product when necessary. This subcode can be used for food identification purposes but not have to be linked to nutrients specific to the brand. Nutrients can be linked to subcodes at any point in time, if desired. Tomorrow Randy LaComb will speak in greater detail about subcodes in the codebook in the workshop on file formats used in the USDA Survey Nutrient Data Base System.

However, before all brand names are divided into subcodes, we must consider how useful those subcodes will be. In a survey, the number of observations for some brands may be too low to be useful. What number of observations are adequate for study by a researcher using subcodes? In the survey, for example, a total of 30 respondents might report eating high fiber crackers made by five different companies. Is this information useful? Is it worth the effort to collect in the field, to process, and to maintain in the food coding data base?

And, how finely should the generic code be split into subcodes? There are many manufacturers across the country making chocolate chip cookies. How many and which ones should be included as subcodes? When we spoke before the National Nutrition Monitoring Advisory Council, we were reminded that it is not necessary to put a "razor's edge on an ax" when collecting dietary data for a nationwide sample. We must consider purposes of our data and the amount of information that can be collected.

Maintenance of the food coding data base is another important issue because it involves the time and skills of staff throughout our agency. Keeping the food coding data base up to date means—

1. We must ensure the accuracy of brand names already in the food coding data base. Products frequently are discontinued, changed in name or in formulation. We presently review food lists from distributors. Staff contact manufacturers, and review all labels and manufacturer brochures received. This type of information is not always current. The success of manufacturer contacts depend upon such factors as size, attitude and resources of the company, rate of product turnover and new product development, and so on. I am hopeful that in the future we might be able to tie into an already existing data base with brand names. This would be particularly helpful after food companies adjust and respond to the new food labeling regulations.

2. Keeping the food coding data base up-to-date also means we must check and verify weights of brand name products already in the food coding data base on a regular basis. Again, as manufacturers react to the new labeling regulations, it is expected that product sizes will change to reflect serving sizes. The appropriate time to change weights for a brand name food must be determined—how long after a manufacturer changes the weight of a product should the changed weight be added to the data base?

3. We must add new brand name foods and weights as appropriate. The HNIS food laboratory will assist in maintaining the data base by purchasing and weighing foods on a regular basis. As I mentioned earlier, they determine gram weights for food items and for cups and other common unit measures of the food when needed. They also obtain cooking directions, ingredient information, and any available nutrient information.

4. After all information has been reviewed, staff must incorporate changes and additions in the data base. The history of each change of food name and weight must be documented in a historical file.

All of this work is related to the identification of foods, not to the development of nutrient values for these foods. The Nutrient Data Research Branch of HNIS is responsible for assigning nutritive values to the food codes in the coding system. Sue Gebhardt will address this shortly.

If brands are collected for more foods in upcoming surveys and are tracked in the data base, we anticipate that the need for additions and changes to codes would dramatically increase, and so would the staff time necessary to update our food coding data base.

In summary, and in looking to the future, we will continue the on-going process of providing individual portion size weights for brand name foods when appropriate. Codes will continue to be created for ethnic foods and for new foods, including brand name foods, as they are reported in CSFII and in NHANES III. In other cases, HNIS and NCHS will coordinate efforts to link brand names to suitable generic food descriptions, nutrient data, and product weights. We will together consider: 1) respondent burden and respondent ability to report brand names, 2) the benefits gained in using brands to code foods and to present data, and 3) the importance of this information for use by data researchers and by other government agencies.

It is the goal of HNIS and NCHS to collect quality food intakes and to process them in ways suitable for our purposes and for those of data users. Brand names contribute much to this goal.

Issues Related to Increasing Brand Names in the Survey Nutrient Data Base

Susan E. Gebhardt, Human Nutrition Information Service

There is a demand for increasing the amount of brand-specific nutrient data in some food groups. However, we are approaching this task cautiously because we know the limitations of the nutrient data that are currently available. We are concerned that people may assume that if nutrient profiles are listed by brand name, the accuracy of the nutrient data base is automatically increased. That is not necessarily true. Based on our experience with nutrient data, we believe that in many cases a generic profile based on a large number of samples analyzed by well-documented, approved analytical methods using quality control materials is more representative of the food than data of unknown quality for many individual brands.

Currently the food groups on the Survey Nutrient Data Base in which we have nutrient data by brand name are breakfast cereals, candies, and infant formulas. There are two reasons why these products have separate nutrient profiles by brand name. The first is identification. It is practically impossible to describe breakfast cereals and candy bars generically. Flaked cereal made from corn, oats, wheat, and rice describes both Team® and Product 19®. Milk-chocolate-coated, peanut-flavored crisped rice with caramel bar is a WHATCHAMACALLIT® Candy Bar. The second reason is differences in nutrient profiles. Candies are developed to give a unique product, and the brand names identify the unique combination of ingredients and the resulting nutrients. Even in this food group, some items such as milk chocolate do have a generic profile.

In breakfast cereals a range of vitamins and minerals may be added at very different levels. Table 1 shows two cereals containing the same grain ingredients. The protein, fat, and carbohydrate content are similar, but because of fortification there are large differences in the content of vitamins and minerals. These value are presented per 100 grams so the values seem quite high.

In discussions with HNIS, many agencies said that they do want additional brand information in the data base, but it is not always clear why—for identification purposes or for specific nutrient profiles. If they need names for identification, additional food codes can be attached to a generic nutrient profile, as described in the previous paper "Brand Names in USDA Survey Food Coding Data Base" in this proceedings.

The following issues are related to providing specific nutrient profiles connected to brand name food items.

Currently, 28 nutrients plus energy and cholesterol are listed in the Survey Nutrient Data Base (Table 2). Individual fatty acids will be added soon. Values for all of these nutrients must be provided for the data base. If analytical data are not available, values must be calculated.

Our sources of nutrient data are the scientific literature (including the FDA Total Diet Study), trade associations, companies, and our own contracts.

Scientific literature—Journal articles usually contain data for only one or two nutrients that are being studied, such as only total dietary fiber data or different forms of a nutrient such as vitamin C. Rarely are all nutrients that we need for the survey data base reported in an article. Also, articles usually do not report brand names of the samples analyzed.

In the Total Diet Study, the Food and Drug Administration reports minerals in individual foods, but they do not identify brand names. In fact, several brands may be composited before analysis, losing the brand identity. A good example is the iron value for corn flakes. Companies fortify this nutrient at different levels, so when several brands are composited for analysis the resulting iron value is not representative of any particular brand and will vary depending on how the brands are composited.

Trade associations—We have received much valuable nutrient data from trade associations representing non-brand-name products such as produce and meat. We also get nutrient data from trade associations representing brand-name products such as snack foods, but this information is often coded so that a specific company's data can not be identified by name.

Company data—Food specialists contact companies and request that they send us the results of nutrient analyses on their food products. There is absolutely no regulation or requirement that companies must send us any information. It is strictly voluntary. We ask for a detailed description of the product, individual nutrient values or the mean plus standard deviation and number of samples included in the mean, the reference for the method of analysis used for each nutrient, and a description of their quality control procedures. It is time consuming for a company to supply all of the information that we have requested. Many companies are unwilling or simply unable to supply this information, so we get varying degrees of responses.

On occasion a company will send us all of the information that we request. However, rarely do we get analytical data for all of the 28 nutrients plus cholesterol and energy that are in the nutrient data base.

Sometimes companies send us analytical data for some of the nutrients but without indication of variability or the method of analysis.

We have received data from one company that reports values for practically all of the nutrients we need but they state that some of the values are the result of analytical analyses and others are calculated. Unfortunately, they won't identify which values are analytical.

Other companies send us a brochure that lists nutrition labeling information. The nutrient values are per serving, proximates are rounded to whole numbers, vitamins and minerals are given as percentage of U.S.RDA and compliance procedures have been applied to the original analytical data.

And finally, we may get no response to our request at all.

If the information we receive is in the Nutrition Labeling format (and we have no other information), we have to back-calculate the nutrients to grams or milligrams per 100 grams of food. One company gave us their original analytical data and the nutrition labeling profile that they developed from those data. In Table 3 uses that information to illustrate the hazards of back-calculating data from the label. First we would calculate the gram weight of a serving by dividing the weight of the package (340 g) by the number of servings (13) for a weight of 26.2 g per serving . Column 2 shows the fat and magnesium values calculated to the 100 g basis. When we compare the original analytical values in column 3 to the values calculated from the nutrition label we see that the analyzed fat value is 1.5 g lower than the calculated value and the analyzed magnesium value is 12.2 mg higher.

If we get nutrient data from information that was generated for nutrition labeling, either original analytical data or data back-calculated from the label, the maximum required labeling nutrients that we would currently get are indicated in Table 2 . With the recent changes in nutrition labeling regulations, data for saturated fat, cholesterol, and total dietary fiber should now be available, but data for thiamin, riboflavin, and niacin are no longer required. Data would be lacking for the other nutrients on the survey nutrient data base. Even if we receive data for most of the nutrients needed for the survey data base, if a few values are missing they have to be estimated—they cannot be left blank.

A procedure frequently used is an optimization technique using linear programming to estimate the proportion of each ingredient in the mixture. The information needed is (1) ingredient information from the label, listed in order of predominance, (2) any available nutrient values for the mixture, and (3) a data base of nutrient values of individual food ingredients per 100 grams. This program has been invaluable in helping us estimate complete nutrient profiles for many products, but it does have limitations. If analytical values were not available for some of the nutrients, label values would have to be back-calculated and, as was shown in the chocolate chip cookie example, back-calculating introduces error into the procedure. Also, many unconventional ingredients, such as cellulose gum and polydextrose, are now being used and the lack of complete nutrient profiles for these ingredients presents new problems in calculating proportion of ingredients.

The final way that we get nutrient data is through contracts that we sponsor to analyze nutrients in specified foods. Offerers have to analyze test samples for the types of nutrients that will be required for the contract in order to demonstrate their ability before the contract is awarded. During the contract they are required to use quality control materials, such as Standard Reference Materials for minerals, and analyze monitoring samples (previously characterized foods) that we send them to ensure the validity of the contract results. It costs us approximately $2,000 to analyze proximate components, total dietary fiber, 9 vitamins, 9 minerals, individual fatty acids and their geometric isomers, cholesterol, and vitamin E in one sample of a food under our contracts. If we had to analyze three brands of a frozen lasagna dinner, we would ideally want to analyze more than one sample of each. Analyzing three samples of each of the three brands of the products would cost $18,000 for complete survey nutrient profiles of one type of product.

In Table 4, examples of actual data we receive are illustrated by the fat values for chocolate chip cookies. Values for brands 1 through 4 were received from manufacturers. Only the data for company 1 gives any indication of the variability of fat content for the brand, and the range of values for the product are fairly wide. The last brand cannot be determined because the data came from the literature.

There are other considerations in providing nutrient data by brand name for additional products:

> In the past some companies have given us data with the understanding that their data would be averaged with other data in a generic nutrient profile and would not be identified by brand name.
>
> Because of differences in the way we report some nutrients versus the way they are reported for nutrition labeling, some companies do not want their product identified in our data base with one value and a different value appearing on their label. An example is calorie content. We use Atwater factors, but in addition to the use of Atwater factors, several other procedures for calculating calories are allowed for nutrition labeling.

When products are listed by brand name, there is additional pressure to keep the nutrient profile current; however, and frequent product reformulations resulting from changes in the cost of ingredients makes this a time consuming process.

"Food Product Development" reports that in 1991, 12,196 new products were introduced. The groups with the largest number of new products were bakery products, with 1,631 introductions; beverages, with 1,367 new introductions; and dairy products, with 1,111 introductions. It would be a formidable task to do specific nutrient profiles for all brands within these groups.

We are talking to representatives of various food companies, about sending us nutrient data by brand name. Discussions are in the initial phase. Many of the issues presented in this talk, such as a complete description of analytical methodology, have been brought up for discussion. It is important that expectations be clarified on both sides. USDA needs to know the types and amounts of nutrient data to expect, and industry needs to know the kind of data that is needed and how it will be used.

We are optimistic that we will be able to increase brand-specific nutrient data in the survey nutrient data base for certain food groups, but we realize that not all data for all nutrients will be analytical and the size and complexity of the data base will greatly increase.

NUTRIENT PROFILES

per 100 g

	PRODUCT 19®	TEAM© FLAKES
Protein (g)	9.6	8.1
Fat (g)	1.2	2.2
Carbohydrate (g)	84.7	84.7
Iron (mg)	63.49	28.57
Sodium (mg)	1,129	635
Zinc (mg)	52.91	1.06
Ascorbic acid (mg)	211.6	52.9
Niacin (mg)	70.55	17.64
Vitamin B_6 (mg)	7.06	1.76

Table 1

BACK-CALCULATING NUTRIENT VALUES FROM A NUTRITION LABEL

1 LABEL...	2 LABEL, per 100 grams...	3 ANALYZED VALUES
Package size: 12 oz (340 g)	340 grams/13 = 26.2 grams in a serving	
Servings per package.....13		
Fat.......................7 grams	7 grams/26.2 g in a serving = 26.7 grams per 100 grams	25.2 g per 100 grams (difference = 1.5 g)
Magnesium.........2% USRDA	2% x 400 mg (USRDA) = 8 mg	
	8 mg/26.2 g in a serving = 30.5 mg per 100 grams	42.7 mg per 100 grams (difference = 12.2 mg)

Table 2

NUTRIENTS REQUIRED FOR NUTRIENT DATA BASE

(● = Currently Included on Nutrition Label)

● Energy	● Vitamin C	● Calcium
Moisture	Thiamin	● Iron
● Protein	Riboflavin	Magnesium
● Total fat	Niacin	Phosphorus
● Saturated fat*	Vitamin B_6	Potassium
Monounsaturated fat	Folate	● Sodium
Polyunsaturated fat	Vitamin B_{12}	Zinc
● Cholesterol	● Vitamin A (IU)	Copper
● Carbohydrate	Vitamin A (RE)	
● Total dietary fiber	Carotene (RE)	
Alcohol	Vitamin E	

* Individual fatty acids will be added.

Table 3

FAT IN CHOCOLATE CHIP COOKIES

Grams per 100 grams

	Mean	*n*	*Low*	*High*	*S.D.*
BRAND 1	22.6	67	18.3	24.0	0.8
BRAND 2	25.2	2	25.1	25.3	--
BRAND 3	21.3	1	--	--	--
BRAND 4	24.7	1	--	--	--
BRAND ?? *(literature)*	21.9	1	--	--	--

Table 4

Recipes: Methods, Problems, and Issues

I. Recipe Calculation Methods

Yield Factor and Summation Methods

Grace J. Petot, *Case Western Reserve University*

Recipe Calculations: Nutrient Retention Factor Method

Kristin Marcoe, *USDA, HNIS*

Yield Factor and Summation Methods

Grace J. Petot, Case Western Reserve University

Two of the most commonly used methods for calculating nutrient content of food mixtures and recipes are 1) the YIELD FACTOR method, sometimes called the Missouri method, and 2) the SUMMATION method. Both methods provide useful information, but we must be aware of the limitations of each method and understand the usefulness for specific purposes. Each of these procedures uses information that is usually readily available and relatively easy to calculate, especially when incorporated into a computer system.

For the greatest accuracy and precision in any recipe calculation method it is necessary to have the following information:

1. Complete list of ingredients including water, cooking fat, seasonings, etc.
2. Descriptive information for each ingredient with as much detail as possible, e.g., cut of meat, fat trim, fresh, frozen, canned, kind of fat, etc.
3. A quantity measure for each ingredient, preferably expressed as a weight, especially for foods of variable densities such as chopped, diced, ground, flaked, etc., amount of salt, drained weight, amount of water, etc.
4. Preparation methods - Boiled, baked, braised, cooking time, etc.
5. Total yield of recipe - preferably in weight and measure, size and number of servings

Not often do we have all of these. For example, if we look at a recipe from a typical institutional recipe file, this is what we might see:

Curry Vegetable Soup

Low sodium chicken base	1 1/2 quarts
Water	3 quarts
Onions, diced	7 ounces
Celery, diced	7 ounces
Carrots, diced	7 ounces
Cabbage, diced	7 ounces
Curry powder	1 1/2 teaspoons
Black pepper	1 teaspoon
Parsley flakes	1/2 cup
Zucchini, 1/4" slices	8 ounces
Summer squash	8 ounces

Simmer first 10 ingredients 1 hour. Add squashes and simmer for 15 minutes.

YIELD: 24 (6 ounces each) servings

This is a recipe written for institutional use and could be called a standardized recipe. Note that most ingredients are quantified by weight, and a total recipe yield is provided.

The following recipe is from a cookbook and is typical of those used in the home:

Potato Soup

6 large potatoes, peeled, cut in 8-10 pieces
1 stalk celery, cut in large pieces
2 carrots, cup up
2 medium onions, peeled, whole
1/2 stick margarine
1/2 teaspoon pepper
1 tablespoon parsley flakes

Cook all together with WATER TO COVER about 1 1/2 hours. Remove onions and celery. Puree one-half of potatoes, return to soup. Serves 6

Note that the vegetable quantities are poorly quantified and the amount of water required is not specified. A serving size measure or total measured or weighed yield is not provided.

These examples represent the kinds of recipes encountered in institutional settings and those that might be provided by subjects in clinical situations, dietary surveys, or for publishing nutrient values of recipes.

The Yield Factor Method

1. Multiply weight of each ingredient by yield factor/s. Yield factors for a single food may include raw preparation yield, a cooked yield and an edible portion yield. For example, in preparing a cooked artichoke, the as purchased vegetable would be trimmed of its stem and top (preparation yield), cooked (cooked yield) and, as eaten, inedible parts would be removed (edible yield) to obtain a final prepared yield for an artichoke. Yield factors for specific recipes are often determined as recipes are developed and tested on site, and indeed, institutions do these measurements as they standardize their own recipes. Yield information for individual foods is published by USDA in Handbook 8, Handbook 456 and Handbook 102, "Food Yields Summarized by Different Stages of Preparation"

2. Compute total weight of recipe after yield factors have been applied to each ingredient.

3. Calculate nutrient content for each nutrient for each ingredient.

4. Total each nutrient for the all ingredients to obtain nutrient content for entire recipe.

5. Divide each nutrient total by number of portions. This will provide nutrients per portion.

6. Divide each nutrient total by number of 100 gram units in total weight of recipe to provide nutrients per 100 gram portion.

Figure 1 is a computer printout of a recipe for Ham and Macaroni au Gratin which was entered into the HVH-CWRU Nutrient Data Base system. It illustrates how yield factors have been used for the ingredients. Measure codes (MC) are two digit numbers and represent volume or weight measures, e.g., 01 = volume ounce, 42 = serving, 04 = quart, etc. Yield factor column headings are PR = preparation yield, CK = cooked yield, and EP = edible portion yield. Most ingredients are coded for cooked foods so that nutrient values will reflect nutrient changes due to cooking. Note that the cooked yield of water in which the macaroni is cooked is zero and the yield of macaroni is 273 percent, a published value which includes the water absorbed by cooking dry macaroni.

When this method is used to calculate nutrients per portion by dividing each nutrient total by number of servings, the nutrient values are more precise than the method which uses nutrients per summed weight of total recipe ingredients (last column in Figure 1) after yield factors have been applied, converting to 100 gram portions, and then calculating nutrients per portion using portion weight.

There is a limitation to this method in that water loss during cooking or baking is not taken into consideration. For some food mixtures, water loss, fat loss or fat uptake would not be counted. A modified version of this method allows for these losses or gains. It applies a factor to the total weight of the recipe for water loss and to the water and fat sums of those ingredients. Nutrient losses due to cooking procedure would not be considered for some ingredients, in this case for milk, flour, and cheese.

The Summing Method

1. Weight of each ingredient is translated to grams.
2. Calculate total weight of recipe: sum of weights of ingredients.
3. Divide total weight of recipe by 100 to obtain number of 100 gram units.
4. Calculate each nutrient per ingredient.
5. Calculate total for each nutrient value for the recipe.
6. Divide each nutrient total by number of portions for nutrients per portion.
7. Divide each nutrient total by number of 100 gram units for nutrients per 100 gram portion.

This method is simple and direct. It does not take into account changes in cooked weights or measures of ingredients or preparation and cooking changes, but it is applicable in some recipes such as for the Cheese Soufflé recipe illustrated in Figure 2. Note that no yield factors have been applied in this recipe, however, the same limitations apply as for the Macaroni and Ham au Gratin recipe in Figure 1.

At Case Western Reserve University, while participating in a clinical trial, we compared the two methods by calculating a number of different kinds of food mixtures to note the differences. We were receiving recipes from patients; most of these had limited information. Usually, we did not have total recipe yield information, but patients told us that they consumed a measured portion or a fraction of the recipe. For this clinical trial, we were primarily interested in the protein content of homemade mixtures and wished to determine the range of differences in the two methods of calculating nutrient content.

Table 1 summarizes the results for several types of recipes. The two vegetable mixtures show only small differences, but the meat mixtures have differences ranging from 30-60% for some nutrients. Note differences in total portion weights for the meat mixtures.

In summary, it is important to understand the limitations of these methods and to consider them in relation to the specific goals or purpose of the study or project. Equally important is the quantity and quality of the information provided about the recipes and mixtures.

References

Adams, C. Nutritive Value of Mexican Foods in Common Units. Agriculture Handbook No. 456. HNIS, U.S. Department of Agriculture 1975

Matthews, R.H. and Garrison, Y.J. Food Yields Summarized by Different Stages of Preparation. U.S. Department of Agriculture,. Agriculture Handbook 102. 1975

Powers, P.M. Recipe calculations - new research in methodologies. In Proceedings of 11th National Nutrient Data Bank Conference. University of Georgia, Athens. 1986

Powers, P.M. and Hoover, L.W. Calculating the nutrient composition of recipes with computers. J Am Dietet Assoc. 89:224-232 1989

U.S. Department of Agriculture, HNIS. Composition of Foods. Agriculture Handbooks 1-21

Recipe Calculations – Nutrient Retention Factor Method

Kristin L. Marcoe

Introduction

The Human Nutrition Information Service (HNIS) of the U.S. Department of Agriculture uses an automated system to create nutrient data bases for appraising the nutrient content of food intakes reported by individuals in dietary surveys. The system uses the USDA Nutrient Data Base for Standard Reference, the basic data set which contains all nutrient values published in Agriculture Handbook No. 8. It is updated continually. The system includes processes for calculating the nutrient content of recipes based on nutrient data for the individual components. The procedure that we use for calculating recipes is called the nutrient retention factor method, and today I will explain that procedure.

Data Set Files

To begin, a number of supporting data set files are used by the computer program: the Primary Nutrient Data Set for Food Consumption Surveys, the USDA Nutrient Data Base for Standard Reference, the Table of Nutrient Retention Factors, and the Recipe File.

The Primary Nutrient Data Set for Food Consumption Surveys (PDS) contains nutrient values for all food items needed to create the survey nutrient data base, including all items used as ingredients in recipes. The 30 food components for which data are included are listed in these slides. The Nutrient Data Research Branch at HNIS is in the process of adding individual fatty acids to this data set.

Most of the data in the PDS come from the USDA Nutrient Data Base for Standard Reference, which is the computer data set corresponding to Agriculture Handbook No. 8 (AH-8). This data base is continually reviewed and updated, with revisions made available in our annual supplements to AH-8. Also, nutrient values are added as needed for nutrients not in the Standard Reference Data Base. For example, Vitamin E data are incomplete in the Standard Reference.

A new PDS code with complete nutrient profile is created for any food needed for the survey that is not in Standard Reference, like new ready-to-eat cereals and salad dressings. To derive the nutrient profile, several sources are used. Analytical data are the first choice. If they aren't available, values are imputed from other forms of the food, or estimates are derived from data for similar foods, or label nutrition information is used to calculate the nutrient amounts. A code is included with each value to indicate whether it is analytical or imputed, and imputed values are replaced with analytical values as data become available.

The PDS currently has over 3,300 food items in it. Data are expressed as the amount of each nutrient in 100 grams of the edible portion of the food.

Another data set used by the computer is the file of nutrient retention factors. This file contains the factors for calculating the retention of 18 vitamins and minerals during cooking. Contract research designed to study the retention of nutrients during cooking was the source for many factors. The file is based primarily on the HNIS "Table on Percent Retention of Nutrients in Food Preparation" but contains several more specific categories of foods and cooking methods. Because analytical data on nutrient retention are not available for all nutrients in each food category, missing factors were estimated to complete the table. Each category of food and the specific process to which it is subjected (cooking or drying) is assigned a code for computer access, designated the retention code. This slide shows some examples of retention codes and descriptions for flour.

The retention factors are percentage adjustments in the nutrients that account for the effect of cooking on the nutrient content. The cooking method, the cooking time, the presence of water, the presence of drippings (as in the case of meat and poultry), and the type of food (such as lean vs. fatty fish) all affect the amounts of vitamins and minerals retained in the final product. By applying retention factors to a recipe ingredient, the content of vitamins and minerals will be adjusted to create the final product's nutrient profile.

Retention codes are linked to retention factors, which are expressed as a percentage of the nutrient retained as related to cooking method. As an example, if flour were baked, using retention code 0301 would result in 80% thiamin retention, 90% each riboflavin and niacin retention, and 100% iron retention. During the recipe calculation, these percentages are applied to the nutrient values for flour to account for the effects of baking the flour.

These retention codes are used in the recipe file. The recipe file controls the generation of a survey nutrient data base using the PDS and the table of retention factors. The items to be included in a survey data base are designated and survey food codes assigned before this file is constructed. In the recipe file, each of the 6,632 survey food codes is linked to one or more PDS items through a set of recipe codes.

A number of items are needed for each recipe: Ingredient descriptions with their corresponding PDS codes, ingredient weights in grams (excluding refuse), and appropriate retention codes for the ingredients.

Each recipe must have a percentage yield - the final weight of the cooked recipe expressed as a percentage of the uncooked weight. This yield is derived by considering any moisture and/or fat change (gain or loss) that occurs in cooking, also expressed as a percentage (plus or minus) of the total weight of the uncooked recipe. For recipes with a fat gain or a fat loss during cooking, the type of fat must be specified by including the correct PDS code for it. If the food is fried, the code chosen may be the frying fat that was used. Agriculture Handbook No. 102, Food Yields Summarized by Different Stages of Preparation, is used as one of the sources for moisture and fat changes during cooking.

The recipes in the recipe file are then run through a computer program. This calculates the nutrient values per 100 grams edible portion for each survey food based on its recipe, thus creating the survey nutrient data base. All nutrient values come from the PDS, either directly for a one-component recipe or indirectly through recipe calculations.

The recipe calculation method involves a number of steps. First, the weight in grams of each ingredient is determined; refuse is subtracted out. Agriculture Handbook 8 contains refuse information and weight-volume relationships.

Second, the nutrients in the specified weight of each ingredient are determined. Nutrient values for 100-gram amounts of ingredients are stored in the PDS.

Third, retention factors are applied to vitamin and mineral values for those ingredients being cooked. The Table of Nutrient Retention Factors contains the retention codes and factors.

Fourth, all ingredient weights are summed to determine the total uncooked weight of the recipe.

Fifth, all nutrient values of the ingredients are summed to determine the nutrient totals for the recipe.

Sixth, moisture and/or fat changes are used to adjust the total values. Moisture may be lost through evaporation or drippings, or it may be gained through absorption. The total moisture value and the total weight of the recipe are adjusted at this point. Fat may be lost through drippings or gained through absorption during frying. Fat changes affect total weight, energy, total fat, fatty acids, and sometimes cholesterol, minerals, and fat-soluble vitamins. These values are also adjusted at this step.

The last step in the recipe calculation is to convert the recipe's total nutrient values to the 100-gram basis.

So you can better understand this process of calculating a recipe, I will use, as an example, ham croquettes. This product calls for already cooked minced foods to be bound together in a white sauce, and then shaped, breaded, and deep-fat fried.

The recipe was entered into the recipe file with the information on this slide. We see eight ingredients listed with their corresponding PDS codes and gram weight amounts. Several of the ingredients are in the raw form; therefore, retentions need to be applied to account for nutrient losses during deep-frying. The amount of parsley is so small, 1.1 grams, that a retention code is not applied to it.

Lastly, we see that for this recipe (coded as 272-2008), there is a 15 percent moisture loss and 4 percent fat gain from deep-fat frying. The frying medium is designated by the PDS code 04031, household hydrogenated soybean and cottonseed shortening.

The recipe program calculates the nutrients for the specified weights of the PDS codes and applies the appropriate set of retention factors to the resulting nutrient values if a retention code has been designated. Calculations for the thiamin in milk are presented on this slide.

In order to illustrate the moisture and fat change effects on the nutrient values and total weight of the ham croquettes, I have shown the steps in the calculation procedure on this slide. The weight and nutrient values for the individual ingredients are summed. The moisture loss decreases the weight of the recipe by 99 grams (15 percent of the subtotal recipe weight of 660 grams) and, of course, of the moisture value by this same amount. The fat gain increases the weight of the recipe by 26.4 grams (4 percent of the subtotal recipe weight of 660 grams).

The total fat value increases by this same amount also. The increase of 233 calories is calculated from the calorie value for 04031, the frying shortening used, with the gain of 26.4 grams of fat. Fatty acids and Vitamin E totals would also be affected and need to be adjusted at this point.

Finally, all nutrient values are converted to the 100-gram basis for inclusion in the survey nutrient data base.

Conclusion

To summarize, the nutrient retention factor method of calculating recipes involves applying retention factors to the vitamin and mineral values of each recipe ingredient at the ready-to-cook stage. Adjustments are made for moisture and fat changes occurring during cooking, resulting in a total yield and nutrient values for the cooked item. We have been using this procedure for our survey data base for approximately 10 years, and the Nutrient Data Bank uses the same procedure for calculating recipes when they are needed for Agriculture Handbook No. 8.

We are in the process of upgrading our computer system. Although our file structures are changing, the recipe calculation method will remain the same. We will be discussing these new formats in detail tomorrow at the workshop on file formats.

SLIDE 1

DATA SET FILES

Primary Nutrient Data Set for Food Consumption Surveys (PDS)

USDA Nutrient Data Base for Standard Reference

Table of Nutrient Retention Factors

Recipe File

SLIDES 2A & 2B

FOOD COMPONENTS IN PDS

Energy	Copper
Moisture	Vitamin C
Protein	Thiamin
Fat	Riboflavin
Total Saturated Fatty Acids	Niacin
Total Monounsaturated F.A.	Vitamin B-6
Total Polyunsaturated F.A.	Folate
Carbohydrate	Vitamin B-12
Calcium	Vitamin A (in IU & RE)
Iron	Carotenes (RE)
Magnesium	Vitamin E
Phosphorus	Cholesterol
Potassium	Alcohol
Sodium	Total Dietary Fiber
Zinc	

SLIDE 3

TABLE OF NUTRIENT RETENTION FACTORS

SLIDE 4

RETENTION CODES AND DESCRIPTIONS

0301	Flour/meal, baked
0302	Flour/meal, boiled, steamed
0304	Flour/meal, reheated
0305	Flour/meal, sautéed
0306	Flour/meal, toasted

SLIDE 5

SELECTED RETENTION FACTORS FOR

0301 - FLOUR/MEAL, BAKED

Thiamin	0.80
Riboflavin	0.90
Niacin	0.90
Iron	1.00

SLIDE 6

ITEMS IN A RECIPE

Ingredient codes and descriptions

Ingredients' gram weights

Retention codes

Moisture and/or fat change

SLIDE 7

RECIPE CALCULATION METHOD

1. Determine ingredient weights
2. Calculate nutrients in each ingredient
3. Apply retention factors
4. Sum ingredient weights
5. Sum nutrients
6. Adjust for moisture and fat differences
7. Convert nutrients to 100-gram basis

SLIDE 8

HAM CROQUETTE RECIPE INFORMATION

PDS CODE	NAME	RETENTION	GRAMS
10153	Ham, cooked		280.0
20081	Flour, all-purpose	0305	31.2
74750	Bread crumbs	0305	50.0
11297	Parsley, raw		1.1
11282	Onion, raw	3465	10.0
01077	Whole milk	2151	244.0
89630	Salt		1.4
04132	Margarine		42.3

SLIDE 9

HAM CROQUETTE RECIPE INFORMATION

Recipe code: 272-2008

Moisture change: -15%

Fat change: +4%

Fat type: 04031 Shortening

SLIDE 10

THIAMIN CALCULATION FOR MILK

$$\frac{.038 \text{ mg thiamin/100 g milk} \times 244 \text{ g milk}}{100} = 0.093 \text{ mg thiamin}$$

.093 X 90% (retention) = <u>0.083 mg thiamin</u>

Recipes: Methods, Problems, and Issues

II. Problems and Issues Associated with Recipes

Recipe Information Obtained During Dietary Survey Interviews–The NHANES III Experience
Margaret McDowell, *DHHS, CDC, NCHS*

Coding Recipes: Dilemmas and Decisions
Betty Perloff, *USDA, HNIS*

Problems and Issues Related to Calculating Recipes in Several Settings
Grace J. Petot, *Case Western Reserve University*

Recipe Information Obtained During Dietary Survey Interviews: The NHANES III Experience

Margaret A. McDowell, M.P.H., R.D., National Center for Health Statistics, Centers for Disease Control, Hyattsville, MD 20782

During the Third National Health and Nutrition Examination Survey (NHANES III), 24-hour dietary recalls are obtained using an automated interview and coding system administered by trained dietary interviewers. The interview system, known as the

NHANES III Dietary Data Collection System or "DDC system", was developed at the University of Minnesota's Nutrition Coordinating Center with Government contract and grant support. The DDC system was described and demonstrated at previous Databank Conferences. This session focuses on the challenges of coding noncommercial recipe foods reported in NHANES III.

When noncommercial foods are reported which cannot be entered into the System at the time of the interview, the dietary interviewers note the description provided by the respondent using the DDC's "Missing Food" screen feature. Information about ingredients, including fat and salt, preparation methods, and amounts of food consumed are recorded. NCHS staff receive hard copy versions Missing Food reports biweekly. During the first half of the Survey, NCHS staff reviewed hundreds of Missing Foods reports. Many new commercial foods were reported as Missing Foods. Noncommercial mixtures, particularly, homemade dishes, modified recipes and ethnic foods are challenging to code.

Several types of noncommercial mixtures have been reported including, desserts made with egg substitutes in lieu of whole eggs, meatloaf prepared with game meats, cornbread prepared with little or no fat, and Mexican American style soups, caldos, and stews. The options used to code new foods reported during the Survey include:

1. Adding new USDA Survey Nutrient Data Base food codes

2. Coding the food using an existing USDA code

3. Partitioning the food using existing food codes

4. Entering the food by individual components

The process used to guide the coding effort requires input from the dietary interviewers, USDA survey data base staff, and NCC. NCHS recognized that recipe mixtures are a challenge for researchers working with dietary data.

Last year, Amy Green, formerly of NCHS, organized a workshop to review approaches for coding recipe mixtures. Grace Petot of Case Western Reserve University chaired the workshop. NCHS provided the workshop participants with examples of recipes which were reported in the Survey. This afternoon, Grace will describe the charge given to the Workshop participants.

Coding Recipes: Dilemmas and Decisions

Betty Perloff, Human Nutrition Information Service,
U.S. Department of Agriculture

Calculating the nutrient content of recipes based on data for ingredients is considered standard operating procedure for the nutritional analysis of dietary intake data. Nutrient calculations for recipes undoubtedly will continue until quick and inexpensive, as well as reliable, laboratory methods of analysis have been developed. Since those analytical procedures do not appear to be on the horizon, we must strive to perfect the recipe calculation procedures to the extent possible.

Kristin Marcoe has described the recipe calculation procedure we use at USDA's Human Nutrition Information Service (HNIS). Many decisions were made during the process of automating this procedure, and many more are made in the day-to-day operation of the system. Today I will present examples of some of the choices we have faced and how the decisions have been approached.

When we began planning the automation of recipe calculations for the Survey Nutrient Data Base, the first decision we faced was to choose an appropriate method for the calculations. Our goals were to select a method that (1) was research based, (2) was shown to be most comparable to analytical results, and (3) that could be updated as new research provides us with better information about changes that take place during cooking or food processing.

In addition to the retention factor method we eventually chose, we also considered two other procedures. The first alternative was also a retention factor method, but it differed from our final selection in that it applied one set of retention factors to the recipe instead of different factors to each ingredient. We referred to this alternative method as the "dish" retention method, as opposed to the "ingredient" retention method that was finally chosen.

The second alternative was to use yield factors for the individual ingredients, converting them to the weight we expected after cooking and applying the nutrient values for the cooked item.

We sponsored two research projects with Oregon State University to provide data for individual ingredients and for recipes cooked from those ingredients. Information from those projects, along with other available data on yields and retentions, were then used to study applications of the three recipe calculation methods.

From this project, we were able to ascertain that the two retention factor methods gave comparable results. Otherwise, the results were largely inconclusive; however, we were able to develop a set of pros and cons for each method. The resulting recommendation was to use the "dish" retention method, and the computer program was originally written for that method. The original decision was based on several factors. Primarily, the reasons were (1) The "dish" retention method was considered the traditional method, since it had been used for earlier editions of Agriculture Handbook No. 8; (2) it would allow for interactions among foods that might affect retention of nutrients; and (3) the method appeared simpler than the ingredient retention method.

However, when we applied this method to our daily work we found it was not simpler to use, because existing retention data were primarily for individual ingredients, not complete mixtures. Using this method frequently required us to calculate the dish retention factors based on the ingredient retention factors. In effect, the process had been complicated, not simplified. Furthermore, prospects for obtaining adequate numbers of "dish" retention factors through research contracts was dim because of the many different types of mixtures that were appearing in our food consumption surveys. If the need to allow for interactions of foods during cooking were to arise, we realized it could be compensated for by additional ingredient factors taking into account other types of foods that might be present.

We quickly revised our computer program to accommodate the ingredient retention factors and computerized the table of percent retention of nutrients in food preparation. As new retention data have become available, we have revised and expanded the table of retention factors.

Recipe Selection

Other types of recipe-related decisions are made on a regular basis at HNIS. The most frequent decision that is faced is the selection of the recipe. Recipe information is frequently provided by survey respondents for home-prepared foods, although this information is seldom complete. For example, recipes for homemade soups usually have no mention of the amount of water or other liquid used in preparation. For foods eaten away from home, the main ingredients or characteristics of the recipe are usually the extent of reported information.

When different versions of recipes already existing in our system are encountered, we now have the ability to modify the existing recipes. So far, this recipe modification feature has been used only in the pilot test for our next survey. Its primary use has been to allow for different types of fats used in recipes or to change or add other ingredients that would likely have a dramatic effect on a recipe's nutrient content. The results of this pilot test appear promising, and we are cautiously optimistic about the potential for this new feature to provide us with greater flexibility for capturing more specific recipe information from our survey respondents.

When new or unique recipes are encountered, the first step is to locate the same or similar item in recipe books. We maintain a supply of current popular cookbooks, as well as selected regional and specialty cookbooks. We try to locate recipes from a minimum of three sources, looking first at the popular cookbooks. Those recipes are compared with each other and with the respondent's recipe. If the same recipe is found in at least two of the sources, it is selected. However, if only widely varied recipes are located, a composite recipe may be constructed. Recipes are reviewed periodically and revised when warranted. Frequently consumed items receive priority for review.

Recipes for commercially prepared mixtures may represent more than one brand name. When a new brand is reported, ingredient labels are compared to the existing recipe. If they are similar, the brand name is added to the food item's description. If they are different, a new formulation estimate is prepared based on the list of ingredients and any nutrient data that are available.

Ingredient selections

Once a recipe is selected, many decisions still remain. Ingredients are matched to identical items on the data base where they exist. For home-prepared foods, ingredients are usually matched to the form of the item that is identified in the recipe. Fresh items are assumed if other forms are not designated. When cooking is applied to an ingredient prior to incorporating it into the recipe, a yield factor is applied to the weight and the cooked form of the food is selected from the data base. For example, if a recipe calls for 1 pound of macaroni prepared according to package directions, then the weight associated with the yield from 1 pound of macaroni after cooking, 1,140 grams, is used with the data base item for the cooked form of macaroni. Likewise, "1 pound of ground beef, browned," is translated into the cooked weight, 352 grams, and used with the appropriate cooked data base item.

When ingredients are missing from the data base, a closely related item is substituted. Missing ingredients for which substitutions are required are flagged, enabling us to track the frequency of their use and to include them in plans for analytical research when appropriate. For example, when we needed to expand the data base for Mexican-American foods reported in Hispanic HANES, several recipes called for Mexican cheeses that did not exist in the data base. We matched them as closely as possible to existing items, and then targeted the Mexican cheeses for analysis when new research was planned.

Commercially prepared foods may include ingredients not found in the data base. We've added some special items, cellulose for example, to facilitate formulating commercial items. We've also added special data records to represent added ascorbic acid and added calcium in commercially prepared foods. Ingredients for commercially prepared frozen entrees are usually matched to frozen forms of the items.

Ingredient weights

Weights for ingredients are selected based on the description of the measure. We maintain an extensive data base of measure descriptions and weights. We have a Weights and Measures Team that is responsible for identifying discrepancies that arise in weights for various measure descriptions, and we are fortunate to have a modern, well-equipped laboratory where discrepancies can be resolved and where weights for new foods can be determined.

Retention codes

To apply retention factors to ingredients for estimating cooking losses, the ingredients are matched against our retention factors description file. This file contains descriptions of various categories of foods and cooking methods for which retention factors are available. Sometimes cooking times are also included in the retention factor descriptions, but specific cooking times are frequently not available. For example, a recipe may call for heating milk 20 minutes; however, the choices for available retention factors are 10 minutes, 30 minutes, and 1 hour. In this example, we chose the retention factors for 30 minutes, providing the more conservative estimate of nutrient content.

Retentions are not always present for the specific cooking method either. Again, we must decide the most similar method. For example, when coding the recipe for doughnuts, the available retention factor categories for flour were baked, boiled, reheated, sautéed, and toasted. Sautéed was selected in this case.

Yield factors

Selecting appropriate yield factors to represent the changes that take place in moisture and fat content of foods during cooking frequently pose difficult choices, and this is an area that may be in greatest need for additional research. The major source of this type of information is Agriculture Handbook No. 102, "Food Yields After Different Stages of Preparation." We match newly coded recipes against previously coded ones, selecting the closest match for type of recipe, ingredients, and cooking method. For example, when we coded the recipe for moussaka, an eggplant and meat casserole, we matched it to tuna noodle casserole and estimated the loss in weight to be 10 percent.

Comparisons—calculations versus analyses

We're frequently asked how accurate are the nutrient values generated from recipe calculations. Obviously, they can be no better than the research on which they are based. Part of the purpose of the original research we sponsored before designing our recipe calculation program was to answer that question. Results from that research were reported at past Nutrient Data Bank Conference. Calculated values for proximate components and minerals usually fell within 10 percent of the analyzed values. The differences for copper, however, were higher. Calculated values for vitamins were usually within 20 percent of the analyzed values; however, differences for vitamin B-12 were greater.

We have made many improvements to our data base of nutrient values for ingredient items since those comparisons were reported. Additional refinements to yield and retention data are needed and may also improve recipe calculation results.

Conclusions

Calculations to determine the nutrient content of recipes are used extensively for the nutritional analysis of dietary intake data at the USDA's Human Nutrition Information Service. Nutrient estimates derived through these calculations are quick and inexpensive, and they serve a very useful purpose. However, many decisions are required before adequate values can be calculated. HNIS selected a recipe calculation method based on research and practical considerations. Daily operations require decisions on recipe selection as well as on ingredients, weights, and retention and yield factors.

Problems and Issues Related to Calculating Recipes in Several Settings

Grace J. Petot, Case Western Reserve University

A recipe is a written direction for combining two or more foods and it includes preparation and serving instructions. It could also be defined as a list of assembled components and preparation procedures for making a mixed dish or menu item. Recipes are received for nutrient analysis from many sources and from a variety of settings:

Dietary records

- Surveys of free-living persons
  - -usually with no follow-up
  - -much unclear information
- Clinical encounters
  - -metabolic, in-patient, weighed, measured
  - -24-hour recalls
  - -diet diaries with or without follow-up
  - -dietary intervention planning

Food service

- Standardized recipes
  - -within institutions–schools, hospitals, etc.
  - -fast foods
  - -some restaurants
- Non-standardized recipes

-institutions

-restaurants

Cookbooks, media, consumers

The quality of recipe information received ranges from very high, with all required information at hand, to very low, with only main ingredients reported. The issue of quality becomes important when considering the significance of the nutrient analysis in the a specific setting. This presentation is a review of a workshop organized by the National Center for Health Statistics (NCHS) to discuss the issues related to coding of non-commercial mixture recipes reported in the National Health and Nutrition Examination Survey III (NHANES III) now in progress.

Goals for the workshop were:

1. To explore approaches for coding non-commercial food mixtures which include school lunch and restaurant foods that are not in the coding data base.

2. To apply coding decision approaches to examples of NHANES III mixture examples.

3. To develop coding guidelines for mixtures that can be used by The National Center for Health Statistics and by The Human Nutrition and Information Service, USDA.

The National Center for Health Statistics invited participants who have had experience in dealing with these issues and problems in a variety of settings:

Janet Ditter-Johnson, University of Minnesota
Roberta Zeug, University of Minnesota
Dierdre Douglas, University of Texas
Monica Yamamoto, University of Pittsburgh
Fran Jones, University of Pittsburgh
Linda Ingwerson, Human Nutrition Information Service, USDA
Grace Petot, Workshop Chair, Case Western Reserve University

Significance of the Problems in NHANES III

Quality of information retrieved:

Dietary recalls may be classified as being of two types. One is the recall in which all foods reported are traditional and/or labeled commercial foods. This type of recall is easily coded and provides more accurate and precise nutrient analyses. The second type of recall is one in which many or most of the food mixtures are home-made, restaurant or institutionally prepared. These recipes become difficult to code when recipe information is sparse. Thus, a final survey analysis combines nutrient analyses from both types of recalled reports. The amount of information retrieved varies from being very specific to very vague. The variability of the nutrient analyses due to coding assumptions made with incomplete information is unknown. To code recipe information and to obtain precise portion quantities, it is necessary to have the following:

1. A complete list of ingredients

2. Descriptive information for each ingredient, e.g., kind and cut of meat, dry or cooked noodles, kind of fat, etc.

3. A quantity for each ingredient

4. Preparation method

5. Total yield of the recipe

Nine soup recipes received during interviews in NHANES III were examined and a matrix (Table 1) was constructed to illustrate the adequacy of the information. It is readily observed that there is missing information for a number of recipes. The task at hand was to determine the best methods for using all of the available information for assigning food codes.

Resources:

There are limited resources for recipe testing and for creating computer algorithms to achieve consistency of assumptions. Missing foods must be reviewed for a decision to use a match in the data base, to code as components, or to code as ingredients. This is very time consuming, especially if several persons are consulted for consensus and documentation.

Survey goals:

NHANES survey goals require analysis results for nutrients and for foods as identification as sources of nutrients. Therefore, it is important that as much food ingredient specificity and quantity be retrieved and coded as is possible.

Recipe Collection During the NHANES Interview

The automated Dietary Data Collection (DDC) system, developed at the University of Minnesota Nutrition Coding Center, is being used in NHANES III for recording dietary recall interviews. This system greatly facilitates the recording of food mixtures but does have some limitations:

1. The level of specificity of a food description may be picked without using food codes. Vitamins A and C content may be captured in some combination foods, i.e., without vegetables or with dark green vegetables.

2. Portion size may be quantified or a food shape recorded.

3. Variable ingredients may be selected, i.e., type of frosting, type of fat used in frosting, but these are limited.

4. Probes for type of fat and for salt may be used.

5. Recipes in data base are not visible to interviewer, e.g., the recipe ingredients linked to a recipe name cannot be viewed on the screen.

6. A recipe cannot be modified by the interviewer, i.e., the recipe ingredients are not in the system which the interviewers use.

7. Two types of generic mixed dishes are included in the food data base. They are combination or mixed dishes with no specific name such as beef with gravy, or are frequently used mixtures defined by common names such as lasagna, chicken chow mein, etc. These recipes have been obtained from popular cookbooks. Soups are defined by the main ingredient, i.e., chicken. If a homemade soup is named, it is being linked currently to a commercial product code.

8. Notes may be recorded within the interview record if different or unique ingredients are named. These must be examined later by NCHS staff and considered for coding, or for editing of the recall and a rerun of the analysis.

It is possible during the interview to capture all of the information provided by the respondent, but the coding becomes imprecise when unique or different ingredients are used in a commonly described recipe. If a homemade soup appears in a recall, the item is linked to a commercial soup code. It is not now possible to code for different ingredients; however, if nutrient information becomes available for "generic" homemade recipes, it may be possible to rerun the recalls later.

Family members who consume the same foods may not be interviewed at the same time, therefore there may be varying levels of specificity for mixed dish information for the same recipe. Each family member may describe the same food differently. The system has fixed combinations for recipe foods which cannot be changed at the time of the interview. There may be as many different recipes for the same soup or muffin or stew as there are families in the survey.

Workshop Participants' Experiences

Participants in the workshop described their experiences in retrieving food mixture information. In clinical settings and clinical studies, training of patients and subjects with continuing contact provides the maximum amount of information and an opportunity for investigators to evaluate quality. In surveys, where there is limited or no follow-up, the information available must be used with the best judgements and decisions made by the investigators.

Using a debriefing question, USDA collected information from interviewers about the easiest and the most difficult foods to describe. They ranked them for level of difficulty from easy to difficult:

Salad - EASY
Omelet
Vegetable combination
Stew
Homemade soup
Ethnic foods, e.g., Chinese, Mexican - VERY DIFFICULT

Criteria are needed for deciding 1) which recipes must be added to the data base, perhaps based on frequency of appearance and 2) which recipes may be matched to an existing food mixture in the data base. Consideration should be given to:

-significant nutrient contributions of the recipes ingredients
-ranges and variability of the nutrient values for similar recipes
-food ingredients of importance

When is an existing food code not a good choice and what assumptions can be made in the face of inadequate information?

What are Mixtures That Pose Problems?

Approximately fifteen per cent of NHANES recalls have "missing foods". About forty per cent of these are food mixtures which require decisions by NCHS staff. To retrieve information for mixtures, the respondent's knowledge and memory are important and the fact remains that for many food mixtures, the most discerning and knowledgeable respondents simply cannot provide the level of detail required. In any case, there is a need to use the amount of detail that is provided. For soups, it is necessary to know if they are homemade, prepared in a restaurant or commercial products. The term 'homemade' must be clarified. Is it from a can? take-out? recipe? from canned or frozen? If a recipe is provided, it takes time to code for each component. It may be necessary to write standards or guidelines for restaurant or take-out foods since most respondents have difficulty describing mixtures.

Soup and cornbread recipes collected during NHANES III were presented for discussion as examples of food mixtures with the same names but with different ingredients and various levels of detailed information. Thirteen soup recipes, all called "chicken soup" or "Mexican chicken soup", were collected in the southwestern United States. The following is a summary of how the ingredients differ in these recipes:

10 recipes with whole chicken parts served in a portion
10 recipes with potatoes
10 recipes with carrots
8 recipes with tomatoes
8 recipes with onions
2 recipes with cabbage
7 recipes with rice

Nine different cornbread recipes were made with a variety of combinations of ingredients:

cornmeal, water, egg
cornmeal, wheat flour, buttermilk, egg
self-rising cornmeal, water, mayonnaise, non-fat dry milk
cornmeal, buttermilk, baking powder, baking soda
cornmeal, milk, egg, margarine
self-rising cornmeal water, egg, wheat flour, non-fat dry milk, oil
cornmeal egg, buttermilk, wheat flour, non-fat dry milk
cornmeal egg, buttermilk, wheat flour - fried in oil
cornmeal, water, onion

Questions were raised about the quality of the cornbread recipes since many appeared to have missing ingredients. However, it was recognized that baked or fried cornmeal mixtures called "cornbread" may be made with few or many ingredients in different combinations. There is an apparent need to investigate regional and ethnic differences. "Typical" regional or ethnic recipes can be added to the data base or more specific guidelines may be written. Existing recipes can be examined and compared for variability in nutrient content. Using cornbreads and soups as models, it may be possible to develop composite recipes as "typical" or representative. Some recipe ingredient information is provided most of the time and portion sizes consumed are given about seventy per cent of the time. It was concluded that several different basic recipes must be added to the data base; however, if uncommon or non-traditional ingredients are used, it may be necessary to continue to code by ingredients.

To facilitate the coding of reported food mixtures, a decision tree was constructed by workshop participants:

DECISION TREE

Review recipe
All ingredients and amounts?

Yes
Match in data base?

No
Main ingredients
No amounts or
portions
Close NDB match?

Yes
Edit record
Use base code
Use guidelines
for partition
codes

No?
Modify for close
NDB match?

No
Enter all
ingredients
ingredients
Save file
Consider
adding to database

Yes
Modify and
edit

No
Use guidelines for
important
or multi-component
food

Which recipes are most important? Which nutrients are to be priorities while keeping the number of data base additions to a minimum? A suggestion was made to collect all recipes for mixtures received as missing foods during the entire survey, and to review all similar mixture recipes for calculated nutrient ranges and variability. This information is necessary to make decisions about whether to code a mixture food recipe or to add a composite, representative recipe to the data base.

The outcome of the participants' discussions produced two primary considerations as guidelines for coding decisions are made. They are

1) Identification of the nutrients of importance to the survey and

2) Identification of food mixtures within food groups.

It was agreed that the decision tree with guidelines, which are yet to be written for each decision point, should be used for the following types of recipe mixtures:

- Meat mixtures with ANY amount of meat
  - Entrees, soups, salads
- Green, yellow and white vegetables
- Milk mixtures
  - Alternates for types milk and cheese
  - Entrees
  - Salads
  - Desserts
  - Beverages
- Cereals and grain mixtures
  - Entrees
  - Salads
  - Baked products, sweet and non-sweet
    - Breads
    - Cakes, cookies, desserts
    - Pastries
    - Stuffings

This workshop was intended to address the primary question "What do we do with the information we get?". A summary of the final discussions produced the following questions and comments:

1. What is the magnitude of the problem?

2. At what point do we stop the decision-making process?

3. What are the resources? There is a limit to time and effort.

4. What constitutes a significant amount of an ingredient in a mixture?

5. A significant amount of ingredient in a recipe may not necessarily be the main ingredient. Evaluate significance in the meal AND in the amount consumed.

6. What should be the form and content of guidelines?

7. What elements in a partial recipe lead to a decision to pursue coding individual ingredients?

8. It does not seem to be a problem to consider fat and sugar unless quantities are changed. It is possible to select alternate fats and milks, but it is not possible to reduce or increase quantity.

9. There is a need to capture as much FOOD detail as possible because this survey is considering both foods AND nutrients.

10. How much burden can we expect to put upon respondents?

11. A lot of questions are asked of the respondents; they may volunteer erroneous information.

12. Develop a method with which the interviewer can evaluate the quality of the information recalled and the respondent's ability and capability to recall; then train interviewers to use it.

13. If information is captured, use it if at all possible.

Research Needed

All mixture reports and decisions should be documented. When they have been accumulated at the end of the survey, examine frequencies and commonalities, calculate variabilities in nutrient content and then consider creation of typical, representative recipes.

Examination of the soup and cornbread recipes collected in NHANES III provided evidence that a more systematic review and analysis is needed of all food mixtures collected during the survey. Data accumulated for the following factors will assist in writing coding guidelines and for deciding what food mixtures are representative:

1. Frequencies of reporting:
    - Food descriptions
    - Quantity measurements
        - Ingredients
        - Yields
    - Preparation procedures
    - Preparation procedures
    - Preparation times
    - Quantity prepared at one time
    - Standing, storage time and conditions
2. Ranges and variabilities of nutrient values
3. Frequencies of consumption

Nutrition at Either End of the Life Cycle

Patterns of Food and Nutrient Intake Among the Elderly
Katherine Tucker, *Tufts University Center on Aging*

Development and Reproducibility of a Young Adult's Food Frequency Questionnaire
Helaine Rockett, *Channing Labs/Harvard Medical School*

The Relationship Between Nutrients and Foods in Children's Diets
Pat Crawford, *University of California,Berkeley*

Nutrient Intakes of American Children Ages 2 to 10 Years
Ann Albertson, *General Mills, Inc.*

Patterns of Food and Nutrient Intake Among the Elderly

Katherine Tucker, USDA Human Nutrition Research
Center on Aging at Tufts University

Introduction

The elderly, as a population group are growing in total numbers and in proportion to the rest of the population. As the baby boom generation moves into older age, the Bureau of the Census projects that the percentage of the population above age 65 will approach 20%. In efforts to control the high cost of health care, there has been a growing interest in health promotion and disease prevention, and, as a central component of this, in the diet and nutritional status of the elderly. As a high risk group for nutrition and health problems, their diet is of interest to those making policy, planning programs and delivering services. As a large and growing market, their consumption patterns and dietary requirements are also of interest to the food industry. A great deal of research has been completed in the past 10 years. However, the largest growing group of elders are those over age 85 and few large data sets currently include information on those over age 74. The demographics also show large increases in minority elderly, groups for which data are only recently becoming available.

Examinations of the diets of the elderly are important for several reasons: 1) identification of specific nutrients which may be consumed inadequately by the elderly population, 2) identification of sub-groups which are most at risk of low intake of specific nutrients or food groups, 3) identification of dietary patterns which place the elderly at nutritional risk and 4) understanding of relationships between nutrient intake or dietary patterns and disease, disability or mortality.

At the USDA Human Nutrition Research Center on Aging at Tufts University, we have been exploring these questions, most recently with three large cross sectional data sets: 1) the HNRCA Nutritional Status Survey—conducted between 1981-1983 with 223 men and 447 women aged 60-89 years, using 3 day records; 2) the Framingham Heart Study—dietary data were collected between 1988 and 1989 with 375 men and 598 women, aged 67-95 using the Willett food frequency questionnaire; and 3) the Normative Aging Study—data were collected between 1987 and 1991 with 1134 men aged 43 through 85 years, again using the Willett questionnaire.

Identification of low nutrient intakes

Energy and nutrient intakes of elderly groups are frequently reported to be low compared with the RDA. In a 1989 review article, Horwath concluded that intakes of vitamin B6, folate, calcium, zinc, potassium, and magnesium were most likely to be inadequate (1). In the nutritional status survey, we also found that intakes of energy, vitamin B6, vitamin D, zinc, calcium and magnesium were low in relation to the 1989 RDA. It is important to note that an earlier analysis of these data, using the 1980 RDA (and a different nutrient database), showed dramatically higher proportions with low levels of folate, vitamin B6 and vitamin B12 intake. This may be partly due to a greater completeness of nutrient data for the latter analysis but mostly it is because the RDA for these B vitamins was lowered in 1989. In a review article of recent studies on nutrient requirements in the elderly, currently in press, Russell and Suter (2) question the wisdom of lowering the RDA for these nutrients. The current RDAs do not distinguish among adults aged 51+. New information, including some I will discuss in a moment, suggests that the RDA need further refinement by age categories and that for many nutrients, they should be higher for the elderly.

Sub-groups at risk: Age

Most studies of intake among the elderly have looked at total nutrient intakes, and they have usually found lower intakes with older age. Upon closer examination, however, some studies, including papers by Block, Mares-Perlman, Slesinger and Cronin, show improvements in diet quality with age, once total energy intake is controlled (3-6). In a sample of men from the Normative Aging Study, we saw strong positive relationships of age with energy adjusted nutrient intake, including complex carbohydrates, dietary fiber, carotene, vitamin C, vitamin E and with number of servings of fruit per day. In the Framingham Heart Study, men's intakes included more vitamin A and iron with age, after control for energy and women's intakes included more retinol and vitamin D. Older men consumed relatively larger amounts of cereals, fruits and vegetables; while women consumed more milk. Age was also related to lower consumption of snack foods, pasta and pizza. Other studies, including those by Davis, Cronin and Mares-Perlman, have also shown lower consumption of snacks (7), carbonated beverages (6) and alcohol (4) with age. Overall, it appears that with age, there is a tendency to lower total food intake, but to better dietary patterns.

Sub-groups at risk: Income, education and living alone

Certain situational factors place the elderly at risk of poor intakes. It is commonly assumed that low income and low education are important risk factors. However, surprisingly few studies have examined these relationships. Nutrients which have been reported to be vulnerable to low income include vitamin C, vitamin B6, folate, iron, and zinc (8,9). Davis et al. (10) also found low dietary diversity with low income and Cronin et al. found lower consumption of beef, non-fat milk and fruits.

In our own work, we have found that education level is frequently related to food and nutrient intake. In the Normative Aging Study, those with College level education consumed greater energy controlled amounts of several key nutrients, including dietary fiber, carotene, vitamin C and calcium. Their intakes of green and orange as well as other vegetables were also significantly greater than those with less education. In Framingham, education was related to several nutrients from dietary intake alone for women but not men, and to total intakes for both men and women, reflecting greater supplement use with education level as well as improved intakes.

Another important factor is living or eating alone. This variable has been examined with several data sets, including national level data, by Davis (7,10) and Murphy (11). In our analysis of the Normative Aging Study, we also found that men living alone were at risk of low intakes, particularly for fruits and vegetables and associated nutrients, including vitamin C, carotene and dietary fiber.

Dietary Patterns

Of course, there is great variation in dietary patterns within any group of elderly. We examined the diets of the Boston Nutritional Status Survey participants using cluster analysis and found four major intake groups: those dominated by alcohol; by fruits, cereals and milk; by breads and poultry; and by meat and potatoes. The group of subjects consuming the milk, cereal and fruit pattern had diets which were significantly higher in many nutrients, including vitamins A, C, riboflavin, folate, vitamin B6, calcium and magnesium. These differences in dietary intake also appeared to translate to nutritional status. This group had higher blood levels of riboflavin, vitamin B12 and folate than other groups (12). From these data it appears that consumption of breakfast cereals, fruit, and milk seems to protect nutrient adequacy. Other studies have also found that eating breakfast, and particularly including breakfast cereals in the diet is protective (10,11). In addition to the Nutritional Status Survey, we have analyzed the Normative Aging Study and the Framingham data using Cluster analysis and have found similar groupings despite differing study populations and data collection methods.

Diet and Health and Disease Prevention

At the USDA Human Nutrition Research Center on Aging there is considerable activity in the investigation of nutrients in relation to aging and health. Vitamins of major current interest include the anti-oxidants vitamin C, vitamin E and β-carotene, which have been found to be protective for several conditions including heart disease, cataract and immune function; folate and associated B vitamins, important to vascular disease; vitamin A, potentially important in cancer prevention; and vitamins D and K, important to bone status.

The relationship between vitamin E and immune function with aging is the focus of work by Simin Meydani and Jeff Blumberg at the HNRCA. They have found dramatic effects in indicators of immune response—including Delayed Type Hypersensitivity skin tests (DTH), an indicator or overall cellular immune response, lymphocyte proliferation and Interleukin 2 levels—with vitamin E supplementation. Recent studies have also found strong protective effects of vitamin E supplementation against heart disease. We have less of an understanding of varying effects with dietary levels.

Folate is increasingly receiving attention as an important nutrient in health maintenance. It has recently been shown to be protective against neural tube defects in pregnancy. There is also accumulating evidence for its role in prevention of vascular disease, through its relationship with homocysteine, a metabolite which requires folate as well as vitamins B6 and B12 for its utilization. In the presence of deficiency, or low levels of these nutrients, particularly folate, it accumulates in the blood and appears to do considerable damage. Jacob Selhub and Paul Jacques have found a strong relationship between dietary folate and homocysteine levels. (13).

One potential complication in studying folate is that there are several forms in food. Currently, the tables reflect only total folate. Jacob Selhub has recently developed a new method of food analysis which allows the identification of the various forms and has found that the profile for example, for liver is different than for lima beans, and these are both very different than for egg yolk. This raises a question about bioavailability. Are all forms equal in their translation to folate status and how does this affect our evaluation of mixed diets? Metabolic studies will be needed to arrive at detailed conclusions. We have done some very preliminary investigation of actual diets with the Framingham population. Holding total folate intake constant, we find that individuals who receive their folate dominantly from supplements have the highest blood levels, followed by breakfast cereals, citrus fruits, vegetables and bread. This initial comparison has not been rigorously tested and has not accounted for other folate antagonists in the diet, but suggests that differences in folate form may have differing bioavailabilities.

Vitamin D is another nutrient of concern. Holick and colleagues have shown that the ability to formulate vitamin D in the skin declines with age (14). Many homebound elderly have little sun exposure and therefore are at risk for low vitamin D status and associated decline in bone status. Little is available on dietary status of vitamin D due to the lack of complete values in food tables.

Finally, there is growing interest in vitamin K, which has also been found to be important to bone mineralization. Due to the very limited availability of information on vitamin K in foods, Jim Sadowski and Sarah Booth, at the HNRCA, have been actively analyzing foods for a revised provisional table (15). They have found that most dietary vitamin K is from vegetables and oils, although it is widely distributed in foods in small amounts. There is great variation among vegetables, with leafy greens contributing the highest levels; and within vegetables, with outer sections generally containing more vitamin K than inner sections. Vegetable oils have considerably more vitamin K than animal fats. Canola, and soybean oil, used commonly in salad dressings, are particularly good sources.

Conclusions

In conclusion, many elderly do appear to have low nutrient intakes, particularly for total energy and for folate, vitamins B6, B12, D, calcium, magnesium and zinc. Energy intake tends to decrease with age and, in association with that, many absolute nutrient intakes decrease as well. On the other hand, there is evidence that dietary patterns, and nutrients in relation to energy level, may actually improve with age. Much remains to be learned with respect to nutrient requirements of the elderly. There do exist variations in dietary pattern within the elderly as a group, which can be identified across studies. Those consuming relatively more energy from cereals, fruits and milk appear to have more adequate nutrient intakes and blood levels for several nutrients. With recent advances in research, we are beginning to gain more understanding of the importance of specific nutrients to health and disease prevention. Of key current interest are folate, which appears to be protective against high homocysteine levels and associated vascular disease; vitamins D and K, which protect bone status and antioxidants which protect against declines in immune function, and against the development of heart disease and cancer.

The theme of this conference is "Moving into the next century". With the changing demographics, we know that the elderly will form a larger proportion of the population. We also know that a growing proportion of these with be from minority groups, with Hispanics the most rapidly growing segment. Our limited current understanding of nutrition and aging suggests that anti-oxidant nutrients, B vitamins, vitamin D and vitamin K will be central to many areas of relevant research in the future. This has direct implications for databases, as the food tables are still incomplete for many of these nutrients, particularly for foods consumed by minority populations.

With a new method to analyze levels of various forms of food folate, much research will be needed to understand their relevance. The accumulating data on carotenoids, especially the new tables prepared by Gary Beecher and Joanne Holden at the USDA Nutrient Composition Laboratory, and on vitamin K developed by Jim Sadowski, Sarah Booth and others, will also be very important to future research on diet and health of the elderly.

Future database needs important to studies of nutrition and aging include the completion and refinement of data for these and other nutrients as well as non-nutrients in food as we increasingly recognize their roles in health maintenance and disease prevention.

References

1. Horwath CC (1989) Dietary Intake Studies in Elderly People. In Bourne, GH (Ed). Impact of Nutrition on Health and Disease. World Rev Nutr Diet. Basel, Karger 59:1-70.

2. Russell RM, Suter PM (in press) Vitamin Requirements of the Elderly: An Update.

3. Mares-Perlman JA, Klein BEK, Klein R, Ritter LL, Freudenheim JL, Luby MH (1992) Nutrient supplements contribute to the dietary intake of middle- and older-aged adult residents of Beaver Dam, Wisconsin. J Nutr 123(21):176-188.

4. Block G, Hartman AM, Dresser CM, Carroll MD, Gannon J, Gardner L (1986) A data-based approach to diet questionnaire design and testing. Am J Epidem. 124: (3) 453-469.

5. Slesinger DP, McDivitt M, O'Donnell FM (1980) Food patterns in an urban population: Age and sociodemographic correlates. J Gerontol. 35(3):432-441.

6. Cronin FJ, Krebs-Smith SM, Wyse BW, Light L (1982). Characterizing food usage by demographic variables. J Am Dietet Assoc. 81:661-673.

7. Davis MA, Murphy SP, Neuhaus JM (1988) Living arrangements and eating behaviors of older adults in the United States. J Gerontol. 43(3):S96-S98.

8. McGandy RB, Russell RM, Hartz SC, Jacob RA, Tannenbaum S, Peters H, Sahyoun N (1986) Nutritional status survey of healthy noninstitutionalized elderly: Energy and nutrient intakes from three-day diet records and nutrient supplements. Nutr Res 6:785-798.

9. Fanelli MT, Woteki CE (1988) Nutrient intakes and health status of older Americans. Annals of New York Academy of Sciences. 94-103.

10. Davis MA, Randall E, Forthofer RN, Lee ES, Margen S (1985) Living arrangements and dietary patterns of older adults in the United States. J Gerontol 40(4):434-442.

11. Murphy SP, Davis MA, Neuhaus JM, Lein D (1990) Factors influencing the dietary adequacy and energy intake of older Americans. J Nutr Educ 22(6):284-291.

12. Tucker KL, Dallal GE, Rush D (1992) Dietary patterns of elderly Boston-area residents defined by cluster analysis. J AM Dietet Assoc. 92(12):1487-1491.

13. Selhub J, Jacques PF, Wilson PWF, Rush D, Rosenberg IH (in press) Vitamin Status and intake as primary determinants of homocysteinemia in the elderly.

14. Holick MF (1986) Vitamin D synthesis by the aging skin in Hutchinson M, Munro HN (eds.) *Nutrition and Aging*. New York: Academic.

15. Booth SL, Sadowski JA, Weihrauch JL, Ferland G (1993, in press) Vitamin K_1 (Phylloquinone) content of foods: a provisional table. J Food Comp Anal.

Development and REPRODUCIBILITY of a Young Adults Food Frequency Questionnaire

Helaine R.H. Rockett, MS, RD, Brigham and Women's Hospital, Boston MA

A Young Adults Food Frequency Questionnaire (YAQ) was developed usinq the same format as the validated adult Nurses' Health Study questionnaire. A group of 179 adolescents (10 to 18 years old) was recruited from a random sample of Nurses' Health Study II participants. The YAQ was evaluated by assessing the one year test-retest reproducibility and by comparing mean nutrient intakes with external national data sets. The Pearson correlations ranged from r=.26 for protein to r=.58 for calcium for the total group. Assessing by gender the females tended to do better and by age the oldest group (16-18 year olds) had the highest correlations in most nutrients. Comparing the YAQ mean nutrient intakes to the Nationwide Food Consumption Survey the mean nutrient intakes were very similar with most nutrients being within 25% of each other.

The Relationship Between Nutrients and Foods in Children's Diets

P.A. Crawford, MPH, RD, School of Public Health, University of California, Berkeley CA

Dietary intake data from 822 nine- and ten-year-old girls enrolled in the Richmond, CA site of the NHLBI Growth and Health Study were examined. Fifty percent of the girls were black, 50 percent white. Each girl kept a three-day food diary and completed a nutrition patterns questionnaire. Sociodemographic information was collected from parents and guardians.

Three-day average nutrient intakes were calculated and examined by race, family income, and maximal parental education level. Percent kilocalories from fat, percent kilocalories from saturated fat, vitamin C, and calcium were independently associated with race, family income and parental education level. Percent kilocalories from polyunsaturated fat was associated with race. No differences between groups were found for kilocalories, protein or vitamin A. Significant interactions between variables were found for total fat intake and iron.

Contributions of specific foods to nutrient intake were examined for each sociodemographic grouping and found to vary with race, family income, and parental education. Patterns of eating were also related to nutrient intake. The data suggest that changing dietary intake and eating patterns of children are related to changes in family lifestyle and food supply.

In conclusion, the constructs by which nutrition professionals assess the dietary intake of children or develop nutrition intervention programs must be based on an understanding of the current relationship between foods, nutrients, and eating patterns in this subgroup of the population.

Nutrient Intakes of American Children Ages 2-10 Years

Ann M. Albertson, MS, RD General Mills, Inc. Minneapolis MN

Nutrient intakes of American children aged 2 to 10 years were compared for the years 1978 and 1988 using a unique nutrient assessment system designed and developed by the Nutrition Department at General Mills, Inc. This system integrated data from three sources: 14-day food consumption diaries collected from 4,000 households in the Market Research Corporation of America Menu Census panel surveys; serving size data from the spring 1977 Nationwide Food Consumption Survey; and nutrient data from the Michigan State University Nutrient Data Bank. The results indicate that energy and macronutrient intakes remained fairly constant over the 10-year period. Average daily vitamin and mineral intakes were lower in 1988 than in 1978 for the majority of those studied; however, most nutrient levels remained over 100% of the Recommended Dietary Allowances (RDAs). For more than 50% of the population, the intakes of calcium, vitamin B-6, and zinc were below the RDAs. Our findings indicate the need for continued monitoring of the impact of changing food consumption patterns on the diets of American children.

Updates

USDA Nationwide Food Surveys
Ellen W. Harris, Director, *Nutrition Monitoring Division, HNIS, USDA*

USDA Nutrient Data
Ruth H. Matthews, *HNIS, USDA*

NHANES III
Margaret McDowell, *NCHS, CDC, DHHS*

Total Diet Study & Nutrition Labeling
Jean Pennington, *Center for Food Safety & Applied Nutrition, FDA*

International Interface Standard and LANGUAL
Jean Pennington, *Center for Food Safety & Applied Nutrition, FDA*

USDA Nutrient Composition Laboratory Update
Gary R. Beecher, Nutrient Composition Laboratory, *BHNRC, ARS, USDA, Beltsville MD*

Update on USDA Nationwide Food Surveys

Ellen W Harris, DrPH, Nutrition Monitoring Division, Human Nutrition Information Service U.S. Department of Agriculture

An update of the most current USDA nationwide food surveys was presented. Data is available and was presented from the 1989-91 Continuing Survey of Food Intakes by Individuals (CSFII) and its follow-up survey, the Diet and Health Knowledge Survey (DHKS). Status of survey preparations for CSFII 1994-96 was also presented.

USDA Nutrient Data Update

Ruth H. Matthews, Technical Advisor to the Director, Nutrition Monitoring Division, USDA, ARS, Hyattsville, MD

Last fall, I assumed a new and challenging role as Technical Advisor to the Director, Nutrition Monitoring Division. My responsibilities include recommending new areas for food composition research; recommending changes; pointing out trends; looking at perceptions about foods; food groups, and nutrients relative to the data bases; and promoting industry cooperation. Meanwhile, ongoing research in the Nutrient Data Research Branch continues to assure currency and accuracy of the data.

Monitoring Data Bases

The emphasis today is monitoring key foods-- those foods that provide the largest amounts of a specific nutrient in American diets according to current food consumption surveys. For carotene, vitamin A, ascorbic acid, calcium, cholesterol, vitamin B-12, and sodium, between 30 and 91 foods provide at least 80 percent of each of these nutrients. For the other nutrients listed from around 100 to 200 foods account for 80 percent of the nutrient consumed.

Key Foods Monitoring

Nutrient	No. of Foods[1]
Carotene	30
Vitamin A	54
Ascorbic Acid	60
Calcium	61
Cholesterol	62
Vitamin B_{12}	79
Sodium	91

[1]Contributing 80 percent of total nutrient consumed as shown by 1987-88 Nationwide Surveys.

Key Foods Monitoring

Nutrient	No. of Foods[1]
Alpha tocopherol	103
Copper	121
Dietary fiber	125
Folate	126
Potassium	161
Thiamin, riboflavin, niacin, vitamin B_6	155-185
Iron, magnesium, phosphorus	178-227

[1]Contributing 80 percent of total nutrient consumed as shown by 1987-88 Nationwide Surveys.

"Key" Foods for Calcium Monitoring

Food	% calcium[1] provided	calcium (mg per 100 g)
Milk, whole	23.2	119
Milk, lowfat, 2%	12.7	122
Cheese, American proc.	6.1	616
Cheese, cheddar	3.3	721
Milk, skim	3.0	123
Bread, white	2.9	116
Total	**51.2**	

[1]Based on 1987-88 NFCS.

In addition to key foods, extramural contracts include analyses for proximates, vitamins, minerals, and lipids (including geometric isomers, cholesterol, and plant sterols) in ethnic and geographic-specific foods and verification of some important retention and yield factors. Data are also being generated on dietary fiber and sugar content.

The Primary Data Set (PDS) is being modified to include individual fatty acids. Data are being reviewed before release.

New Foods Data

Reduced-fat and lowfat foods are appearing in the supermarkets in ever-increasing numbers. Whether baked products, salad dressings, margarine-like spreads, frozen desserts, frostings, crackers, cookies, puddings, candies, sausages, luncheon meats, or dairy items such as cheese and cream products, the proportion of the usual ingredients has been changed. Some of these types of reduced-fat, lowfat, no fat items were analyzed on two small contracts. Some of the data are being reported here.

These and other foods are reduced in fat by the use of ingredient modifiers that duplicate the sensory properties of fat. Various soluble-fiber materials are used, such as guar gum, xanthan gum, carboxymethylcellulose (CMC), locust bean gum, carrageenan; starches such as rice, potato, and modified cornstarch; and alpha-cellulose, cellulose gel, or cellulose gum which hold added water. Polydextrose and tapioca dextrin also ingredients that help duplicate textural properties in products such as frozen desserts, puddings, frostings, and salad dressings.

PUBLICATIONS

The following publications were released since last year's meeting:

Publications

- 1991 Supplement to AH-8
- AH-8-18 Baked Products
- AH-8-10 Pork Products (revised)
- Provisional Table on Selenium

Content

AH-8 1991 Supplement
AH-8-18 Baked Products
AH-8-10 (rev.) Pork Products
Provisional Table on Selenium

The long-awaited AH-8-18, Baked Products, which includes over 400 items; the 1991 Supplement to AH-8; the revised AH-8-10 Pork Products, with new fresh pork data; and a provisional table on selenium were released.

A new "red book," AH-699 designed to replace the 1963 edition of AH-8 will soon be published. This publication will contain over 2,000 foods in 100-gram edible portion measures including all nutrients reported in AH-8 except individual fatty acids and amino acids. The branch is also working on revising AH-456, "Nutritive Value of American Foods in Common Units," which is expected to be available in 1994. A trans fatty acid provisional table is also nearing completion.

Nutrient Data Bank Bulletin Board

The Nutrient Data Bank Bulletin Board continues to increase in popularity and has become more utilitarian because of its link with Internet. The provisional tables on vitamins D and K and selenium; the three supplements to AH-8; and the handbook sections on Baked Products and Snacks and Sweets have been very popular. Many individuals have been anxious for data to appear on the Bulletin Board before the published manuscript is available.

Nutrient Data Bank Upgrade

An important component in the whole process for the Branch is upgrading the National Nutrient Data Bank System (NNDBS), beginning this year with anticipated completion in about 3 years. The new system will be designed to expedite and enhance the Branch's work by providing easy updating of data for AH-8 and other food tables, as well as the Survey Nutrient Data Bases, and to help avoid the kinds of delays we've had in the past. The system will help the branch achieve its long-range goals of providing quality, current food composition data.

Quality Assurance Program

The Quality Assurance (QA) Program includes several components:

Quality Assurance Program

- QA Materials Development
- QA Materials Use
- Annual Meeting of Contractors
- Consultant Panel

QA Materials development (under contract or with NCL)
Use of QA Materials
Annual Meeting of Contractors
Consultant Panel

A three-member NDRB panel decides on appropriate reference materials for screening prospective contractors and for monitoring their performance during the course of the contract. Reference material development is carried out under a small contract and is often conducted in consultation with ARS personnel. Reference materials are used for screening prospective contractors, for improving performance where some weakness in accuracy exits, and for evaluating performance during the course of the contract period. USDA/HNIS contractors meet annually at the time of the IFT annual meeting to discuss problems in sample preparation, analytical methods, report writing, and other matters.

A vital part of quality assurance is the three-member Consultant Panel, initiated in 1991. They are often called upon during the year to advise, review, and evaluate proposals, manuscripts, and plans of work. Consultant panel members are selected from industry, academia, and government and have expertise in analytical methods, data base management, and data base building. They are consulted regularly on issues relating to their areas of expertise.

Keeping Current

The scientific literature continues to focus on health issues relating to total fat content, degree of unsaturation, individual fatty acids, and the antioxidant vitamins A (especially beta-carotene), C, and E. Also important are other components such as zinc, copper, and iron; individual carbohydrates by direct analysis, starch, sugars, and dietary fiber components; and trans fatty acids.

Priority Food Components for Review

- Total Fat
- Fatty acids, individual
- Antioxidant vitamins
  - A
  - C
  - E

Important Food Components for Review

- Selected minerals – zinc, copper, iron
- Carbohydrate components (direct analysis)
  - starch
  - sugars (individual and total)
  - dietary fiber components
- Trans fatty acids

Perceptions about food are important for accuracy in surveys. One example would be identification of some types of bread. In general, wheat bread (about 30 percent whole wheat flour) and whole wheat bread (100 percent whole wheat flour) are often confused. These breads differ considerably in mineral content.

Comparison of Two Breads in Mineral Element Content

Mineral Element	Whole Wheat Bread[1]	Wheat Bread[2]
	(mg per 100 grams)	
Calcium	72	105
Magnesium	86	46
Phosphorus	229	150
Potassium	252	201
Zinc	1.94	1.04
Copper	0.284	0.212
Manganese	2.324	1.024

[1]Made with 100 percent whole wheat flour.

[2]Made with approximately 30 percent whole wheat flour, 70 percent white flour.

Values for real mayonnaise and the reduced-calorie and fat-free, cholesterol-free types are shown here. Differences in fat content are reflected in the differences in calorie values.

Selected Food Components in Mayonnaise and Mayonnaise-Type Dressings

Food Components	Mayonnaise	Mayonnaise-Type Dressings: Reduced Calorie	Mayonnaise-Type Dressings: Fat-Free Cholesterol-Free
Water (%)	15.3	56.0	80.7
Fat (%)	79.4	29.7	0.3
Protein (%)	1.1	0.5	0.2
Carbohydrate (%)	2.7	12.0	16.5
Calories (/100 g)	717	334	70
Cholesterol (mg/100 g)	59	45	0

Data for American cheese, cheese food, cheese spread, and cheese products are presented here. One observes the dramatic differences in composition. However, these products are the same color, are individually wrapped and, in general, are similar in appearance.

Selected Food Components in Cheese and Cheese Products[1]

Food Components	Cheese	Cheese Food	Cheese Spread	Cheese Product
Water (%)	39.2	43.2	47.6	57.1
Fat (%)	31.2	24.6	21.2	5.0
Protein (%)	22.2	19.6	16.4	14.5
Carbohydrate (%)	1.6	7.3	8.7	9.5
Calories (/100 g)	375	328	290	143
Cholesterol (mg/100 g)	94	64	55	45

[1]American process type

Industry reports that American cheese constitutes about 10 percent of the market; cheese food, 60 percent; cheese spread, 10 percent; and cheese product, 20 percent. The cheese product first appeared on the market in 1990. Fast-food establishments and restaurants most often use cheese food because it melts more easily than the cheese. Unless nutritionists are able to obtain specific information on these differences, a weighted value for American cheese products should be used for surveys. As shown by earlier survey results, American cheese is one of the major contributors of protein, fat, cholesterol, calcium, phosphorus, and zinc.

Let us compare fat content of wild and farmed fish. Catfish is essentially all farm-raised. The data show the farm-raised to be more than 2-1/2 times the fat content. Effects of feeding practices are also reflected in the fatty acid profiles.

Comparison of Selected Food Components in Catfish[1]

Food Components	Wild	Farmed
Water (%)	80.36	75.38
Fat (%)	2.82	7.59
Protein (%)	16.38	15.55
Calories (/100 g)	95	135
Cholesterol (mg/100 g)	58	47

[1]Raw

Wild rainbow trout are essentially only available by recreational fishing. Aquaculture of rainbow trout began in 1928, the pioneer for the industry.

Comparison of Selected Food Components in Rainbow Trout[1]

Food Components	Wild	Farmed
Water (%)	71.87	72.73
Fat (%)	3.46	5.40
Protein (%)	20.48	20.87
Calories (/100 g)	119	138
Cholesterol (mg/100 g)	59	59

[1]Raw

Atlantic salmon is increasing in popularity and production today and is about 95 percent farm raised. As early as 1988, about 30 percent of the Atlantic salmon was produced by aquaculture and imported from Norway, and now, Maine. Note the differences in fat content between the farm-raised and the wild forms.

Comparison of Selected Food Components in Atlantic Salmon[1]

Food Components	Wild	Farmed
Water (%)	68.50	68.90
Fat (%)	6.34	10.85
Protein (%)	19.34	19.90
Calories (/100 g)	142	183
Cholesterol (mg/100 g)	55	59

[1]Raw

Another changing area is improvement of functional qualities in foods by adding vitamin C as sodium erythorbate or as sodium ascorbate in processing luncheon meats, frozen fruits, fruit desserts, fruit-flavored punches and ades, and selected wheat flours, to name a few uses. The vitamin C is not present for fortification, but significant amounts can remain after storage or food preparation. The vitamin C present in these foods must be accounted for especially in epidemiological studies when knowing the level of the nutrient accurately may be crucial for interpretation of results. The major producers of U.S. luncheon meats (75 percent of market) recently switched from sodium ascorbate to sodium erythorbate, which has no vitamin C activity.

The Future

In accordance with the Ten Year Comprehensive Plan for the Nutrition Monitoring and Related Research Program, addition of nutrients to the data bases will be prioritized. Need for and availability of data will have a marked effect on this activity.

The data base for vitamin E as alpha tocopherol equivalents will be reviewed and updated based on a significant amount of new data. Data on individual carotenoids will be adapted to the PDS as NDRB staff time permits.

Future expansion of the data base on carbohydrate components will provide valuable information that may be helpful in interpreting glycemic response-- an area of special interest for the study of diabetes control.

A Memorandum of Understanding between HNIS and ARS was recently prepared and will promote more collaboration in several research areas. Development and distribution of reference materials, and Laboratory Performance Evaluation (LPE) are areas that need the expertise of the NCL staff and the experience of the nutritionists in NDRB. The LPE will provide continuing performance evaluation of analytical laboratories that may conduct nutrient analyses for food composition research for NDRB.

Update on Activities for the Third National Health and Nutrition Examination Survey (NHANES III)

Margaret McDowell, Centers for Disease Control, National Center for Health Statistics (NCHS), Hyattsville MD

NHANES data are used to assess the health and nutritional status of the U.S. population, to estimate the prevalence of selected health conditions, and to examine secular trends in the prevalence of many diseases and health risk factors. NHANES III began in 1988 and will continue until late 1994. Approximately 20,000 persons 2 months of age and older have completed the interview and examination components of the Survey. The dietary assessment methods used in NHANES III include 24-hr recall and food frequency interviews, and dietary practices questions. NHANES III 24-hr recalls are collected with the NHANES III Dietary Data Collection (DDC) system, an automated interview and coding system developed by the University of Minnesota's Nutrition Coordinating Center with Federal funding. The DDC system features include a standardized interview format and structured probes. During the past year preliminary findings on the prevalence of high blood pressure in the U.S. population were released. Body measurement and serum lipid data will be available shortly. The NCHS dietary data group completed preliminary edits on all Cycle I recall data. HNIS provided a nutrient composition data file and survey recipe and codebook files used to complete data processing.

Update On The Total Diet Study And Nutrition Labeling

Jean AT Pennington, PhD, RD, FDA, Washington, DC

Total Diet Study

The Food and Drug Administration's (FDA) Total Diet Study is a yearly program that monitors the levels of nutrients and contaminants in the U.S. food supply and in the daily diets of selected age-sex groups. The program is revised periodically to update the food list and diets so that it reflects current food consumption patterns. The nutrient data obtained from analyses of 234 foods collected four times per year from April 1982 to April 1991 are being summarized and evaluated. The foods were purchased in grocery stores and restaurants in specified cities and sent to the Total Diet Laboratory in Lenexa, Kansas, where they were prepared for consumption and analyzed. Results to be reported from this work include the levels of 11 nutritional elements in the 234 foods and estimates of the daily intakes of these elements for eight age-sex groups. Trends and changes in nutrient intakes over this nine-year time period will also be assessed.

A revised Total Diet Study program began in September 1991. The food list and diets for the revised program are based on information from the 1987-88 USDA Nationwide Food Consumption Survey. The revised program includes 265 foods and diets for 14 age-sex groups. The additional foods include more fast foods, mixed dishes, and infant foods. The age-sex groups evaluated in the program are infants, children ages 2, 6, and 10 years, teenage girls and boys 14-16 years of age, and women and men 25-30, 40-45, 60-65, and 70+ years. As with the previous program, the foods will be purchased four times per year and sent to the Total Diet Laboratory for analyses.

Nutrition Labeling

FDA's final regulations concerning the mandatory status of nutrition labeling, label content and format, serving sizes, nutrient content descriptors, and health claims were published in the *Federal Register* on January 6, 1993. Regulations pertaining to health claims became effective in May 1993. Most of the other regulations become effective in May 1994.

Criteria for nutrient content descriptors were defined for the following terms: free, low, reduced/less, modified, high, light/lite, good source, more/added, lean, and extra lean. There are now defined descriptive terms for the levels of calories, sodium, fat, saturated fat, cholesterol, and sugars in foods.

Health claims for seven diet-disease relationships were developed and may be used by manufacturers if their products qualify for them. The seven health claims that have been authorized concern:

- saturated fat and cholesterol and coronary heart disease;
- fat and cancer;
- sodium and hypertension;
- calcium and osteoporosis;
- fiber-containing grain products, fruits, and vegetables and cancer;
- fruits, vegetables and grain products that contain fiber, particularly soluble fiber, and coronary heart disease; and
- fruits and vegetables and cancer.

The voluntary nutrition labeling program for raw fruit, vegetables, and fish has been in place since November 27, 1991. Retailers are encouraged to provide nutrition information in their stores for the 20 most frequently consumed raw fruit, vegetables, and fish. FDA identified these foods and provided the nutrition labeling values for them. Several trade associations developed posters and brochures that provide the nutrition labeling information. Retailers can obtain the information from the trade associations and make it available to the consumers in their stores. Alternatively, retailers can develop their own posters, brochures, or other materials to make the nutrition labeling information available to consumers.

The compliance of retailers with the voluntary nutrition labeling program was determined to be "substantial" based on a survey of 2,000 stores conducted by FDA in November and December 1992. Substantial compliance was defined as having at least 60% of the retail stores surveyed participating in the program. The program will remain voluntary for the next two years, and compliance will be reassessed in 1994. The nutrition labeling values for the 20 most frequently consumed fruit, vegetables, and fish have been revised to update them and to reflect the new labeling regulations for processed, packaged foods. A proposal concerning this revision was published in the *Federal Register* in May 1993. The final regulation will be published after the public comments are considered and the necessary changes are incorporated.

Other labeling issues which are forthcoming include a final rule on the definition of the descriptive term "healthy"; a proposal to revise the Daily Values for vitamins and minerals; and a proposal for the labeling of nutritional supplements.

FDA and the Food Safety and Inspection Service of the U.S. Department of Agriculture established the Food Labeling Education Information Center in September 1992 to encourage the exchange of information about projects and research in labeling education. The Center, which is located at the National Agriculture Library in Beltsville, Maryland, has a database with listings of print materials (books, fact sheets, etc.), audiovisuals, children's materials (games, comic books, etc.), media kits, program materials (exhibits, conferences, etc.), computer materials, and research results (reports, studies, and bibliographies).

International Interface Standard And Langual

Jean A.T. Pennington, Ph.D., R.D., Thomas C. Hendricks, M.S., and Elizabeth C. Smith, M.S.L.S., Center for Food Safety and Applied Nutrition, Food and Drug Administration, Washington, DC

International Interface Standard

An interface standard, which incorporates LANGUAL as the food description language, is under contractual development at the Food and Drug Administration (FDA) to allow international exchange of food composition, food consumption, and other food-related data. The interface standard will provide a means for clearly and precisely identifying foods and the data associated with them. The intent of this effort is to improve and standardize food descriptions, allow for matching of foods among databases, facilitate sharing and exchanging of data, and facilitate retrieval of information from databases.

The first task of this project, the refinement and implementation of the schema for the interface standard, has been completed. The aspects of the schema are food name and synonyms, LANGUAL factors, other descriptive factors (agricultural and storage factors), ingredients and recipes, and data sources. Thus, it includes complete LANGUAL coding, as well as descriptive terms for other aspects of foods. It provides a means of capturing full ingredient and recipe information.

The second task, which is funded and ongoing, is the development of a personal computer program for retrieval of information (a series of queries), using the standard interface. The third task calls for the dissemination of the results of this project to an international audience through demonstration projects for international symposia and pilot tests for scientific applications.

LANGUAL

LANGUAL, which stands for "Langue des aLiments" or "language of food," is an automated method for describing, capturing, and retrieving data about food. It has been developed by FDA over the past 20 years as an ongoing cooperative effort of specialists in nutrition, food technology, and information science. LANGUAL is based on the concept that:

- foods (or food products) can be systematically described by a combination of characteristics;
- these characteristics can be categorized and coded for computer processing; and
- the resulting codes can be used to retrieve data about the food from external databases.

There has been considerable international interest and use of LANGUAL, particularly in the European Community (EC). Some of these activities are listed below:

- LANGUAL is being adapted for use in the European Prospective Study on Nutrition, Cancer, and Health by the International Agency for Research on Cancer (IARC) in Lyon, France. This study includes more than 400,000 participants from at least seven countries over a ten-year period.
- LANGUAL has been used at the Centre Informatique sur la Qualite des Aliments (CIQUAL) in Paris for several years to describe the French foods analyzed by this organization.
- LANGUAL is being used at the Centre de Rescherche pour l'Etude et l'Observation des Conditions de Vie (CREDOC) in Paris for the evaluation of data from French national food consumption studies.
- A test of LANGUAL for use as the EC standard was completed last year by FLAIR (Food-Linked Agro-Industrial Research) EUROFOODS/ ENFANT (European Network on Food and Nutrition Tables). This is a concerted action program concerned with improvement of the quality and compatibility of food consumption and composition data in the EC. The results of the test were favorable and work is underway to determine how to incorporate LANGUAL into European databases.

USDA Nutrient Composition Laboratory Update.

Gary R. Beecher, Nutrient Composition Laboratory, BHNRC, ARS, USDA, Beltsville MD

The mission of the Nutrient Composition Laboratory is to conduct research to meet critical needs relative to the composition of foods. This mission is accomplished by conducting research in several activities including: 1) development of measurement systems, 2) development of sampling strategies for the U.S. food supply, and 3) analysis of foods. Relative to the development of analytical methodology, research continues for such nutrients and food components as carotenoids, cholesterol, dietary fiber, fatty acids, flavonoids, folate, several minerals, vitamin C, vitamin E, tocotrienols and several water soluble vitamins. Instrumentation development for mineral analysis is also an active component of the research program. Several projects are oriented toward the development of stable and applicable food reference materials which will improve the accuracy of nutrient data. Data are being evaluated from a large project on the analysis of carotenoids in tomatoes and tomato products and will be added to the carotenoid database as soon as the data are summarized and published. Collaboration continues with many commercial, state and federal laboratories and other research organizations.

Food Analysis 101: How to Get Good Data

Food Analysis 101: How to Get Good Data

Speaker: Joanne M. Holden, *Nutrient Composition Laboratory, USDA*

Food Analysis 101: How To Get Good Data

Joanne M. Holden, Nutrient Composition Laboratory, BHNRC, ARS/USDA, Beltsville, MD 20705

Food composition data are essential to the understanding of the relationship between dietary intake and nutritional status. Dietary effects on health may be acute or long term. In order to accurately assess these effects, accurate and precise component estimates are required. Variance in component levels due to the measurement process (sample selection and preparation, chemical analysis, and mathematical estimation) can be partitioned from variance inherent to the food product (brand, season, geographic location) and should be minimized. In addition, food composition estimates should be unbiased and representative of foods and components in the diets of the study population. To assure the accurate and precise execution of a given analytical method, the method should be validated before samples of unknown composition are measured. Reference materials of known composition can be analyzed as part of a comprehensive quality assurance program to validate the analytical method, to monitor day-to-day accuracy, and to avoid bias and drift of the on-going measurement process. The selection of representative samples is based upon an appraisal of food products, their descriptions, and consumption characteristics. Sales data and manufacturers descriptions, including food labels, can be used to define specific product categories. Demographic data can help to identify sampling locations. Pilot studies provide estimates of component variance, a critical element in calculation of numbers of samples required to obtain statistically sound estimates.

Database Quality and Variability

Criteria of Quality and Sources of Variability

Jack L. Smith, *University of Delaware*

Nutrient Variability

Jean Pennington, *Center for Food Safety and Applied Nutrition, FDA*

Criteria Of Quality And Sources Of Variability

Jack L. Smith, University of Delaware

As a continuation of basic discussion of nutrient composition, there needs to be an understanding of the basis of quality and variability of the nutrient values in a database. There is no single measure of database quality. The quality of a database must be defined based on the uses for which it is intended. The most obvious factors include the number of foods in the database, the number and types of nutrients included, the amount of missing data, the sources of the data and the quality of the data from each source. There are less obvious considerations that include the description of the food, the data from manufacturers, the inclusion of label data, modifications of products, the amount of imputed or calculated data and the validity of those calculations.

The term accuracy has very little meaning when applied to a nutrient database since the individual nutrient value for a single food item may differ from another sample of apparently the same food. There are many sources of variation for the individual values. The size of the variance and whether it is a normal distribution is important to know. Differences relating to methodology, inter- and intra-laboratory differences, sampling and sample variation due to differences in biological origins, growing conditions, storage conditions are largely uncontrollable factors, but tend to increase the variance of the values. How well the individual values are documented pertaining to source of the data, conditions under which it was obtained and the degree to which values are aggregated occurred, has great effect on the values listed in a database.

Nutrient Variability

Jean AT Pennington, PhD, RD[1], Richard H Albert, PhD[1],
and William M Rand, PhD[2]

Measures of nutrient variability are particularly useful to database compilers, food analysts, and food manufacturers. Database compilers use them to make decisions regarding the aggregation and compilation of data from various sources, food analysts use them to gauge the potential results of prospective analyses, and food manufacturers use them in product development and nutrition labeling. Measures of nutrient variability are also of importance to dietitians, nutritionists, and researchers who use food composition databases to plan and evaluate the diets of patients, clients, and study participants.

Causes of nutrient variability include inherent, environmental, and processing factors such as variety, agricultural conditions, storage conditions, and cooking methods. The causes of nutrient variability are food specific and are, for the most part, difficult to quantitate or separate. Some nutrient variability is the result of artifacts such as sampling scheme, analytical methods, quality control, laboratory bias, and statistical treatment of data.

Information about nutrient variability is usually expressed as a standard deviation (SD), standard error (SE), or coefficient of variation (CV). A comparison of mean and median values and an examination of the range of values also provide some indication of how a nutrient varies in a food. However, nutrient variation is most visually apparent with the use of frequency distributions. The examples of nutrient variation presented here are from the Food and Drug Administration's (FDA) Total Diet Studies, 1982-91.

Figure 1.
CALCIUM IN WHOLE FLUID MILK

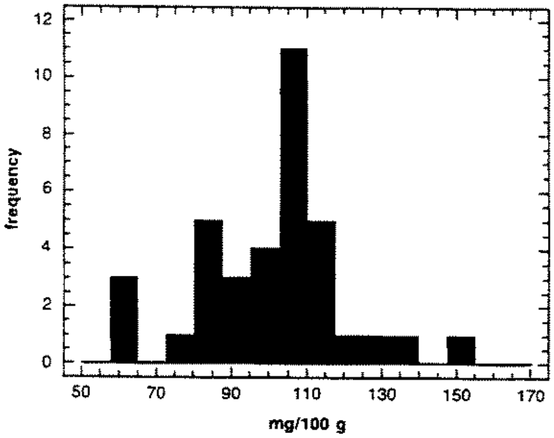
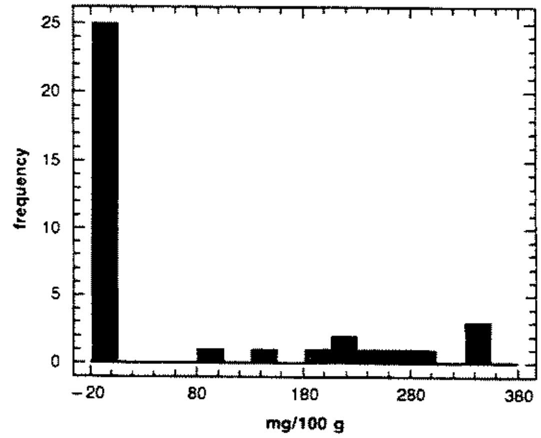


Figure 2.
SODIUM IN COOKED WHITE RICE

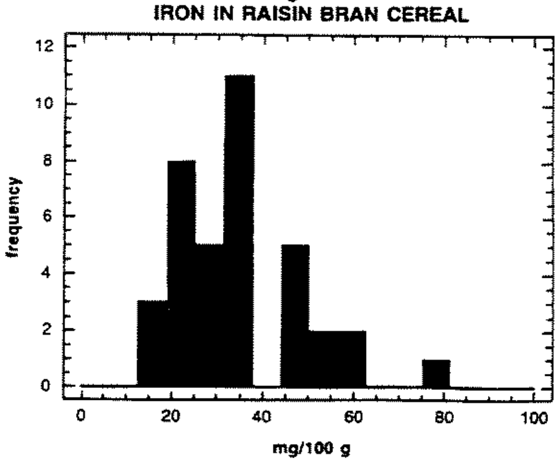


The level of calcium in whole milk (Figure 1) might vary because of environmental factors such as season and the type of diet fed to cows and because of factors inherent in the cows such as stage of lactation, age, and species. Processing variables include the pooling of milk from many cows within a dairy and the pooling of milk from various dairies before it is processed, packaged, and sold to consumers. Milk, which is commonly recommended as a source of calcium, provides an average level of 247 ± 50 mg of calcium per eight fluid ounces, however, the amount of calcium varies from 142 to 378 mg per eight fluid ounces.

The variability of sodium in processed foods is primarily dependent upon the quantity of salt and other sodium-containing compounds added by the manufacturer. The sodium content of processed foods is often brand specific. The sodium content of various brands of condensed, diluted vegetable beef soup from the FDA Total Diet Study is 669 ± 226 mg/cup with a range of 284 to 1,624 mg/cup. This variation indicates the importance of brand- specific information for the nutrient content of some foods, especially if the nutrient content of individual diets is to be assessed.

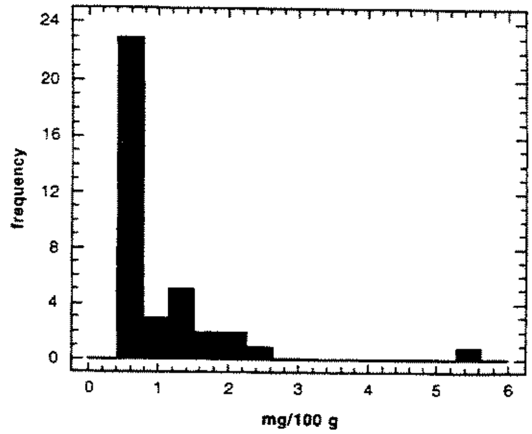
The mean and median values for the sodium content of cheddar cheese, 170 and 168 mg/ounce, respectively, are similar; however, the range (113 to 249 mg/ounce) indicates the different levels of sodium added to cheese during processing.

Figure 3.
IRON IN RAISIN BRAN CEREAL



Frequency distributions for sodium in cooked white rice, oatmeal, farina, and corn grits are similar, but not normal (See Figure 2 as an example). These distributions show a high frequency of low values and a scattering of values at the higher end. The "regular" form of these four grain products was supposed to have been purchased, but sometimes instant products were mistakenly collected by the FDA inspectors. The instant products usually contain added sodium compounds and are higher in sodium than the regular products. Another source of sodium variation has been salt added to these products at the contract kitchen where the foods are prepared and cooked. Some of the sodium values from the earlier years of the studies are higher because

Figure 4.
IRON IN CANNED TOMATO SAUCE



the food preparers added salt according to package directions. The food preparers were subsequently instructed not to add salt to these foods during cooking. Since then the sodium values for these foods have become consistently low. The mode more accurately reflects the sodium content of these foods than the mean; the mean value reflects neither the salted nor the unsalted product.

Iron in raisin bran cereal (Figure 3) illustrates variability caused by different fortification levels. This product is commonly sold unfortified, fortified at a 25% U.S. RDA for iron, or fortified at a 100% U.S. RDA for iron. The mean value of iron in this product (0.96 ± 0.14 mg/ounce; range 0.73-1.46 mg/ounce) does not accurately reflect any of the subtypes of which it is composed. If a brand-specific product had been collected and analyzed, the range and standard deviation would have been smaller.

Frequency distributions are useful for identifying outliers. The outlying high iron level in canned tomato sauce shown in Figure 4 may have resulted from iron contact or contamination at the manufacturing plant, but it does not reflect the usual iron content of this product. Outliers may result from errors in the purchase, compositing, or analysis of a food. If the nutrient values are off by a factor of 10, 100, or more, there may have been errors in sample dilution or in data entry. To the extent possible, the identification of outliers should be confirmed by analysts in the laboratory. If there are no reserve samples to reanalyze and no other laboratory information to rely upon, the data evaluator must make the final decision about which values to include in a database. If there are sufficient numbers of samples, outliers may have no effect on mean values. However, when they do, it is best to exclude them or to use median values. Decisions regarding the treatment of outliers should be documented for later reference.

Most users of databases want values that reflect the value most likely to occur or the value with the highest probability of occurring. In most cases, this would be the mean or median. If there are outliers, the median might be a better choice. In some cases (as with the sodium in white rice), the mode (most frequently occurring value) might be the best solution. The data compiler must be knowledgeable about each food and the variables that affect nutrient values.

When food composition data are published or otherwise made available, it is desirable that the data be accompanied by complete food descriptions, sampling design, number of samples, analytical method, quality control information, and median and mean values with an estimate of variance (or individual data points). Additional information that might account for unusual levels of nutrients should be provided. This might include information about food additives (e.g., magnesium additives in canned green beans), fortification (e.g., iron in ready-to-eat cereals), or processing (e.g., mechanical deboning of meat which increases calcium content). Information to explain large variances should also be provided. For example, a large standard deviation for vitamin A in sweet potatoes or vitamin C in grapefruit may be the result of several cultivars in a sample.

When evaluating frequency distributions, one might consider the following questions:

1. Was the sampling design appropriate? If not, how might it have altered the frequency distribution?
2. If the frequency distribution is not normal (i.e., non-Gaussian), is it skewed or bi-modal? Are there apparent explanations for the non-normal distribution (e.g., several different populations)?
3. Are outliers apparent and, if so, should they be omitted?
4. Does the distribution suggest that the mean, median, or mode might be the best choice for the "typical" level of the nutrient in the food?
5. Is the concentration of this nutrient in this food of any practical importance? If a food is not a good source of a nutrient (e.g., copper in milk), the distribution will probably not be normal because there may be many zero, trace, or very low values. If a food is not a potential source of a nutrient (e.g., less than 2% of the Daily Value), the shape of the frequency distribution is of little practical consequence.

Dietary advice given by dietitians and nutritionists should be based on realistic information about food composition. Specific foods that are promoted as being good sources of a nutrient should also be reliable sources of that nutrient. How much can a nutrient vary before the "typical" value is considered unreliable? Might health professionals provide better dietary advice if the databases they use have information about nutrient variability?

Questions of interest with regard to nutrient variation are still rather basic:

1. How variable are nutrients in foods?
2. Are some nutrients more variable than others?
3. Are there similarities in variance among food groups?
4. Are there similarities in variance among nutrients?
5. What are the criteria for using means, medians, and modes?
6. Does the use of medians vs. means vs. modes affect dietary assessments?
7. What happens to variability as more data are collected?

Preliminary results from the Total Diet Study indicate that for minerals, there are no apparent similarities in variation among food groups and that the use of medians (instead of means) has little effect on assessment of daily nutrient intakes.

The more samples that are analyzed, the more valid the database becomes and the more clearly the outliers are identified. However, more data do not decrease variability. More data allow variability to be more clearly defined. With more data, one can put more confidence in median or mean values, but this does not allow for clearer predictions of the nutrient levels of any specific sample.

[1] Center for Food Safety and Applied Nutrition, Food and Drug Administration, Washington, DC.
[2] Department of Community Health, Tufts University School of Medicine, Boston, MD.

Carbohydrates: Beyond Proximate Analysis

Nutrition Labeling of Carbohydrates: Definition, Analyses, and Caloric Calculations
Betty Wang Li, *Nutrient Composition Laboratory, USDA*

Carbohydrate Data: Present and Future Needs
Karen W. Andrews and Pamela R. Pehrsson, *HNIS, USDA*

Carbohydrate Based Food Ingredients: Use, Energy Value, and Analysis
John S. White, *A.E. Staley Manufacturing Co.*

Nutrition Labeling of Carbohydrates: Definition, Analyses, and Caloric Calculations

Betty Wang Li, Nutrient Composition Laboratory, BHNRC, ARS, USDA

Carbohydrates are composed of polyhydroxy aldehydes, ketones, alcohols, and acids of varying degrees of polymerization. They are categorized according to sizes into three classes: 1) Monosaccharides are the simplest of carbohydrates; examples are the hexoses - fructose, glucose, and galactose; and the sugar alcohols - mannitol, sorbitol, xylitol. 2) Oligosaccharides are polymers with 2 to 10 monosaccharide units; examples are the disaccharides - lactose, maltose, and sucrose; the trisaccharides - maltotriose and raffinose; and the tetrasaccharides - maltotetrose and stachyose; and 3) Polysaccharides are complex carbohydrates of polymers with 11 to thousands of monosaccharide units; examples are homopolysaccharides - starch and cellulose; and heteropolysaccharides - pectin and galactomannan.

For nutrition labeling purposes (1), carbohydrates are grouped and defined as follows: *Total carbohydrate*: total weight of food - (crude protein + total fat + moisture + ash); *Sugars*: free monosaccharides and disaccharides; *Sugar alcohols*: saccharide derivatives in which a ketone or aldehyde group is replaced by a hydroxyl group, and whose use in food is listed by FDA or is GRAS; *Dietary fiber*: defined according to AOAC method 985.29 and 991.43 with *soluble dietary fiber* and *insoluble dietary fiber* defined according to AOAC method 991.43; and *Other carbohydrates*: total carbohydrate -(dietary fiber + sugars + {sugar alcohol}).

Chromatographic methods have been developed for the separation and quantification of individual sugars and sugar alcohols in foods. Presently, there are several high-performance liquid chromatographic (HPLC) methods which have been adopted by AOAC for the analysis of honey, corn sirup (sic), milk chocolate, and presweetened cereal. Two gas-liquid chromatographic (GLC) methods are also listed as official methods for fruit juices, apples, and apple by-products, as shown in Table 1. A general discussion of these chromatographic methods may be found in the Proceedings of the 11th National Nutrient Databank Conference (2). Whether HPLC or GLC technique is used for sugar determination, sample preparation and extraction procedures still need to be collaboratively studied for a number of food matrices.

Physiologically, dietary fiber is defined as that component of food which consists of remnants of the plant cells resistant to hydrolysis by the alimentary enzymes of humans. Chemically, it may be regarded solely as the nonstarch polysaccharides or nonstarch polysaccharides plus lignin. Gravimetrically, it is the residue that remain after enzymatic treatment of a food sample minus residual crude protein and ash. The last definition is the basis for the nutrition labeling regulations. The two enzymatic-gravimetric methods, AOAC method 985.29 and 991.43, are recognized by FDA as the official methods (3) for determining dietary fiber and its soluble and insoluble fractions. Both methods utilize a heat stable α-amylase and an amyloglucosidase for the removal of starch and a protease for protein hydrolysis in aqueous medium, which is phosphate buffer for method 985.29 and MES-Tris buffer for method 991.43. For foods containing very little or no starch, e.g. most fruits and vegetables, a nonenzymatic-gravimetric method (4) has been approved by the AOAC Methods Committee and was adopted as first action by AOAC Methods Board in May 1993. In this method, which requires no enzyme treatment, samples are suspended in deionized water and diluted with 95% ethanol to yield, after correction for crude protein and ash, total dietary fiber values comparable to those using the official methods.

Caloric values of foods are generally calculated from the amounts of protein, fat, and carbohydrate in the foods using energy conversion factors, expressed as kcal/g or kJ/g. With the emerging status of various carbohydrates in nutrition labeling, calorie calculations need to be reexamined. For regulatory purposes, five options have been provided for the calculation of caloric content of foods. They are 1) specific Atwater food factors, 2) general factors of 4, 4, and 9 calories per gram of protein, total carbohydrate including dietary fiber, and fat, respectively, 3) same as 2) except that insoluble dietary fiber content may be subtracted from total carbohydrate content, 4) specific factors for particular food ingredients petitioned by manufacturers/users and approved by FDA as appropriate, and 5) bomb calorimetry data after subtraction of 1.25 calories per gram of protein.

A sample of reduced-calorie white bread and another of pork and beans were analyzed for the various carbohydrate fractions as specified in the labeling regulations. Using the analytically determined carbohydrate data and the label information on serving sizes, fat and protein contents, the caloric values for these products were calculated using the different options, including an additional one which has long been used in the United Kingdom (5). Summaries of the results are given in Table 2 and 3. For a processed food such as pork and beans, the calculated caloric values ranged from 170 to 310. Such discrepancy would be expected for most foods that contain relatively high level of dietary fiber.

Many issues concerning carbohydrates for nutrition labeling are still under discussion. For example, should the term "complex carbohydrate" be resurrected, and if so, how should it be defined? Do all analytically determined "soluble dietary fiber" have the same physiological effects? What is the caloric content of various dietary fibers from different sources?

Table 1. AOAC Approved Chromatographic Methods for Sugar and Sugar Alcohol Determination

Method	Method Type	Foods	Analytes
977.20	HPLC	Honey	Fructose, Glucose and Sucrose
979.23 983.22	HPLC	Corn Sirup	Fructose, Glucose, Maltose and Maltotriose DP_2 & DP_3
980.13	HPLC	Milk Chocolate	Fructose, Glucose, Lactose, Maltose, and Sucrose
982.14 984.17	HPLC	Presweetened Cereals Licorice	Fructose, Glucose, Maltose, and Sucrose
971.18	GLC	Fruit Juices	Fructose, Glucose, Maltose, and Sorbitol
973.28	GLC	Apples and Apple By-products	Sorbitol

Table 2. REDUCED-CALORIE WHITE BREAD—Serving size 1.0 ox (28.3 g); Total dietary fiber, 2.82 g; Insoluble dietary fiber, 2.34 g; Available carbohydrate, 9.65 g

	gram/serving	calories				
		I	II	III	IV	V
Protein	2.47	9.88	9.88	9.88	9.88	9.88
Fat	0.71	6.39	6.18	6.39	6.39	6.39
Carbohydrate	12.6	*39.1*	*42.8*	*50.4*	*41.0*	*36.2*
Total Calories		55.4	58.9	66.7	57.3	52.5

I – protein x 4; fat x 9; (carbohydrate — dietary fiber) x 4
II – protein x 4.0; fat x 8.7; carbohydrate x 3.4
III – protein x 4; fat x 9; carbohydrate x 4
IV – protein x 4; fat x 9; (carbohydrate — insoluble dietary fiber) x 4
V – protein x 4; fat x 9; available carbohydrate x 3.75 [U.K.]

Table 3. PORK AND BEANS – Serving size, 8 oz (227 g); Total dietary fiber, 10 g;`Insoluble fiber, 6.8g; Available carbohydrate, 29.8 g

	gram/serving	calories					
		I	II	III	IV	V	VI
Protein	9	36	32	36	36	36	—
Fat	3	27	26	27	27	27	—
Carbohydrate	44	*136*	*172*	*176*	*149*	*111*	—
Total calories		199	230	239	212	174	310

I – protein x 4; fat x 9; (carbohydrate — dietary fiber) x 4
II – protein x 4.0; fat x 8.7; carbohydrate x 3.4
III – protein x 4; fat x 9; carbohydrate x 4
IV – protein x 4; fat x 9; (carbohydrate — insoluble dietary fiber) x 4
V – protein x 4; fat x 9; available carbohydrate x 3.75 [U.K.]
VI – bomb calorimetry value – 1.25 calorie x gram of protein

References

1. Food and Drug Administration (January 6, 1993) Food Labeling, Federal Register, 58, 2095-2111.
2. Li, B. W. (1986) Sugars. In: Proceedings of the 11th National Nutrient Databank Conference, June 29 - July 2, 1986, Athens, GA, pp. 54-62.
3. Supplements to Official Method of Analysis (1990), 15th Ed., AOAC International, Arlington, VA.
4. Li, B. W. and Cardozo, M. S. (1992) Nonenzymatic-gravimetric Determination of Total Dietary Fiber in Fruits and Vegetables. J. AOAC International, 75, 372-374.
5. McCance and Widdowson's The Composition of Foods (1992), 5th Ed. The Royal Society of Chemistry, Cambridge, UK.

Carbohydrate Data - Present and Future Needs

Karen W. Andrews and Pamela R. Pehrsson, U.S. Department of Agriculture, Human Nutrition Information Service, Hyattsville, Maryland

Introduction

The Nutrient Data Research Branch (NDRB) of the Human Nutrition Information Service (HNIS), USDA, collects, compiles, and publishes information about the nutrient content of foods in Agriculture Handbook No. 8 (AH-8) (1). New labeling regulations have focused attention on the carbohydrate fractions of foods and the methods available to analyze them.

Carbohydrate data are obtained from contracted research, trade associations, the scientific literature, industry, and other government agencies. Most of the total dietary fiber (TDF) data in NDRB's current computer files have been obtained through contracts. Most of the sugar data are from the literature.

Dietary Fiber Methodology and Publications

Understanding the methodology for any nutrient analysis is the key to proper data evaluation and use. This is especially true with fiber. Dr. Li, in another paper in this session, presented an overview of carbohydrate methodology. This paper will begin with a brief review of the progression of dietary fiber data that have been compiled by this agency for food consumption surveys and for AH-8.

The development of a carbohydrate data base at HNIS began in the early 1980's. Dietary fiber was added to the food consumption survey data tape (2) starting with the 1985 Continuing Survey of the Food Intakes by Individuals (3) and updated with all subsequent survey data tapes. (The latest available data tape is Release 6 (4).

The Breakfast Cereal section of AH-8 (section 8, 1982) lists insoluble fiber in addition to crude fiber for many foods. The insoluble fiber values were generally determined using the neutral detergent fiber (NDF) dietary fiber method, which is approved by the American Association of Cereal Chemists (5).

For the Fruits and Fruit Juices section of AH-8 (section 9, 1982), the Vegetables and Vegetable Products section (section 11, 1984), and the Legumes and Legume Products section (section 16,

1986) footnotes on the data pages give NDF and pectin values for many foods. The pectin value was considered a measure of soluble fiber, especially in fruits (6).

HNIS began publishing total dietary fiber (TDF) values in 1988. The "Provisional Table on the Total Dietary Fiber Content of Selected Foods" (7) lists analytical TDF values for over 200 foods determined using the Prosky method (8). At that time, the Prosky method was the only method approved by the Association of Official Analytical Chemists (AOAC) for estimating the combined soluble and insoluble components of dietary fiber. This enzymatic-gravimetric method was initially approved in 1984, received final approval in 1986, and was modified in 1988 (9).

Appendix tables included in the 1989 Supplement to AH-8 present TDF values for selected fruits and fruit juices, vegetables, legumes, nuts and seeds, and snacks and sweets. The Baked Products section (AH 8-18, 1992), also contains an appendix table with TDF values.

In the 1993 release of the Standard Reference data base (10), the electronic version of AH-8, TDF replaced crude fiber. The TDF values are coded to indicate whether the value is analytical or calculated. In the 1992 Supplement to AH-8, TDF also replaced crude fiber.

Total Dietary Fiber Data

Tables 1 and 2 list the eight most consumed raw fruits and vegetables in the United States. Consumption order was determined using data from the 1990 Continuing Survey of Food Intakes by Individuals (4). The TDF values listed are the current values in Release 10 of the Standard Reference data base. They are all aggregates of values determined using AOAC methods.

Raw fruits generally are 1 to 3 percent dietary fiber on a wet weight basis (as eaten). A notable exception in table 1 is watermelon. Some fruits that contain small seeds have higher TDF values. Standard deviations and number of analyses are listed. Citrus fruits (oranges and grapefruit), can show a large variation in fiber content because of differences in the amount of albedo (the spongy white material beneath the outer peel) remaining during analysis.

TDF values in vegetables also usually range from 1 to 3 percent on a wet weight basis. Broccoli has a higher standard deviation than other vegetables, probably because different ratios of stem to floret in individual samples affect fiber content. The cucumber value includes analyses both with and without skin.

Sugar Methodology

The Food and Drug Administration, for nutrition labeling purposes, has defined total sugars as the sum of free monosaccharides and disaccharides. The individual sugar content of many foods, especially fruits and vegetables, varies considerably among cultivars and among samples with different moisture levels, growing times, maturity, storage times, and growing locations.

A few commodity-level foods contain single sugars, for which almost any method of analysis would be appropriate(11). However, most sugar-containing foods in a mixed diet contain combinations of sugars. For analysis of these foods, chromatographic methods are most accurate. Gas liquid chromatography(GLC) for separation and quantification of sugars is useful once the sugars have been derivatized. However, high-performance liquid chromatography(HPLC), which does not require derivatization, has become the preferred method for analysis of sugars in foods(11).

Table 1. TOTAL DIETARY FIBER IN RAW FRUITS

FOOD ITEM	MEAN*	STD	n
Apple with skin	2.7	0.56	10
Banana	2.4	0.54	10
Orange	2.4	0.33	6
Watermelon	0.5	0.10	9
Grapes	1.0	0.31	8
Grapefruit	1.1	---	2
Peach	2.0	---	2
Pear	2.4	---	2

*grams per 100 grams, edible portion (10)

TABLE 2. TOTAL DIETARY FIBER IN RAW VEGETABLES

FOOD ITEM	MEAN*	STD	n
Tomato	1.1	0.36	5
Lettuce, iceberg	1.4	0.17	4
Cucumber	0.8	0.31	9
Carrot	3.0	0.28	6
Onion, mature	1.8	0.27	4
Pepper, sweet	1.8	0.21	9
Broccoli	3.0	0.65	5
Cauliflower	2.5	0.22	5

*grams per 100 grams, edible portion (10)

Sugar Publications

Information on individual sugars was first published by HNIS in an appendix table to the Breakfast Cereals section (AH-8-8) in 1982.

In 1986, a "Provisional Table on the Sugar Content of Selected Foods" (12), the first comprehensive publication on individual and total sugars for many foods across food groups, was published. This was expanded in 1987 to "Home Economics Research Report No. 48" (13), a listing of the individual monosaccharides and disaccharides and total sugars content of approximately 500 foods, both per 100 grams and by serving size. Data on stachyose, raffinose, mannitol, and sorbitol were also presented. The total sugars data from this publication were linked to the Nutrient Data Base for Standard Reference and disseminated through our bulletin board beginning in 1989.

The Snacks and Sweets section (AH 8-19) was updated with an appendix table listing individual and total sugars in 1991.

Sugars Data

Tables 3 and 4 list individual sugar data for high-consumption fruits and vegetables. In table 3, the individual sugar patterns vary from one fruit to another. They all contain fructose, the largest component for three of the eight fruits. In the fruits reported here, total sugars ranges from 6.4 grams per 100 grams for grapefruit to almost 17 grams per 100 grams for grapes.

In table 4, the raw vegetables also show differences in sugar patterns as well as total sugar amounts. The values per 100 grams for three of the most highly consumed vegetables are 0.1 grams for spinach, 0.9 grams for broccoli, and 4.2 grams for carrots.

Both tables present values for glucose, fructose, and sucrose. This should not suggest the absence of other sugars but represents those found in the largest amounts and for which data were available.

Contract Data

USDA/HNIS contracts with laboratories to obtain carbohydrate data. The laboratories are evaluated on a regular basis as part of an on-going quality assurance program. This program includes an initial technical evaluation of each proposal. All technically acceptable offerors are sent samples to analyze. Based on the analytical performance and on the proposals, the contract is awarded. Any problem nutrients are double-checked using demonstration samples that require the laboratory to demonstrate the ability to analyze for that nutrient. Check samples are sent twice each year to monitor the accuracy of analysis. Written into each contract is also a provision for repeating the analyses that yield inconsistent or questionable data.

Table 3. SUGARS IN RAW FRUITS

FOOD ITEM	INDIVIDUAL SUGARS*				TOTAL SUGARS		
	glucose	fructose	sucrose		Mean*	STD	n
Apple w/skin	2.6	6.4	2.5		11.5	2.1	9
Grapes	7.0	7.3	1.1		16.8	1.7	6
Grapefruit	2.0	1.9	2.5		6.4	0.3	3
Peaches	2.5	1.0	5.3		8.7	1.7	6
Pears	3.3	6.7	0.9		11.4	2.3	3
Plums	3.1	2.6	2.7		8.4	1.9	3
Watermelon	1.6	3.3	3.5		8.7	1.7	3

*grams per 100 grams, edible portion (10)

Table 4. SUGARS IN RAW VEGETABLES

FOOD ITEM	INDIVIDUAL SUGARS*				TOTAL SUGARS		
	glucose	fructose	sucrose		Mean*	STD	n
Broccoli	0.4	0.4	0.1		0.9	0.4	3
Carrots	0.6	0.5	3.1		4.2	0.4	3
Spinach	0.1	tr**	tr**		0.1	0.0	3

*grams per 100 grams, edible portion (10)
**trace amounts (<0.05) detected

Table 5 lists the contracts that have collected TDF data for HNIS over the last 10 years. A wide variety of foods have been analyzed. Most of the contracts were planned to provide complete nutritional profiles of the foods. Some contracts were specifically for carbohydrate or dietary fiber analysis. Our most recent contracts focus on ethnic foods, new foods, and reduced-calorie foods.

The 1988 dietary fiber contract provided soluble dietary fiber (SDF) and insoluble dietary fiber (IDF) data in addition to TDF data. At the time, the recommended method for SDF was a two-step process conducted on separate samples of the same food: SDF was calculated as the difference between TDF determination and a direct IDF analysis.

TABLE 5. CONTRACT DATA FOR TOTAL DIETARY FIBER

YEAR	CONTRACT	NUMBER OF FOODS
1983-1985	Carbohydrate Fractions of Foods	56
1984-1987	Cereal and Cereal-based Products	115
1986-1987	Selected Foods	31
1988	Dietary Fiber Contract	303
1987-1988	Nutrients in Specialty Fruit	31
1987-1988	Collaborative Study-TDF Methods	25
1989-1992	Selected Foods	38
1991-1992	Key Foods*	115
1991,1992	TDF Purchase Orders	154
1991	New, Reduced-fat and Fat-free Foods	35
1992	Ethnic Foods	31
	TOTAL	934**

*Key foods are those foods identified by nationwide survey data as, in sum, contributing 80 percent of a particular nutrient to the U.S. diet.
**This value may represent some duplication of foods.

As discussed earlier, most of the sugars data compiled by HNIS came from the scientific literature. Data were obtained from three contracts (table 6), one of them specifically devoted to sugars analysis. This contract studied the variability of individual sugars for the same food but after different storage times.

Earlier contract data (1985 contracts) are available on individual sugars. With new labeling regulations, total sugars has been defined as the sum of monosaccharides and disaccharides; many of the earlier values for total sugars are no longer acceptable. This certainly applies to much of the total sugars values derived from the scientific literature. A 1991 report indicates that galactose is present in many fruits and vegetables (14). Assumptions on the presence or absence of certain sugars in a food need to be re-evaluated. Not all individual monosaccharides present in foods are reported (e.g., mannose and pentoses such as arabinose).

Table 6. CONTRACT DATA FOR SUGARS

YEAR	CONTRACT	NUMBER OF FOODS
1985	Determination of the Nutrient Content of Selected Candies, Nuts, Condiments, Beverages and Vegetables	66
1985	Investigation of the Carbohydrate Fraction of Foods	62
1989	Variability of Sugar Content of Foods	100
	TOTAL	228*

*This value may represent some duplication of foods.

Soluble Dietary Fiber

In an effort to establish which analytical methods were acceptable for dietary fiber compilation, HNIS sponsored an international collaborative study in 1989. Each laboratory analyzed 25 foods in duplicate using several different methods of analysis. Food samples were freeze-dried. The same samples of food and enzymes were provided to the laboratories to minimize variables. Table 7 illustrates the results for the fruits and vegetables analyzed using only the AOAC method. The TDF values were consistent from laboratory to laboratory. The range of soluble fiber values, however, was quite broad. The results clearly indicate a lack of consistency in the soluble fiber data determined using the 1988 AOAC procedure. This lack of precision, which was also evident in the 1988 AOAC interlaboratory study (15), is the main reason why SDF calculated by difference was recommended for a time. The 1988 HNIS contract, which calculated SDF by difference, however, produced soluble fiber data which was not consistent or reliable for some types of foods.

In table 7, the TDF mean is composed of values determined directly as well as those calculated by summing soluble fiber plus insoluble fiber. Because the soluble and insoluble values were determined by filtering the same sample, the insoluble values adjusted with the soluble to produce a TDF value that is quite acceptable—in line with TDF determined directly.

TABLE 7. 1989 INTERNATIONAL COLLABORATIVE STUDY - AOAC Method Results

FOOD ITEM	SOLUBLE FIBER* (Range)	TDF* (direct & s+i)	STD	CV	n
Apple, raw	0.44-0.75	2.01	0.101	5.35%	7
Carrot, raw	0.91-1.36	3.02	0.148	4.90%	7
Cabbage, raw	0.71-1.25	4.00	0.166	4.16%	6
Potato, cooked	0.44-0.67	1.69	0.112	6.64%	6

*grams per 100 grams, edible portion

Future of Carbohydrate Data

For nutrition labeling and for many data bases, dietary fiber data determined using the soluble and insoluble breakdowns by enzymatic-gravimetric methods are adequate. Foods can be compared to each other and fiber intake estimated.

An AOAC-approved method for the direct determination of soluble fiber and insoluble fiber is now available (16). The organic buffer used in this method produces more consistent soluble fiber data. TDF can be determined accurately by direct analysis or by totaling direct soluble and insoluble data. These calculated analytical values for TDF can also be aggregated with direct analytical TDF values from other approved enzymatic-gravimetric methods (17).

For sugar analysis, methods using high-performance liquid chromatography (HPLC) are proposed for compliance with U.S. food labeling regulations. HPLC is precise, accurate, practical, and widely used. It is appropriate for broad range sugars analysis and the method of choice for publishable data in the Nutrient Data Bank. The AOAC Task Force on Nutrient Labeling Analyses, Carbohydrate Subgroup, has recommended a specific HPLC method (using an amino-bonded column) for sugar analysis. Samples should be defatted prior to extraction and free from sodium chloride interference (11).

The new labeling regulations should make available from industry TDF, soluble fiber, insoluble fiber, and total sugars data. In the future, HNIS will be planning new contracts for the determination of SDF, IDF, TDF (by calculation), and individual monosaccharides and disaccharides in high-consumption foods. Other contracts will continue to generate TDF data. The upcoming redesign of the National Nutrient Data Bank will facilitate incorporation of new carbohydrate fractions into the Standard Reference data base.

Much research is still needed on the chemical components of total dietary fiber. For example, pectin and hemicellulose are found in both the soluble and insoluble fractions of many foods (18). Reliable methods are needed for analysis of other carbohydrate fractions such as starch, sugar alcohols, oligosaccharides, and resistant starch. For all analyses, quality assurance programs in laboratories and the use of standard reference materials will help to assure consistency and accuracy of data.

As approved methods become available for the different carbohydrate fractions (especially starch), total carbohydrate will be determined by summing the individual fractions, instead of being calculated by difference.

References

1. Department of Agriculture. 1976-1992. Composition of Foods: Raw, Processed, Prepared. Agric. Handb. No. 8: AH-8-1, Dairy and Egg Products, 1976; AH-8-2, Spices and Herbs, 1977; AH-8-3, Baby Foods, 1978; AH-8-4, Fats and Oils, 1979; AH-8-5, Poultry Products, 1979; AH-8-6, Soups, Sauces, and Gravies, 1980; AH-8-7, Sausages and Luncheon Meats, 1980; AH-8-8, Breakfast Cereals, 1982; AH-8-9, Fruits and Fruit Juices, 1982; AH-8-10, Pork Products, 1992; AH-8-11, Vegetables and Vegetable Products, 1984; AH-8-12, Nut and Seed Products, 1990; AH-8-13, Beef Products, 1990; AH-8-14, Beverages, 1986; AH-8-15, Finfish and Shellfish Products, 1987; AH-8-16, Legumes and Legume Products, 1986; AH-8-17, Lamb, Veal, and Game Products, 1989; AH-8-18, Baked Products, 1992; AH-8-19, Snacks and Sweets, 1991; AH-8-20, Cereal Grains and Pasta, 1989; AH-8-21, Fast Foods, 1988; 1989 Supplement, 1990; 1990 Supplement, 1991; 1991 Supplement, 1992.

2. Department of Agriculture, Human Nutrition Information Service. 1986. USDA Nutrient Data Base for Food Consumption Surveys, Release 2.1. Springfield, VA; National Technical Information Service. Accession No. PB87-181020. Computer Tape.

3. Department of Agriculture, Human Nutrition Information Service. 1988. Continuing Survey of Food Intakes by Individuals (CSFII), 1985. Springfield, VA; National Technical Information Service. Accession No. PB88-201249. Computer Tape.

4. Department of Agriculture, Human Nutrition Information Service. 1986. USDA Nutrient Data Base for Food Consumption Surveys, Release 6. Springfield, VA; National Technical Information Service. Accession No. PB94-500527GEI. Computer Tape.

5. Approved Methods of the AACC. Annual Supplement. 1983. St.Paul: American Association of Cereal Chemists.

6. Dudek, J.A., et al. 1985. Investigation of Total Dietary Fiber Methodology in the Characterization of the Carbohydrate Fraction of Canned Pears. J. Food Sci. 50:851-852.

7. Department of Agriculture. Human Nutrition Information Service. 1988. Provisional Table on the Total Dietary Fiber Content of Selected Foods. Hyattsville, MD.

8. Prosky, L., et al. 1985. Determination of Total Dietary Fiber in Foods, and Food Products: Collaborative Study. J. Assoc. Off. Anal. Chem. 68:677-679.

9. AOAC Method 985.29, Total Dietary Fiber in Foods: Enzymatic-Gravimetric Method. Official Methods of Analysis, 15th ed., AOAC, International, Arlington, VA, 1992.

10. Department of Agriculture, Human Nutrition Information Service. 1993. USDA Nutrient Data Base for Standard Reference, Rel.#10. Springfield, VA; National Technical Information Service. Accession No. PB93-502771. Computer Diskette.

11. Report of the Task Force on Nutrient Labeling Analyses, Subgroup on Carbohydrates: AOAC Methods and Determination of Sugars. 1993. The Referee. 17:7-13.

12. Department of Agriculture. Human Nutrition Information Service. 1986. Provisional Table on the Sugar Content of Selected Foods. Hyattsville, MD 20782.

13. Department of Agriculture. Human Nutrition Information Service. 1987. Home Economics Research Report No. 48, Sugar Content of Selected Foods: Individual and Total Sugars. Hyattsville, MD 20782.

14. Gross, K.C., and Acosta, P.B. 1991. Fruits and Vegetables are a Source of Galactose: Implications in Planning the Diets of Patients with Galacosaemia. J. Inher. Metab. Dis. 14:253-258.

15. Prosky. L., et al. 1988. Determination of Insoluble, Soluble, and Total Dietary Fiber in Foods and Food Products: Interlaboratory Study. J. Assoc. Off. Anal. Chem. 71:1017-1023.

16. AOAC Method 991.3, Total, Soluble, and Insoluble Dietary Fiber in Foods: Enzymatic-Gravimetric Method, MES-TRIS Buffer. Official Methods of Analysis, 15th ed., 3rd suppl. Arlington, VA, 1992.

17. Lee, S.C., et al. 1992. Determination of Total, Soluble, and Insoluble Dietary Fiber in Foods—Enzymatic-Gravimetric Method, MES-TRIS Buffer: Collaborative Study. J. Assoc. Off. Anal. Chem. 75:395-416.

18. Marlett, J.A. 1992. Content and composition of dietary fiber in 117 frequently consumed foods. J. Am. Dietet. Assoc. 92:175-186.

Carbohydrate-Based Food Ingredients: Use, Energy Value, And Analysis

John S. White, Research & Development Division, A.E. Staley Manufacturing Company, Decatur IL

Carbohydrate ingredients are ubiquitous in our food supply. They exert profound physical and functional effects on the foods in which they are used because of vast ranges in their size and structure. With recent recommendations from the National Academy of Sciences and others that Americans reduce fat and increase complex carbohydrates in their diets, carbohydrate ingredients have found new uses as fat replacers and bulking agents. Carbohydrate fat replacers and bulking agents exhibit wide differences in digestibility, absorption, metabolism and fermentation. This paper explored some of the unique challenges carbohydrate food ingredients pose to those who would measure their energy

Nutrition Monitoring in the States: Experiences, Benefits, and Outcomes

Daily Fruit and Vegetable Consumption Among Vermonters
Alison Gardner, TA Foster , LJ Paulozzi, RF Spengler, CA Finley, *Vermont Department of Health*

Knowledge, Attitudes and Beliefs about Diet and Cancer in Appalachian Ohio
Barbara Pryor, Mary E. Plummer, Ellen M. Capwell, *Ohio Department of Public Health*

Developing a State Nutrition Surveillance Monitoring Program: Problems and Possibilities
Tom Melnik, *New York State Health Department*

Methodological Issues in Analyzing School Menus
Pat McKinney, *FNS, USDA*

Daily Fruit And Vegetable Consumption Among Vermonters

Foster TA, Paulozzi LJ, Spengler RF, Gardner A, Finley, CA Vermont Department of Health Burlington VT

A telephone survey of cancer-related behaviors in the adult Vermont population was conducted in February and March 199O. Survey methodology was very similar to that used by the Behavioral Risk Factor Prevalence Surveys. The sample size was 1,314; the response rate was 57 percent. The questionnaire included ten questions that asked "how often" respondents ate fruit and vegetables. Information on food consumption was collected to assist in the development of a statewide campaign to increase the proportion of Vermonters consuming five or more servings of fruit or vegetables a day (the 5-a-day camp) . Only 2.6 percent of respondents reported eating five or more servings of fruit or vegetables per day; 20.6 percent reported eating three or more. Twenty-nine percent of women and 11.2 percent of men ate three or more. Consumption of three or more servings was highest among people in the 30-39 age group (25.9%) and lowest among people 60 or more years old (15.1%). Consumption increased in a continuous fashion with increasing education level. These results indicate lower consumption of fruits and vegetables than found nationwide in NHANESII, especially among men and older people, and dramatically lower consumption in all categories when compared to the 1989 California Dietary Practices Survey. The telephone survey was repeated during March of this year, preliminary results were discussed.

Knowledge, Attitudes And Beliefs About Diet And Cancer In Appalachian Ohio

Results of a 1990 Point-in-Time Survey Conducted by

The Ohio Department of Health, Bureau of Chronic Diseases, Columbus, Ohio

Barbara A. Pryor, RD, LD; Mary E. Plummer, MS; Ellen M. Capwell, PhD, CHES

Introduction

Effective application of nutrition interventions aimed at reducing the risk of cancer is dependent on understanding the characteristics of specific population subgroups to be targeted. One group, residents of 14 rural Appalachian counties in southeastern Ohio, were the focus of a nutrition survey conducted by the Ohio Department of Health (ODH) during 1990. The telephone survey was designed to identify the knowledge, beliefs, and behaviors of this sample concerning the relationship between nutrition and cancer. By focusing on this culturally unique group, baseline information about their knowledge, beliefs and behaviors related to nutrition was assessed and used to develop and guide appropriate diet and cancer intervention strategies for this population.

Survey Instrument

The survey instrument was developed using original and modified questions from existing national surveys. Sources used included: 1989-90 Knowledge, Attitudes and Behavior Survey-Cancer, National Cancer Institute (NCI); 1989 Diet and Health Knowledge Questionnaire, U.S. Department of Agriculture (USDA); 1987 National Health Interview Survey-Cancer Supplement, National Center for Health Statistics (NCHS); and the 1990 Behavioral Risk Factor Surveillance System (BRFSS) Fat Module and Fruit and Vegetable Module, Centers for Disease Control (CDC). Additional questions were developed which focused on topics of particular relevance to the cancer dietary guidelines, as well as culturally specific eating patterns, health beliefs and behaviors of the target population. Content validation of the draft survey was accomplished through review by health professionals from the ODH, NCI, and CDC. Modifications resulted in a questionnaire consisting of 114 questions covering the following content areas: 32 food consumption, 7 eating patterns, 29 beliefs concerning food/health relationships, 18 food purchasing, 17 changing behavior, and 11 demographic questions

The foods chosen as high in fat were identified from NHANES II data[1] as the top ten contributors of fat in the American diet. The fruit and vegetable questions (excluding juice) were expanded from the CDC/BRFSS module to focus on those fruits and vegetables emphasized by the 1984 Dietary Guidelines of the American Cancer Society as high in vitamins A or C, or classified as cruciferous. Questions were added to determine consumption frequencies of foods currently promoted as high in fiber, such as legumes and high fiber/bran cereals[2].

The 32 food consumption questions assessed responder-reported frequency of intake of selected foods, not portion size. Therefore, no analysis of total dietary adequacy or caloric intake was possible. It also should be noted that food consumption data reported from this survey do not provide a complete record of daily fat intake because not all sources of dietary fat were included. The fruit, vegetable and fiber questions were designed to determine frequency of consumption, not grams of fiber, and to assess reported eating patterns of respondents in relation to current dietary recommendations for chronic disease prevention[3].

A pilot test of the complete instrument was conducted with approximately 30 respondents. Calls were monitored and interviewers were questioned following the calls to determine clarity of the questions and smooth flow of the survey. Minor modifications were made in wording and format based on the pilot.

Methods

The telephone survey was conducted to determine food consumption patterns for persons living in fourteen southeastern Ohio counties, which are considered to be part of Appalachia (Appendix A). Phone prefixes were identified for rural Appalachian counties having cities with less than 13,120 persons. Phone numbers were generated using CDC random number generation software. Respondents were eighteen years of age and older and members of the residence called. Interviewers used final call dispositions and rules of replacement according to the protocol setup by CDC to conduct the BRFSS. The survey was conducted during weekdays, evenings, and on weekends between March and July of 1990. Of 6095 calls made, 601 (10%) households were reached, and 465 (77%) interviews were completed from those households.

Data Entry And Analysis

Survey data were entered from information recorded on response sheets using Epi Info, Version 5[4]. Basic frequencies and percents were obtained on all questions, providing a first review of the data. SAS[5] was used for further analysis.

Daily fat intake was calculated with an algorithm derived from one used for the 1987 National Health Interview Survey (Appendix B). Grams of fat were calculated based on a standard portion size, the consumption frequency of each fat food item, and then summed. Fiber intake was categorized based on the respondent's reported consumption frequency of wheat bread, cereals, beans, fruit (excluding juice), garden vegetables, lettuce salads, and baked or boiled potatoes. Reported consumption frequency of fruits (excluding juice), garden vegetables, lettuce salads, beans, and baked/boiled potatoes was used to assess fruit and vegetable intake. If responses to any food intake question were unknown or refused, this person was excluded from the analysis for that specific item. Persons with reported daily fat intake of less than one gram or over two hundred grams were excluded from the analysis of fat intake. A response of unknown or refused to a demographic question excluded that person from the specific analysis involving that demographic variable. Two tailed t-tests and analysis of variance (ANOVA) were calculated for mean daily fat intake and demographic variables. Tukey's HSD was calculated to compare groups in the ANOVA analysis.

Mean and median daily consumption levels were calculated for fiber and fruit and vegetable intake. To determine the percentage of persons consuming less than one, one to two, three, four, or five or more servings of fruits and vegetables a day, standard rounding procedures were used. Weekly median consumption for selected high fiber foods, fruits, and vegetables were calculated. Chi-squares were calculated for fiber intake and demographics based on three levels of fiber intake: low, medium and high. The three levels were determined based on the reported daily intake of fiber foods, where high represents the highest quartile of intake, medium the second and third quartile, and low the lowest quartile of fiber consumption. Chi-squares for fruit and vegetable consumption and demographic variables were calculated for two groups; those reporting consumption of three or more fruits and vegetables a day, and those reporting consuming less than three. A p value of 0.05 or less was considered significantly different for all of the analyses.

Body Mass Index (BMI) was determined with the following formula: BMI=(weight in kg/height in meter^2). A BMI $\geq$120% of ideal body weight ($\geq$=27.3 for females and $\geq$=27.8 for males, based on the 1959 Metropolitan Life tables) was assessed as High.

Results

Demographic Profile of Respondents

Of the 465 respondents, 183 (39.4%) were male and 282 (60.6%) were female. The majority of the sample (456, 98.5%) was white; only seven (1.5%) of the respondents reported non-white race. One hundred and forty (35.1%) had an annual household income below $15,000, 123 (30.8%) had income between $15,000 and $25,000, and 136 (34.1%) had income above $25,000. The majority of the respondents (331, 71.5%) were employed (employed for wages, self-employed, or homemaker). The remaining respondents identified themselves as either retired (101, 21.8%), or unemployed (31, 6.7%). Most of the respondents, 292 (62.9%) reported that they were living in a couple arrangement (either married or living as an unmarried couple); and 172 (37.1%) were single (either divorced, widowed, separated, or never married). The age distribution of the respondents was as follows: 56 (12.1%) were 18 to 24 years, 103 (22.2%) were 25 to 34 years, 84 (18.1%) were 35 to 44 years, 56 (12.1%) were 45 to 54 years, 57 (12.3%) were 55 to 64 years, and 107 (23.1%) were 65 years and older. One hundred and ten (24.0%) had less than a high school education, 236 (51.4%) were high school graduates, and 113 (24.6%) had more than a high school education. One hundred and ten (23.7%) of the respondents had a high BMI.

Compared to the 1990 Census[6] for this geographical area, the proportion of respondents by gender shows that females were oversampled (60.6% for the survey, 52.4% for the Census). The racial composition of the survey was in close agreement with the Census (98.5% white for the survey, 98.3% from the Census) The age of the sample was somewhat older than the Census, with the largest discrepancy occurring in the over 65 group (23.1% for the survey, 19.1% for the Census). Marital status compares favorably with the Census with 62.9% of the sample living in a couple arrangement, compared to the Census figure of 61.5% of persons reporting their status as married. The educational breakdown for the sample as compared to the Census shows a large undersampling of the less than high school education group (24.0% for the sample, 34.3% for the Census), and a large over-sampling for the high school graduate group, (51.4% in the sample, 42.8% for the Census). (Table 1)

Food Consumption Patterns

Fat Intake

The mean daily fat intake as measured by the 14 fat food questions was 48.6 grams (n=403 sd=27.8). The median was 44.4 grams. Mean daily fat intake had a direct relationship to yearly income, with those in the lowest income group (less than $15,000) also reporting the lowest fat intake (42.4 grams). Those respondents in the lowest income group had mean daily fat intake which was significantly less than those in the higher income groups (54.3 grams for $15,000 to $25,000, compared to 55.3 grams from household income greater that $25,000). Persons living as a couple had significantly higher mean daily fat intake (51.4 grams) than singles (44.2 grams). Males had significantly higher mean daily fat intake than females (58.7 grams versus 42.1 grams). Retirees had significantly lower daily fat intake (35.9 grams) than those who were employed (52.2 grams), or unemployed (52.2 grams). There was an inverse relationship between age and daily fat intake, with persons 18 to 24 having the highest intake (63.6 grams), compared to those over 65 (33.5 grams). Respondents 65 years and older also had significantly lower daily fat intake than those under 55 years of age; and respondents 54 years and under had significantly lower daily fat intake than those under 35 years of age. No significant differences in mean fat intake were found for education level or BMI. These results are displayed in Table 2.

Median weekly frequency of consuming high fat foods is displayed in Table 3. As a group, respondents consumed a high fat meat 6.00 times a week, with ground beef having the highest median frequency of consumption (1.92 times a week) and hot dogs/lunchmeat, bacon/sausage, and pork each having the lowest median weekly frequency of consumption (0.46). Excluding meat, the high fat food with the largest median weekly consumption was butter/margarine at 7.00, followed by whole milk with 5.00 as a median. Cheese and sweets each had a median weekly consumption of 2.00. Both french fries/fried potatoes and snack foods had medians of 1.00 time a week.

Fruit and Vegetable Intake

The mean daily frequency of fruit and vegetable consumption was 2.58 (n=458, SD=1.25), the median was 2.43. For fruit only, the mean was 0.68 (SD=0.69), median 0.71. For vegetables only, the mean was 1.90 (SD=0.90), median 1.71. Only 31 (6.8%) reported eating five or more fruits and vegetables daily, 53 (11.6%) ate four a day, 128 (27.9%) ate three a day, 241 (52.6%) ate one or two a day, and five (1.1%) ate less than one a day. (Table 4). The median weekly consumption frequency for fruits and vegetables is presented in Table 5. The median weekly frequency of fruit and vegetable consumption for the sample was 17.00. To meet the five-a-day goal, a weekly consumption frequency of 35 servings is required. Garden vegetables represented the largest consumption category at 7.00 (median) per week, with lettuce and baked/boiled potatoes each contributing a weekly median of 2.00, and beans the lowest with 0.69 (median) weekly consumption. Vegetables and fruits which are a significant source of vitamin A (carrots, sweet potatoes, cantaloupe, spinach, winter squash, oranges, and peaches) had a median weekly intake of 2.00. Vegetables which are considered cruciferous had median weekly consumption of 1.00 for brussels sprouts, cauliflower, and cabbage and 1.00 for broccoli and greens.

TABLE 1
Demographic Profile of Rural Respondents
Pit Nutrition Survey
(n = 465)*

Group	Number	Percent	1990 Census
Sex			
Male	183	39.4	47.6
Female	282	60.6	52.4
Race			
White	456	98.5	98.3
Non-White	7	1.5	1.7
Income			
< $15,000	140	35.1	
$15 to $25,000	123	30.8	
> $25,000	136	34.1	
Employment			
Employed	331	71.5	
Unemployed	31	6.7	
Retired	101	21.8	
Marital Status			
Couple	292	62.9	61.5**
Single	172	37.1	38.5
Age (Years)			
18 - 24	56	12.1	12.8
25 - 34	103	22.2	20.8
35 - 44	84	18.1	19.5
45 - 54	56	12.1	14.9
55 - 64	57	12.3	13.0
65+	107	23.1	19.1
Education			
< High School	110	24.0	34.3
H.S. Graduate	236	51.4	42.8
> H.S. Graduate	113	24.6	23.0
Body Mass Index			
High	110	23.7	
Not High	355	76.3	

* Note: Some persons refused to respond to all of the questions.
** For persons 15 years and older.

TABLE 2 Mean Daily Fat Intake (Grams) by Demographics*					
Group	N	Mean Fat (Grams)	(95% CI)	T or F Value	P
*Income***					
< $15,000	114	42.2	(38.3,46.6)		
$15 to 25,000	113	54.3	(49.0,59.7)	8.22	<0.01
> $25,000	120	55.3	(50.3,60.3)		
*Marital Status***					
Couple	251	51.4	(47.9,54.9)	2.56	0.01
Single	152	44.2	(39.9,48.4)		
*Sex***					
Male	160	58.7	(53.9,63.5)	5.77	<0.01
Female	243	42.1	(39.2,45.0)		
*Employment***					
Employed	290	52.2	(49.0,55.4)		
Unemployed	26	52.2	(41.2,63.3)	12.42	<0.01
Retired	87	35.9	(31.2,40.6)		
Education					
< High School	91	46.6	(40.2,53.0)		
H.S. Graduate	211	49.3	(45.6,53.0)	0.39	0.68
>H.S. Graduate	97	49.8	(44.7,54.8)		
*Age***					
18 - 24	49	63.6	(55.3,71.8)		
25 - 34	89	56.3	(51.0,61.5)		
35 - 44	71	52.9	(47.4,58.3)	11.68	<0.01
45 - 54	49	48.4	(40.5,56.3)		
55 - 64	52	43.0	(33.5,52.5)		
65+	91	33.5	(29.5,37.4)		
Body Mass Index					
High	99	48.9	(43.7,54.0)	0.08	0.94
Not High	304	48.6	(45.4,51.8)		

* T-test for 2 level varibles ANOVA for ≥ level variables.
** Significantly different at $p \leq 0.05$.

Significant differences in the number of servings of fruit and vegetables a day were found only for education and age. Persons with education beyond high school were significantly more likely to report consuming three or more fruits or vegetables a day (58.9%) than were persons with a high school diploma (45.1%), or persons with less than a high school education (35.9%) (x^2=11.97, df=2, p<0.01). As age increased, the proportion of persons who reported eating three or more fruits and vegetables increased significantly (18-24 years 30.4%, 25-34 years 40.8%, 35 to 44 years 42.2%, 45 to 54 years 56.4%, 55-64 years

48.2%, and 65 years and over 58.3%). Fruit and vegetable consumption information is presented in Table 6.

TABLE 3

Median Weekly Frequency of Consuming High Fat Foods

Food	Median
High Fat Meat Total	6.00
Hot dogs/Lunchmeat	0.46
Bacon/Sausage	0.46
Ground Beef	1.92
Beef Steaks/Roasts	0.69
Pork (Chops, Roasts, etc.)	0.46
Fried Chicken or Fish	1.00
French Fries/Fried Potatoes	1.00
Cheese	2.00
Sweets (doughnuts, cake, pastry, pies or chocolate candy)	2.00
Snack Foods (chips, cheese puffs)	1.00
Ice Cream	0.46
Bacon Grease/Fatback/Lard	0.00
Butter/Margarine	7.00
Salad Dressing/Mayonnaise	1.00
Milk	5.00

Fiber Intake

The mean daily frequency for consumption of foods high in fiber was 3.50 (n=451, SD=1.67). The three levels of daily fiber intake used for the demographic analysis, determined by the reported daily frequency of consuming high fiber foods, were: (1) $\geq$4.29 for the highest quartile; (2) between 4.29 and 2.35 for the middle two quartiles; and (3) $\leq$2.35 for the low quartile fiber intake group. The percent of persons classified as consuming foods high in fiber increased significantly with increasing age. The proportion of persons classified as consuming high fiber was lowest for those 18 to 24 years (16.4%), and highest for persons 65 years and older (40.6%). Level of education was also a significant factor in fiber consumption. A greater proportion of respondents with higher level of education were classified as consuming a high fiber diet (33.0%). Respondents with less than a high school diploma represented the smallest proportion of persons in the high fiber category (16.2%). No significant differences in mean daily fiber consumption were found for any other demographic variables. This information is presented in Table 7.

The median weekly frequency of consuming food high in fiber is reported in Table 8. Overall, respondents reported eating foods high in fiber 22.31 times a week. Garden vegetables had the highest median weekly consumption (7.00), and fruits were the next highest with a median weekly consumption of 5.00. The reported median weekly consumption of dark breads was 2.00, and high fiber cereal was 1.16 times a week. Bean consumption was infrequently reported with a median of 0.69, equivalent to less than one time a week.

TABLE 4

Daily Intake of Fruits and Vegetables*

Frequency of Consumption	Number	Percent
< 1	5	1.1
1 - 2	241	52.6
3	128	27.9
4	53	11.6
5 or more	31	6.8
Total	458	100

* Does not include juice; standard rounding procedures used.

BELIEFS, ATTITUDES, AND BEHAVIORS ABOUT DIET AND DISEASE

Diet and Disease Relationships

Most respondents (66.5%) reported their belief that disease was related to the foods people eat and drink. Only 18.3% said foods were not related, and 15.3% did not know.(Table 9) The respondents who thought diseases may be related to food consumption were then questioned about the specific diseases they thought may be related. Of that group, 53.4% mentioned heart disease; 40.8% mentioned cancer, 20.1% mentioned hypertension, 13.9% mentioned diabetes, and 11.7% mentioned obesity (Figure A).

Respondents were also asked if they thought certain types of cancer may be related to what people eat and drink. Most respondents (54.0%) said yes, 23.0% said no, and 23.0%

did not know.(Table 9) Those who responded yes were then asked which cancers were diet-related and responded as follows: all kinds - 16.3%, colon/rectal - 43.4%, stomach - 16.3%, liver - 5.6%, and don't know - 31.5% (Figure B). Despite significant public education campaigns on the relationship between diet and cancer, 46.0% of the sample did not believe that food consumption was related to cancer. Of the respondents that did believe a link existed between diet and cancer, close to one-third did not know what types of cancer are related to diet.

TABLE 5

Median Weekly Frequency of Consuming Fruits and Vegetables

Food	Median
Total Vegetables	12.00
Lettuce	2.00
Baked/Boiled Potatoes	2.00
Garden Vegetables	7.00
Beans (Baked, Lima, Kidney, etc.)	0.69
Fruit	5.00
Total Fruit and Vegetables	17.00*
Significant Sources of Vitamin A	
Carrots, Sweet Potatoes, Cantaloupe, Spinach, Winter Squash, Oranges or Peaches	2.00
Cruciferous	
Brussels Sprouts, Cauliflower, Cabbage	1.00
Broccoli, Greens (Mustard, Collard, Kale, Beet or Chard)	1.00

* Does not include juice.

When asked if certain types of cancer may be prevented by eating or drinking more or less of certain foods, 45.2% of the respondents said yes. However, almost one-third of the respondents (no - 30.5%) did not believe that consumption of certain foods might prevent cancer, and almost one-quarter (24.3%) did not know. Respondents who agreed that consumption of certain foods might prevent cancer were asked to identify foods which should be eaten more or less often. Foods chosen as those to be eaten more often were: high fiber foods 48.1%, vegetables 45.7%, fruit 38.6%, water 8.6%, and don't know 12.9% (Figure C). Foods mentioned as those to be eaten less often were: fats 71.4%, processed meats 19.5%, alcohol 10.5%, caffeine 6.7%, and don't know 14.8% (Figure D).

TABLE 6

Chi-square for Daily Fruit and Vegetable Intake by Demographics for Rural Respondents*

Group	Eats 3 or More n	(%)	Eats Less Than 3 n	(%)	x^2	df	p
Income							
< $15,000	56	(40.9)	81	(59.1)			
$15 to 25,000	59	(49.2)	61	(50.8)	1.96	2	0.37
> $25,000	64	(47.1)	72	(52.9)			
Marital Status							
Couple	142	(49.5)	145	(50.5)	2.96	1	0.09
Single	70	(41.2)	100	(58.8)			
Sex							
Male	86	(48.3)	92	(51.7)	0.48	1	0.49
Female	126	(45.0)	154	(55.0)			
Employment							
Employed	145	(44.2)	183	(55.8)			
Unemployed	14	(45.2)	17	(54.8)	2.68	2	0.26
Retired	52	(53.6)	45	(46.4)			
*Education***							
<High School	38	(35.9)	68	(64.2)			
H.S. Graduate	106	(45.1)	129	(54.9)	11.97	2	<0.01
> H.S. Graduate	66	(58.9)	46	(41.1)			
*Age***							
18-24	17	(30.4)	39	(69.6)			
25-34	42	(40.8)	61	(59.2)			
35-44	35	(42.2)	48	(57.8)	15.78	5	<0.01
45-54	31	(56.4)	24	(43.6)			
55-64	27	(48.2)	29	(51.8)			
65+	60	(58.3)	43	(41.8)			
Body Mass Index							
High	50	(45.5)	60	(54.6)	0.04	1	0.84
Not High	162	(46.6)	186	(53.4)			

* Fruit and vegetables include garden vegetables, lettuce, baked and boiled potatoes, beans, and whole fruit; does not include juice.

** Significantly different $p \leq 0.05$.

Note: Standard round procedures used for frequency of consumption.

TABLE 7

Chi-square for High, Medium and Low Fiber Intake by Demographics for Rural Respondents*

Group	High Fiber n	High Fiber (%)	Medium Fiber n	Medium Fiber (%)	Low Fiber n	Low Fiber (%)	x^2	df	p
Income									
< $15,000	31	(23.0)	67	(49.6)	37	(27.4)			
$15 to 25,000	36	(30.3)	55	(46.2)	28	(23.5)	2.86	4	0.58
> $25,000	32	(24.1)	71	(53.4)	30	(22.6)			
Marital Status									
Couple	77	(27.4)	139	(49.5)	65	(23.1)	1.03	2	0.60
Single	42	(24.9)	81	(47.9)	46	(27.2)			
Sex									
Male	47	(26.7)	82	(46.6)	47	(26.7)	0.87	2	0.65
Female	72	(26.2)	139	(50.6)	64	(23.3)			
Employment									
Employed	78	(24.2)	161	(50.0)	83	(25.8)			
Unemployed	11	(35.5)	9	(29.0)	11	(35.5)	9.13	4	0.06
Retired	29	(30.2)	51	(53.1)	16	(16.7)			
*Education***									
< High School	17	(16.2)	55	(52.4)	33	(31.4)			
H.S. Graduate	65	(28.0)	107	(46.1)	60	(25.9)	12.66	4	0.01
> H.S. Graduate	36	(33.0)	56	(51.4)	17	(15.6)			
*Age***									
18 - 24	9	(16.4)	25	(45.5)	21	(38.2)			
25 - 34	22	(21.8)	43	(42.6)	36	(35.6)			
35 - 44	18	(22.0)	47	(57.3)	17	(20.7)	33.30	10	<0.01
45 - 54	14	(25.5)	26	(47.3)	15	(27.3)			
55 - 64	15	(27.3)	32	(58.2)	8	(14.6)			
65+	41	(40.6)	48	(47.5)	12	(11.9)			
Body Mass Index									
High	27	(24.6)	49	(44.6)	34	(30.9)	3.12	2	0.21
Not High	92	(27.0)	172	(50.4)	77	(22.6)			

* Fiber includes cereal, beans, wheat bread, garden vegetables, boiled and baked potatoes, fruit and lettuce.

** Significantly different $p \leq 0.05$.

TABLE 8 Median Weekly Frequency of Consuming Foods High in Fiber	
Food	Median
Beans	0.69
(Baked, Pinto, Lima, Kidney, etc.)	
Cereal	1.16
(Bran, High Fiber)	
Breads	2.00
(Wheat, Rye, Oat, Dark Only)	
Garden Vegetables	7.00
Baked/Boiled Potatoes	2.00
Lettuce	2.00
Fruit	5.00
High Fiber Foods	22.31

Overall, these responses reflect the lack of knowledge regarding diet and cancer. Even persons who reported that they knew a relationship existed between diet and cancer named inappropriate foods such as water or caffeine (8.6% and 6.7% respectively), and the most commonly mentioned correct items such as fruits, vegetables and avoidance of high fat foods, were mentioned by less than half of the respondents.

Factors which influence food purchases were assessed by asking those respondents who did most of the grocery shopping for the household to identify concerns which were important to them when shopping for food. Of all the choices available, quality, taste, appearance, and product safety were rated as most important when shopping for food. How well food keeps, its nutritional/health benefits, availability, price, and medical advice were rated less important. Of least importance when shopping for food were factors including: "Food I always buy," "ease of preparation," "brand name," and "advertising." (Table 10)

Attitudes Toward Dietary Change

Insufficient or incorrect knowledge about diet and cancer relationships can be addressed fairly directly through additional educational efforts. However, attitudes about diet and the need to make changes present a more difficult challenge. To assess these issues, a group of statements were read to respondents with instructions to choose the ones which they believed were true. The majority of respondents (53.3%) reported that they enjoyed the things they ate and did not want to change. Close to one-third (29.1%) agreed that, "Everything I eat is bad, so why bother changing." Over half (58.1%) were confused about which diet recommendations to follow, and nearly half (43.0%) stated that the things they ate were healthy and there were no reasons to change. Despite these largely negative feelings about dietary change, most respondents did not think that, "making changes would be hard" (11.2%), or "expensive" (29.9%). Only a relatively small number of respondents (13.1%) believed that the rest of their family would be opposed to change. (Table 11) When asked to list factors which would motivate them to make dietary changes, respondents reported that they would be most likely to make dietary changes to treat a specific health problem (38.8%), to lose weight (24.6%), or to look or feel better (20.9%). Only 0.4% of respondents would make dietary changes to prevent cancer. (Figure E).

TABLE 9

Beliefs About Diet and Disease Relationships

	Yes		No		Don't Know	
	n	(%)	n	(%)	n	(%)
Do you think any diseases may be related to what people eat and drink?	309	(66.5)	85	(18.3)	71	(15.3)
Do you think certain types of cancer may be related to what people eat or drink?	251	(54.0)	107	(23.0)	107	(23.0)
Do you think certain types of cancer may be prevented by eating or drinking more or less of certain foods?	210	(45.2)	142	(30.5)	113	(24.3)

A chi-square analysis was conducted to determine if having cancer or having a household member with cancer had a significant relationship with the belief that cancer may be related to what we eat or drink. Close to forty percent (39.2%) of the respondents had cancer or a household member with cancer. For those who reported a household member with cancer, 42.1% believed that cancer may be related to what we eat and drink, compared to 47.1% of those who did not have a household member with cancer who thought a relationship existed. The analysis showed no significant difference ($x^2 = 1.36$ df=2, p=0.57). (Table 12)

Resources to Promote Dietary Change

Respondents were also asked what types of assistance would help if they wanted to change their eating habits. A list of choices was provided, and the following responses were named most frequently: physician recommendations (77.5%), recommendations by other health professionals (62.4%), self help information (54.6%), printed information (48.2%), flyers with nutritional information (42.4%), one to one counseling (41.3%), nutrition classes (41.3%), and supermarket shelf labeling (41.3%) (Figure F). When asked to list where they would get information about changing their eating habits, the following resources were the most commonly mentioned: physician or health professional (62.6%), television (15.1%), local health department (10.3%), and magazines (9.7%). More than ten percent (12.3%) did not know where they would go for help (Figure G).

TABLE 10 Opinions of Main Household Grocery Shoppers Regarding Food Purchases (n = 308)						
	Importance					
	Very		Somewhat		Not	
	n	(%)	n	(%)	n	(%)
Quality	279	(90.6)	23	(7.5)	6	(1.9)
Taste	272	(88.3)	32	(10.4)	4	(1.3)
Appearance	252	(81.8)	46	(14.9)	10	(3.2)
Product safety	251	(81.5)	38	(12.3)	19	(6.2)
How well food keeps	238	(77.3)	54	(17.5)	16	(5.2)
Nutrition/health benefits	232	(75.3)	65	(21.1)	11	(3.6)
Availability	219	(71.1)	71	(23.1)	18	(5.8)
Price	215	(69.8)	68	(22.1)	25	(8.1)
Medical advise	194	(63.0)	73	(23.7)	41	(13.3)
Food you always buy	180	(58.4)	98	(31.8)	30	(9.7)
Ease of preparation	146	(47.4)	110	(35.7)	52	(16.9)
Brand name	96	(31.2)	123	(39.9)	89	(28.9)

Conclusions And Discussion

Although the amount of dietary fat reported in this survey is a low estimate, assuming that no systematic bias exists for the demographic subgroups, differences between the subgroups should help health professionals target intervention strategies. Results of this survey are similar to sex and age differences for fat intake as reported in NHANES II data[7]. Mean fat intake was higher for males than females, and total mean fat intake decreased with age. This is accounted for, in part, by the fact that males consume more food than females, and that total food intake usually decreases with age. No association was found between high BMI and high fat intake.

Despite the current emphasis on increasing consumption of fruits, vegetables and high fiber foods, survey respondents fell far short of meeting current dietary recommendations. For example, only 6.2% met the goal for five servings of fruits and vegetables a day. A strong association existed between increased fruit and vegetable intake and education level, with those in the highest education group consuming more fruits and vegetables. Data from national surveys also support the fact that increased consumption is associated with higher income[2]. We have not seen data that suggest otherwise for the Appalachian population. On a more positive note, 43.4% of respondents consumed three to four servings of fruit and vegetables a day. Educational strategies focused on making small improvements in existing habits would move this segment of the population considerably closer to meeting this important dietary goal.

TABLE 11

Personal Beliefs Regarding Diet

	Yes		No		Don't know	
	n	(%)	n	(%)	n	(%)
Everything I eat is bad for me so why bother changing.	135	(29.1)	303	(65.3)	26	(5.6)
I enjoy the things I eat and don't want to change.	248	(53.3)	195	(41.9)	22	(4.7)
I am confused about which diet recommendations to follow.	270	(58.1)	172	(37.0)	23	(4.9)
I eat out so much making changes would be hard.	52	(11.2)	406	(87.3)	7	(1.5)
Making changes in the food I eat would be expensive.	139	(29.9)	306	(65.8)	20	(4.3)
I would like to change my diet but the rest of my family won't change	61	(13.1)	386	(83.0)	17	(3.7)
The things I eat are healthy so there is no reason for me to make changes.	200	(43.0)	236	(50.8)	29	(6.2)

Fiber intake, as assessed in this survey, fell short of meeting current recommendations for a daily intake between 20 to 30 grams. While the survey could not estimate actual grams of fiber consumed, frequency of daily servings of high fiber foods do allow an estimate of overall consumption. For example, Block and Patterson[2] estimate that five servings of fruits and vegetables contribute about 17 grams of fiber. A daily serving of high fiber cereal would increase intake to better than twenty grams of fiber. To meet current dietary fiber recommendations, respondents would need a consumption frequency of at least six servings of high fiber foods. The Ohio average of 4.29 servings for those in the high fiber consumption quartile demonstrates another wide disparity between current health recommendations and actual consumption. Respondents in the youngest age groups ate the lowest amount of fiber. As with national data[2], fiber intake increased with age. Ohio data show that fiber intake also increased with income and education level. National data[2] also link increased fiber intake with higher income levels.

Many opportunities and challenges exist to educate this population about the role of diet in cancer prevention. For example, less than 1% of respondents mentioned cancer prevention as a motivation for changing eating habits. Despite major public information efforts by NCI and the American Cancer Society about the relationship between obesity and breast cancer, only 2.4% of the respondents mentioned breast cancer when asked which types of cancer were related to the foods people eat and drink. The current attention being directed to early detection of breast cancer provides an opportunity to also educate women about reducing the risk of breast cancer through improved dietary habits. More respondents (43.4%) were aware of the link between diet and colon cancer. However, more than 25% of all respondents did not know which types of cancer were diet related and more than 15% believed that all cancers were diet related.

TABLE 12

Beliefs About Food Consumption and Cancer Related to Whether a Household Member Had/Has Cancer

	Believe cancer may be related to what we eat or drink					
	Yes		No		Don't know	
	n	(%)	n	(%)	n	(%)
Non-cancer household	130	(47.1)	83	(30.1)	63	(22.8)
Cancer household	75	(42.1)	57	(32.0)	46	(25.8)

When asked about cancer prevention strategies, only 7.1% of respondents identified a low fat diet as an option. White and Maloney[8] note that participants in their study did not view diet as a preventive measure for chronic diseases, but believed a healthy diet was appropriate only for "building up resistance" to communicable diseases.

As health professionals attempt to encourage people to eat healthier foods, it is important to appeal to those qualities that are viewed as most important. When shopping for food, taste was considered very important by more people (88.3%) than was any other option available. Educational efforts to change eating habits need to emphasize that foods which are promoted as more healthful can also taste good.

Fatalism, or the belief that some events are preordained and beyond a person's control, is a strong part of the Appalachian culture. Some findings from the survey support fatalism as a guiding force for a portion of the respondents. For example, 29% of respondents agreed with the statement that, "Everything I eat is bad for me so why bother changing." More than half (54.7%) of the respondents either did not believe or did not know if eating more or less of certain foods would prevent cancer. There was also no association between the belief that cancer was related to diet whether or not they had experienced cancer themselves or in their households. To reach those with a fatalistic attitude it may be helpful to involve neighbors and family to legitimize intervention activities, use a religious argument in support of using assistance available, or graphically present evidence of unhealthy life-styles coupled with evidence of improvements possible with healthy changes.

Despite the finding that only 6% of respondents ate five or more servings of fruits and vegetables a day, and that fiber intake also fell below recommended levels, 43% of respondents believed they presently ate a healthy diet and had no reason to change. This may be related to the finding that 58% of the respondents said they were confused about which dietary recommendations to follow. Rather than focus educational efforts on abstract concepts such as grams of fat or fiber in foods, these efforts may produce better outcomes if messages are focused on specific foods, number of servings to eat in a day, and the similarity among dietary recommendations for the major chronic diseases. For example, it may be more helpful to say, "Eat five servings of fruits and vegetables each day," instead of, "Be sure to get 20 to 30 grams of fiber each day."

Respondents viewed physicians and other health professionals as major resources both for assistance and information to help promote dietary change. This suggests the need to network with physicians and other health professionals to facilitate better professional training and in-service concerning patient counseling and education. It also suggests the need to make available quality, time-efficient materials to aid them in counseling patients.

The two responses of 38.8% indicating that respondents would be motivated to change to treat a medical problem, and only 0.4% saying they would change to prevent cancer may indicate that persons will not change prior to the appearance of a medical problem. Dietary recommendations made by physicians at the time of diagnosis may motivate some behavior change to reduce the long-term complications of the disease. Intervention strategies may have the greatest impact if delivered by physicians or health professionals at a time when specific health problems are being experienced or initially diagnosed. The greater frequency of medical problems in older people may explain why they tend to have better diets than younger individuals.

Although only 10.3% of respondents indicated that their local health department would be a source of information about changing eating habits, this was the third most frequently mentioned source by respondents; mentioned more often than sources such as Cooperative Extension Service, dietitians, nutrition or weight loss classes, or pamphlets/brochures. Efforts need to be made to enhance the ability of local health departments in the Appalachian counties to provide assistance since they are a source used by this population.

Survey data support the conclusion that residents of Ohio's Appalachian counties would benefit from nutrition education activities targeted toward increasing fruit and vegetable consumption, increasing dietary fiber content, and decreasing the amount of high fat foods. Data also indicate that educational efforts targeted to the higher behavioral risk segments of the population — persons under 55 years of age, and those with less income and education — are particularly appropriate.

References

1. Block G, Dresser CM, Hartman AM, and Carroll MD. Nutrient data sources in the American diet: Quantitative data from the NHANES II survey. II. Macronutrients and fats. Am J Epidemiol 122:27-40, 1985.

2. Patterson BH, Block G. Food choices and the cancer guidelines. Am J of Public Health 78:282-286, 1988.

3. National Research Council. Diet and Health: Implications for Reducing Chronic Disease Risk. National Academy Press, Washington, DC, 1989.

4. Dean AD, Dean JA, Burton AH, and Dicken RC. Epi Info, Version 5: A word processing, database, and statistics program for epidemiology on microcomputers. USD, Inc., Stone Mountain, GA, 1990.

5. SAS Institute, Inc. SAS user's guide: statistics, version 5. SAS Institute, Inc., Cury, NC, 1985.

6. Ohio Data Users Center. STFI State Data Center profile series: Ohio, 1990. Ohio Department of Development (a state affiliate of the U.S. Census Bureau) Columbus, OH, 1991.

7. Block G, Rosenberger WF, and Patterson BH. Calories, fat and cholesterol: Intake patterns in the U.S. population by race, sex and age. Am J of Public Health, 78(9):1150-1155, 1988.

8. White SL, and Maloney SK. Promoting healthy diets and active lives to hard-to-reach groups: a market research study. Public Health Reports, 105(3):224-231, 1990.

FIGURE A: DISEASES BELIEVED TO BE RELATED TO DIETARY HABITS

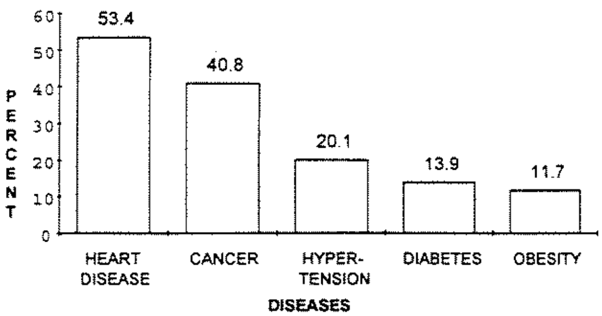


FIGURE B: TYPES OF CANCER WHICH ARE RELATED TO DIETARY HABITS

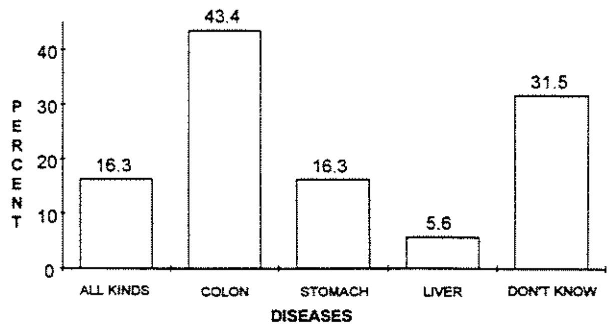


FIGURE C: WHAT FOODS SHOULD PEOPLE EAT OR DRINK MORE OF TO PREVENT CANCER

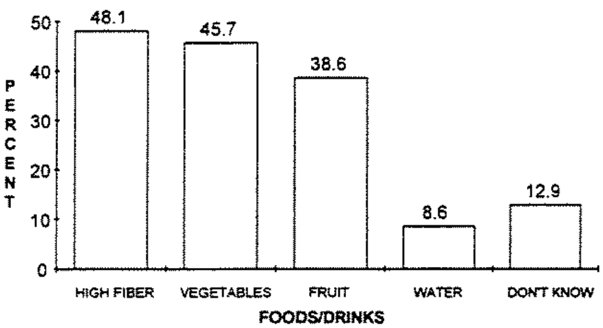


FIGURE D: WHAT FOODS SHOULD PEOPLE EAT OR DRINK LESS OF TO PREVENT CANCER

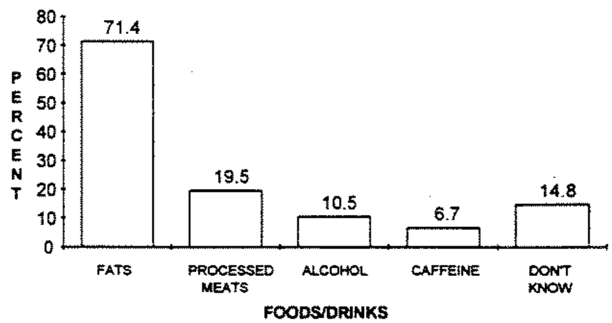


FIGURE E: MAJOR REASON FOR CHANGING EATING HABITS

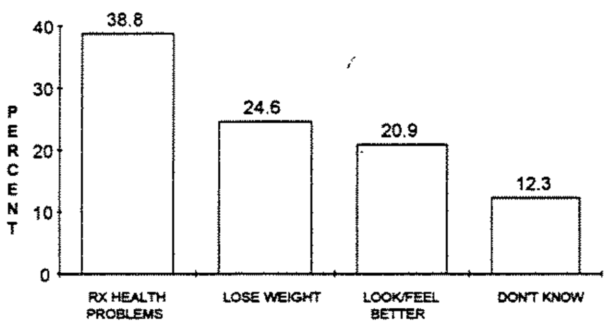


FIGURE G: WHERE WOULD YOU GET INFORMATION ABOUT CHANGING YOUR EATING HABITS

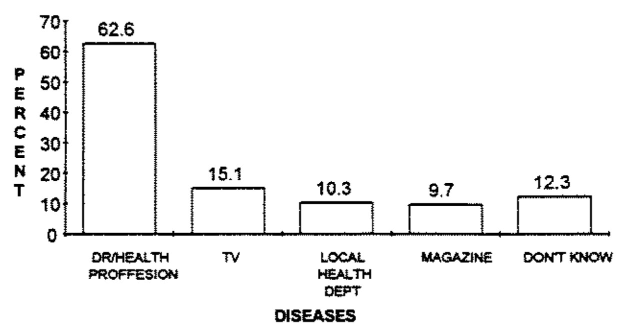
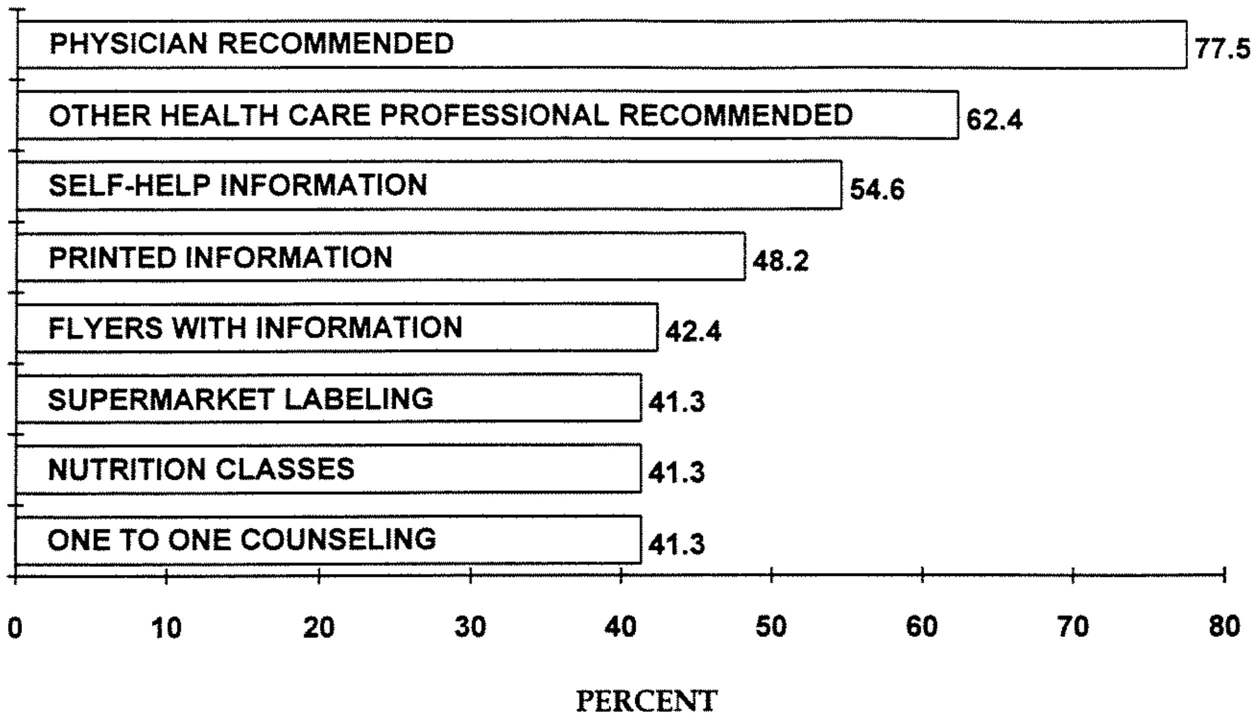


FIGURE F: WHAT TYPES OF ASSISTANCE WOULD HELP YOU CHANGE YOUR EATING HABITS



Appendix A

Ohio 1990 Point-in-Time Survey

Appalachian Counties

Appendix B

ALGORITHM

OHIO CANCER-NUTRITION POINT-IN-TIME SURVEY

The algorithm and data base for calculating the nutrient intake score are derived from those used for the 1987 National Health Interview Survey. Grams of fat will be calculated for each food item and these summed over all food items. The algorithm to do this is as follows: "Times" = # times in the "How often" question; "Factor" indicates the time unit: Day = 7, Week = 1, Month = 0.231; "Portion" = average portion size (grams). The grams of fat for each food item will be calculated as follows:

Times X Factor X [Portion (grams) X Fat/100 grams]

Developing A State Nutrition Surveillance Monitoring Program: Problems And Possibilities

Thomas A. Melnik, DrPH, Division of Nutrition New York State Department of Health, Albany NY

The New York State Nutrition Surveillance Program began in 1984 and has developed into a comprehensive and broad-based system representing all stages of the life cycle from pregnant women at risk for poor birth outcomes to the frail elderly. The major components of the surveillance program include the Pediatric (PedNSS) and Pregnancy (PNSS) Nutrition Surveillance Systems, nutrition surveillance of school-age children. dietary surveillance, nutrition surveillance of the homeless and destitute, and surveillance of the frail elderly. The Nutrition Surveillance Program also works closely with the nutrition service delivery programs administered by the Division of Nutrition to estimate need for services, derive means for targeting and allocation of resources, and to conduct evaluations of program interventions. Possibilities for nutrition monitoring at the state level include coordination with CDC surveillance activities (PedNSS, PNSS, BRFSS, PRAMS), making creative use of other data systems for nutrition monitoring including census of the population, vital statistics, and hospital discharge data, making use of surveys done by other public, private, and academic institutions, data linkages to enhance the base of information available for nutrition monitoring, and expanding the use of nutrition monitoring information for other applications including needs assessment and program evaluation. The challenges encountered in developing a state nutrition monitoring effort include competition for scarce financial and staff resources the growing demand for information at the local level, data quality control, need for representation of states in national surveys, standardization of terms, definitions, and reference populations, modification and enhancement of other systems for nutrition monitoring, development of methods for hard to reach population groups, and training and technical expertise

Methodological Issues In Analyzing School Menus

Patricia McKinney MS, RD, USDA/Food and Nutrition Service/Office of Analysis and Evaluation, Alexandria VA

FNS recently completed a nationally representative study of school nutrition programs in which menus were collected from 515 schools. The objective of the school meal analyses was to determine the **average** nutrient content of USDA meals **as offered.** Cafeteria managers supplied information (description, amounts served, recipes and labels) for one week's menus. Methodological issues resulted from two main aspects of school food service: how to develop an average nutrient content when schools had a large number of choices available at each meal, and how to determine amounts for selfserve options such as salad bars for which there are no standard servings. To compute the average nutrients **offered** each food was assigned a USDA meal component code and a code to link items served together such as salad with salad dressing. The nutrients were summed for each meal component food group. We assumed each meal offered contained the numbers and types of foods required under the USDA meal pattern, plus any non-creditable items such as dessert or condiments. All entrees offered, all bread/bread alternate, all fruits and vegetables, and all types of milk were calculated separately and an average nutrient value for meal component was obtained. The average nutrient content of each lunch was then calculated as the sum of nutrients in one entree, one bread, two fruit/vegetables, one milk and one dessert and/or condiment (if offered). Nutrient averages for salad and other food bars were calculated by assuming quantities based on USDA lunch component requirements.

USDA Survey Nutrient Data Base System: Workshop on File Formats

Development of a New Database Format for USDA's CSFII Food Codes
Randy LaComb, *HNIS, USDA*

Recipe and Nutrient File Formats
Nancy Raper, *HNIS, USDA*

Programmers' Perspective - Use of Formats in Other Systems
Lois Steinfeldt, *University of Texas*

Development of a New Data Base Format for USDA's CSFII Food Codes.

Randy LaComb, HNIS, USDA

Introduction

Today I am going to talk about upcoming changes in the format, or structure, of the food codebook used for USDA's Continuing Survey of Food Intakes by Individuals (CSFII).

The Survey codebook is the centerpiece of an extensive technical system that supports the CSFII. It contains approximately 6,700 7-digit food codes used for coding foods reported in 24-hour dietary recalls collected by interviewers in the CSFII. For each code, there is a description of the food; a set of common measures for the food, such as "cup" or "small, medium, and large"; and gram weights for the edible portions of those measures. For each food there is also a default weight value available for use when amounts consumed were unclear or not specified.

We are changing the codebook format as part of the process to upgrade the CSFII technical support system. We will begin using the new format for the next CSFII, which begins in January 1994. As in the past, the codebook will be made available to the public as part of documentation for the survey.

Old format

The old codebook format **(OVERHEAD 1)** reflected the time of its creation in 1977, when there were no sophisticated data base programs. A word processor was used to create the original nine files, and it wasn't until later that they were converted into the current ASCII format. The nine codebook files were divided into nine basic food groups as shown on the screen. The "structure" of these files can be seen in this next slide **(OVERHEAD 2)**. A code number appears on the left, followed by the description. Food items similar in nutrient composition are listed below the main description in parenthesis. These are called "include statements." The measure descriptions and associated weights in grams are listed beneath the description.

As you may know, there are problems associated with this type of format. Some are shown in this slide **(OVERHEAD 3)**. Due to time constraints, I will only briefly describe these problems.

The first problem deals with updating the codebook when either a new code must be added or an existing code must be edited. Editing requires documentation about the type of changes made to the code, and this documentation must be stored in a historical file. These two processes of updating codes and documenting updates were performed separately.

The next problem to consider occurs when searching the codebook. The user has to know which of the nine separate files includes the food item they are interested in. If the files were combined, the increased size of the file would notably increase the search time.

Also, because the codebook is in an ASCII format and lacks "set" fields, importing it into database programs is difficult. Some programming has to be done in order to set up the files so that they can be imported into a database program without losing important information.

III. New Format

Because of these and other problems with using the codebook in ASCII format, we decided to change it to help our staff maintain the codebook with easy-to-use editing tools, to allow better tracking of types of foods such as brand names and to allow better tracking of nutrient changes in foods, which Nancy Raper will discuss. It will also allow our users to easily import the codebook into their favorite data base program.

The data base package that we use is Paradox for Windows, which is compatible with Paradox 4.0 for DOS.

After converting the nine ASCII codebook sections into a suitable format to import into Paradox, we have seven different files, each containing a component of the codebook. No longer are the files categorized by the nine major food groups, but by their components as follows:

The names of the seven different files and their meaning are listed on this screen **(OVERHEAD 4)**. They are the CODEBOOK DESCRIPTION (CBDES), CODEBOOK INCLUDE (CBINCL), CODEBOOK MEASURE DESCRIPTION (CBMDES), CODEBOOK GRAM WEIGHTS (CBGMWT), CODEBOOK SUBCODE (CBSUBCOD), CODEBOOK SUBINCLUDE (CBSUBINC), AND CODEBOOK SUBCODE DESCRIPTION (CBSUBDES). I will now take each file separately and describe the format structure for that file. As I describe each file, the format will appear on the top half of the screen and a sample entry from the old codebook will appear on the bottom half of the screen to show which information was taken and placed into the new file.

The first file is the **CODEBOOK DESCRIPTION** file, abbreviated CBDES **(OVERHEAD 5)**. As with this and all subsequent files the name of the field is first, followed by the type of field (N=numeric, A=alphanumeric, and D=date), the length of any alphanumeric field, and whether or not it is indexed (the * symbol). An index on a database table is like an index in a book; it helps you locate information quickly. This file contains the primary code description and the abbreviated version of the description as well as other important information as follows:

Code Number	N*	7 digit food code number
Descriptor	A200	description of code
Abbreviated descriptor	A60	abbreviated description
Status	A1	whether or not code is discontinued
Last Modified	D	date of last change
USDA System field	A1	
Fl oz / Wt oz	A1	describes the type of ounce
USDA System field	A1	
Start date	D	date code started
End date	D	date code no longer to be used

The next file is the **CODEBOOK INCLUDE** file, abbreviated as CBINCL **(OVERHEAD 6).**

This file contains "includes" - specific foods that are associated with a particular 7 digit food code number. Each "include" for the same code number has its unique line number for easier management.

Code Number	N*	7 digit food code number
Include Line Number	N*	
Include Description	A80	description of include
Start date	D	
End date	D	
Last modified	D	

The next file is the **CODEBOOK MEASURE DESCRIPTION** or CBMDES **(OVERHEAD 7)**

This file is used by two codebooks: the survey codebook and the Primary Data Set, or PDS, codebook, which Nancy Raper will be talking about later. Sharing the data base between the two codebooks allows us to maintain one file and avoid duplication of measure descriptions. This file contains a five digit number for each unique measure description that can be found in the codebook. The same measure may be used for many foods. "Cup" is # 10205 and is used as a measure for many food codes.

Meas descr number	N*	
Description	A120*	description of measure
Start date	D	
End date	D	

The next file is the **CODEBOOK GRAM WEIGHTS** file or CBGMWT **(OVERHEAD 8)**
This file contains the weight in grams for each measure of a particular food item. For example, 1 cup (10205) of egg salad is 222 grams: 1 cup of soybeans is 180 grams. This file is also shared with the PDS codebook. This is to insure that the gram weights for a PDS food item which is similar to a survey item contain the same weights and measure descriptions. There may also be survey food items that do not correspond to PDS items and vice versa.

Code Number	N*	
NDB number		
Subcode number	N*	a unique 7 digit number that specifies either a brand name food item or special case item, it is linked to the CBSCDES file
Seq number in wt category	N*	unique line number
Meas desc number	N*	5 digit code that describes a unique measure description, linked to the CBMDES file
Gram Weight	N	weight of food item
USDA System field	A1	
Start date	D	
End date	D	
Last modified	D	

The next file is the **CODEBOOK SUBCODE DESCRIPTION** or CBSUBDES **(OVERHEAD 9)**
This file contains information directly related to a unique subcode. This file and the next two files are new concepts that we are introducing into the codebook. This file will allow us to list brand name food items and special case food items separately to enable us to keep better track of them. After I describe these files, I will demonstrate some codes that have subcode numbers. This file contains a 7 digit code for each unique brand name item or special case food item.

Subcode number	N*	
Subcode Descriptor	A60*	description of subcode
Start date	D	
End date	D	

The next file is the **CODEBOOK SUBCODE** or CBSUBCOD **(OVERHEAD 10)**

Code Number	N*	
Subcode number	N*	a unique 7 digit number that specifies either a brand name food item or special case item, linked to the CBSCDES file
Nutrients	A2	if nutrients are available for this product
Start date	D	
End date	D	
Last modified	D	

The last file is the **CODEBOOK SUBINCLUDE** or CBSUBINC **(OVERHEAD 11)**
This is like the CBINCL file, but describes the includes for a subcode.

Code Number	N*	
Subcode number	N*	
Seq number	N*	
Include	A60	description of subinclude
Start date	D	
End date	D	
Last modified	D	

Now that we have all of this data separated into different files, you may be wondering, how does it all fit together? This next slide **(OVERHEAD 12)** shows in pictorial format which files link together and with what field. As you can see, the three main files: the CODEBOOK DESCRIPTION (CBDES), CODEBOOK INCLUDE (CBINCL), and CODEBOOK GRAM WEIGHTS (CBGMWT), and the 2 subcode files CODEBOOK SUBCODE (CBSUBCOD) and CODEBOOK SUBINCLUDE (CBSUBINC) are linked together by the 7 digit code number. The CODEBOOK MEASURE DESCRIPTION (CBMDES) file is linked to the CBGMWT file by the measure description number and the CODEBOOK SUBCODE DESCRIPTION (CBSUBDES) file is linked to the CBSUBCOD file by the subcode number.

The next set of slides show some of the codes and subcodes in a format that shows how the links are made.

The first slide **(OVERHEAD 13)** shows a normal code with no includes and no subcode number. This is code number 421-1120 - Peanuts, dry roasted, salted. (show various parts of the code).

The next slide **(OVERHEAD 14)** shows an entry with several includes. This is code number 543-0400 - Cheese Cracker. (show various parts of the code).

This slide **(OVERHEAD 15)** shows a code that has subcodes. This is code number 917-0506, and it has 3 subcodes. The first subcode is 999999. This allows us to represent the default gram weight values for this code. (**show values**). The next slide **(OVERHEAD 16)** shows the subcode 1000045, which represents Hershey Milk Chocolate with Almonds and its associated measure descriptions and gram weights.

This next slide **(OVERHEAD 17)**shows a code number that has a subcode which has an include. The number is 917-0504 "Chocolate, milk, with nuts, not almond or peanuts". As you can see, first is 999999, or the default values, and the next slide **(OVERHEAD 18)** shows the subcode number 1000038, which is Bridge Mix and has Brach's as an include.
As of now, it is mostly the candy section of the codebook that uses the subcode numbers.

That was an overview of how the files are structured and how they link together. Another implementation that we are introducing is an automated historical file **(OVERHEAD 19)** associated with each codebook file. As mentioned earlier, updating the codebook was a two step process. After making a change to the original codebook file using one program, another program was used to record the changes in a historical file (also an ASCII file). This second step is now eliminated because as changes are made to the codebook, information is automatically recorded into a historical data base file. This information includes what code was changed or added, by whom, when, and why. Each historical file also contains the original entry as well as the new entry and the type of change whether it was a data or food change. The signatures of the individual who makes the original change, and two other individuals who review the entry and their "signatures" and date of review are recorded into the data base.

Another benefit of having these historical files is that it provides complete documentation of changes made to the codebook. It will also be easier to keep track of changes over time for a particular food item as well as brand names and data trends.

Next I would like to review some of the benefits gained by use of these new codebook structures. The next slide **(OVERHEAD 20)** lists some of these benefits.

a) The first deals with updating the codebook. By using several files with a data base package, maintaining the codebook is much easier. First, we don't directly make changes to the original files. Temporary files, structured exactly like the original files, are used to hold the new codes or code changes being made to the codebook. This allows a more extensive review of the part of the code that is being added or changed.

b) Second, it helps reduce the chance of introducing errors, such as, assigning an existing code number to a new food.

c) Third, there is more consistency in spelling and type of information entered; for example, it will reduce the number of misspellings or unnecessary variations of measure descriptions.

d) A very important benefit is the ability to exporting the data into various data base formats so that users can import the data into their database package without having a detailed knowledge of programing. The codebook will be made available in an ASCII delimited format.

e) Finally, by having the codebook in a data base package such as Paradox, changes can be made to the structure itself at any time without having to redo the entire codebook. This means that if we decide to track a new or different variable in the future, a new field can be added quite easily without affecting the rest of the database. In this sense the codebook has become dynamic.

IV. Conclusion

This concludes my explanation of the new USDA codebook format. Some changes are still being made or are under discussion, but the core of the codebook has been converted and reviewed extensively. **(OVERHEAD 21)** These new formats for the codebook, associated historical files and temporary holding files allow us to have better overall quality control in maintaining the codebook.

CODEBOOK SECTIONS

1 MILK
2 MEAT, POULTRY & FISH
3 EGGS
4 LEGUMES
5 GRAIN PRODUCTS
6 FRUITS
7 VEGETABLES
8 FATS & OILS
9 SWEETS & BEVERAGES

OVERHEAD 1

OLD CODEBOOK STRUCTURE

543-0400 Cracker, cheese
(Include Cheez-its, Cheese Ritz)

	(grams)
1 Twig	2
1 round cracker	3
1 small square cracker	1
1 cup, NF	28
1 single serving bag	72
Serving not specified	12

OVERHEAD 2

PROBLEMS WITH OLD CODEBOOK FORMAT

UPDATING CODEBOOK

SEARCHING

IMPORTING

OVERHEAD 3

CODEBOOK FILES

CODEBOOK DESCRIPTION	CBDES
CODEBOOK INCLUDE	CBINCL
CODEBOOK MEASURE DESCRIPTION	CBMDES
CODEBOOK GRAM WEIGHTS	CBGMWT
CODEBOOK SUBCODE	CBSUBCOD
CODEBOOK SUBINCLUDE	CBSUBINC
CODEBOOK SUBCODE DESCRIPTION	CBSUBDES

OVERHEAD 4

CODEBOOK DESCRIPTION
(CBDES)

SURVEY CODE	N*
DESCRIPTOR	A200
ABBREVIATED DESCRIPTOR	A60
STATUS	A1
LAST MODIFIED	D
USDA SYSTEM FIELD	A1
FL OZ / WT OZ	A1
USDA SYSTEM FIELD	A1
START DATE	D
END DATE	D

535-4210 Granola bar, oats, sugar, raisins, coconut

(Include with chocolate chips, Nature Valley Chewy Granola bars, Quaker Oats Chewy Granola Bars)

1 bar	43
1 Quaker Oats or Nature Valley bar	28
Serving not specified	43

OVERHEAD 5

CODEBOOK INCLUDE
(CBINCL)

SURVEY CODE	N*
INCLUDE LINE NUMBER	N*
INCLUDE DESCRIPTION	A80
START DATE	D
END DATE	D
LAST MODIFIED	D

535-4210 Granola bar, oats, sugar, raisins, coconut

(Include with chocolate chips, Nature Valley Chewy Granola bars, Quaker Oats Chewy Granola Bars)

1 bar	43
1 Quaker Oats or Nature Valley bar	28
Serving not specified	43

OVERHEAD 6

CODEBOOK MEASURE DESCRIPTION
(CBMDES)

MEAS DESCR NUMBER	N*
DESCRIPTION	A120*
START DATE	D
END DATE	D

535-4210 Granola bar, oats, sugar, raisins, coconut

(Include with chocolate chips, Nature Valley Chewy Granola bars, Quaker Oats Chewy Granola Bars)

1 bar	43
1 Quaker Oats or Nature Valley bar	28
Serving not specified	43

OVERHEAD 7

CODEBOOK GRAM WEIGHT
(CBGMWT)

SURVEY CODE	N*
NDB CODE	N*
SUBCODE NUMBER	N*
SEQ NUMBER IN WT CATEGORY	N*
MEAS DESC NUMBER	N*
GRAM WEIGHT	N
USDA SYSTEM FIELD	A1
START DATE	D
END DATE	D
LAST MODIFIED	D

535-4210 Granola bar, oats, sugar, raisins, coconut

(Include with chocolate chips, Nature Valley Chewy Granola bars, Quaker Oats Chewy Granola Bars)

1 bar	43
1 Quaker Oats or Nature Valley bar	28
Serving not specified	43

OVERHEAD 8

CODEBOOK SUBCODE DESCRIPTION
(CBSUBDES)

SUBCODE NUMBER	N*
SUBCODE DESCRIPTOR	A60*
START DATE	D
END DATE	D

917-0505 Chocolate, milk, with fruit and nuts

(Include Chunky with fruit and nuts; Chunky, NFS; Chunky Original)

917-0505 Chocolate, milk, with fruit and nuts (Include Chunky with fruit and nuts; Chunky, NFS; Chunky Original)

Chunky with fruit and nuts

(Include Chunky, NFS, Chunky Original)

1 individually wrapped piece	33
1 large bar	170
Serving not specified	33

OVERHEAD 9

CODEBOOK SUBCODE
(CBSUBCOD)

SURVEY CODE	N*
SUBCODE NUMBER	N*
NUTRIENTS	A2
START DATE	D
END DATE	D
LAST MODIFIED	D

917-0505 Chocolate, milk, with fruit and nuts
(Include Chunky with fruit and nuts; Chunky, NFS; Chunky Original)

Chocolate, milk, with fruit and nuts

1 piece	11
1 bar	33
Serving not specified	33

Chunky with fruit and nuts
(Include Chunky,NFS; Chunky Original)

1 individually wrapped piece	33
1 large bar	170
Serving not specified	33

OVERHEAD 10

CODEBOOK SUBINCLUDE
(CBSUBINC)

SURVEY CODE	N*
SUBCODE NUMBER	N*
SEQ NUMBER	N*
INCLUDE	A60
START DATE	D
END DATE	D
LAST MODIFIED	D

917-0505 Chocolate, milk, with fruit and nuts

(Include Chunky with fruit and nuts; Chunky, NFS; Chunky Original)

Chocolate, milk, with fruit and nuts

1 piece	11
1 bar	33
Serving not specified	33

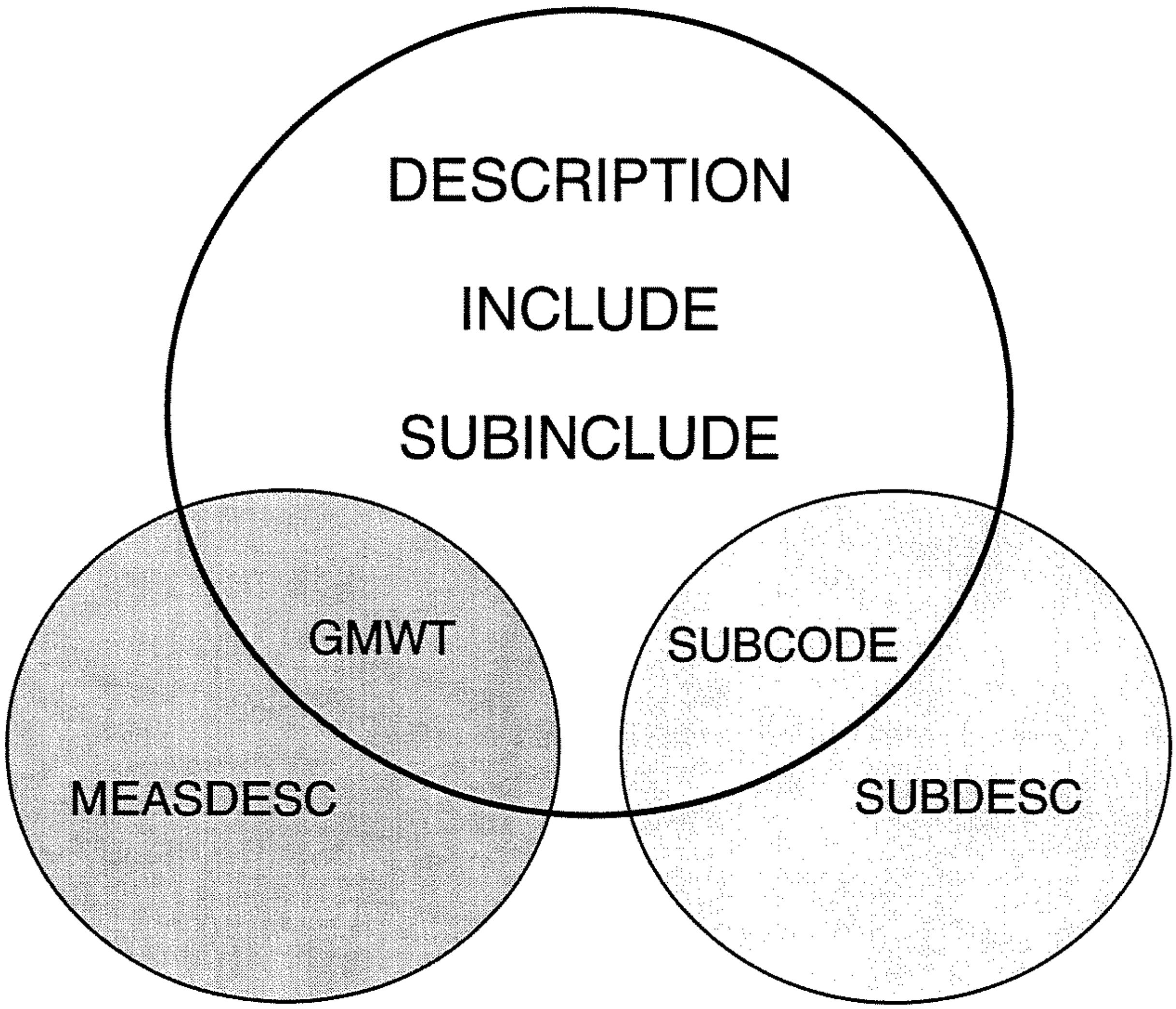
Chunky with fruit and nuts

(Include Chunky, NFS; Chunky Original)

1 individually wrapped piece	33
1 large bar	170
Serving not specified	33

OVERHEAD 11

Code Number



MEASURE

DESCRIPTION #

SUBCODE #

Code #	4211120
Description	Peanuts, dry roasted, salted

Include

Subcode

Subcode Include

	Measure Description	Wt
1	1 cup	144
2	1 oz (28 nuts)	28
3	Serving not specified	18

OVERHEAD 13

Code #	5430400
Description	Cracker, cheese

Include

cheese sticks

Cheeblers

Subcode #

Subcode Include

	Measure Description	Wt
1	1 Twig	2.0
2	1 round cracker	3.0
3	1 small square cracker	1.0
4	1 cracker (various shapes)	3.0
5	1 cup, NFS	52.0
6	1 cup, crushed	72.0

OVERHEAD 14

Code # 9170506

Description Chocolate, milk, with almonds

Include

Subcode # 999999

Subcode Include

Measure Description

	Measure Description	Wt
1	1 piece	11.0
2	1 bar	41.0
3	Serving not specified	41.0

OVERHEAD 15

Code # 9170506

Description Chocolate, milk, with almonds

Include

Subcode # 1000045 Hershey with Almonds

Subcode Include

	Measure Description	Wt
1	1 bar (1.45 oz)	41
2	1 piece	4
3	1 miniature bar (.5 oz)	14
4	1 large bar (21 squares, 4 oz)	113
5	1 extra large bar (32 squares, 8 oz)	227
6	Serving not specified	41

OVERHEAD 16

Code #	9170504
Description	Chocolate, milk, with nuts, not almond or peanuts

Include

Subcode # 999999

Subcode Include

	Measure Description	Wt
1	1 piece	11.0
2	1 bar	33.0
3	Serving not specified	33.0

OVERHEAD 17

Code # 9170504

Description Chocolate, milk, with nuts, not almond or peanuts

Include

Subcode # 1000038 Bridge Mix

Subcode Include

Brach's

	Measure Description	Wt
1	1 piece	3
2	1 cup	186
3	Serving not specified	27

OVERHEAD 18

AUTOMATED HISTORICAL FILE

WHAT – WHY – WHEN – WHOM

ORIGINAL AS WELL AS NEW ENTRY

DOCUMENTATION OF CHANGES

OVERHEAD 19

BENEFITS OF NEW FORMAT

UPDATING CODEBOOK

REDUCE CHANCE OF ERRORS

CONSISTENCY

EXPORT – IMPORT (ASCII delimited)
DATABASE STRUCTURE CHANGES

OVERHEAD 20

CONCLUSION

BETTER QUALITY CONTROL IN
MAINTAINING CODEBOOK

OVERHEAD 21

Recipe And Nutrient File Formats

Nancy R. Raper, Human Nutrition Information Service U.S. Department of Agriculture

An issue of increasing importance in monitoring what Americans eat is the need to compare food and nutrient intakes over time. In order to compare results from surveys, nutrient data bases used to calculate intakes must account for improvements in food composition data and also reflect the nutrient content of foods at each point in time. To meet the need to compare nutrient intake data over a number of years, HNIS is developing a nutrient data base system which will account for new and improved food composition data and thus will allow the recalculation of previously collected food intake data. This system will also permit tracking changes in nutrient values that are due to a variety of reasons, such as reformulation of a food with a lower sodium content. The design of the system, files included, their purpose and structure were described.

Programmer's Perspective - Use Of Formats In Other Systems

Lois Steinfeldt, University of Texas, Health Science Center at Houston, Houston, TX

The two major changes in the Survey Nutrient Database System described here today present both an opportunity and a challenge. An opportunity to use the food and nutrient data which will now be available in an easily accessible fashion to improve nutrition related applications and a challenge to use this data accurately and appropriately.

The conversion of the Survey Codebook from a word processing file to a set of normalized data base files; the creation of the measure description file to standardize measures for the gram weights of foods; and the creation of codebooks for the PDS, retention and moisture fat change data sets represents a significant amount of work which greatly enhances the usefulness of the Survey Nutrient Database System. These files can now be easily imported into a variety of software packages providing much greater flexibility in the use of the data. In data base management, statistical or spread sheet software these files can easily be queried and analyzed.

These codebooks are now a resource which can be used not only by programmers, but by anyone with some knowledge and experience in software packages. They should be considered when evaluating and selecting sources of food and nutrient data for specific projects. Listed here are a few examples of what types of information can be obtained from the codebook files.

Table 1
Potential Uses For Survey And Pds Codebooks

- Create subset databases using food codes and/or descriptions
  - Foods whose descriptions contain the word chicken
  - Foods whose codes begin with 57 (cereals)
- Select and calculate gram weights for selected foods
  - Average grams per surface inch of pizza
- Calculate nutrient values for standard measures for selected foods
  - Sodium content for 1 cup of chicken soups
  - Iron content of 3 oz raw weight of meats
  - Vitamin A content for 1 cup of cold cereals

The Nutrient Database System for Trend Analysis presents both a conceptual and a technical challenge. While it solves problems which are inherent in sequential versions of nutrient data bases, the size and complexity of the system are increased. It will require an additional step in order to retrieve data accurately. Dates must be taken into account for each use of the data files. When data is requested for a specific date a single record is returned. If no date or a range of dates is requested, decisions must be made about the meaning and processing of multiple records. For example, the links shown earlier between the files which comprise the survey codebook must be made not only on the data items which link the files such as food code and subcode, but also with reference to a specific date. The date may be the date of the food intake, the current date, or any other date of interest.

Table 2 shows the data for a sample food from the codebook description and gram weight files. The food description has an effective date range of 4/1/1985 to 12/31/2010. However there are two gram weights for measure number 61528 with different effective dates. The first gram weight of 46.8 is effective from 04/01/1985 to 12/31/1992. The second gram weight of 35.0 is effective from 01/01/1993 to 12/31/2010. This change in the gram weight of 1 package is a food change. It could result from changes in packaging or from changes in the food itself.

Table 2

SURVEY CODEBOOK

FOOD CHANGES IN GRAM WEIGHTS

CODEBOOK DESCRIPTION FILE

Survey Code	Description	Starting Date	Ending Date
1010101	Sample food description	04/01/1985	12/31/2010

CODEBOOK GRAM WEIGHT FILE

Survey Code	Sequence Number	Measure Number	Gram Weight	Starting Date	Ending Date
1010101	1	61528	46.8	04/01/1985	12/31/1992
1010101	1	61528	35.0	01/01/1993	12/31/2010

In order to retrieve the correct gram weight, the date for which the data is applicable must be part of the selection of the data records. For example, in Table 3 a simple selection command is shown to retrieve the codebook description and gram weight data for the sample food. First using the codebook description file, select the record with food code = 1010101 and starting date less than or equal to the current date and an ending date greater than or equal to the current date. Second using the gram weight file select the record using the same criteria.

Table 3

SURVEY CODEBOOK
DATA SELECTION PROCESS

Use codebook description file

Select the record with food code = 1010101 and
starting date <= current date and
ending date >= current date

Use codebook gram weight file

Select the record with food code = 1010101 and
starting date <= current date and
ending date >= current date

If the current date were taken from the computer, different records would be retrieved on different days. If this retrieval were done today, the gram weight would be 35.0. However, if the retrieval were done 1 year ago, the gram weight would have been 46.8. In each of these cases only 1 gram weight record would meet the selection criteria and that record would contain the correct gram weight for the current date. This same concept and the same general method of retrieval applies to all the codebook files. Each codebook file, including the description file, may have multiple records with different effective dates.

Table 4

SURVEY CODEBOOK
DATA SELECTION RESULTS

For current date = 05/24/1993

1010101 Sample Food

61528 1 package 35.0

For current date = 05/24/1992

1010101 Sample Food

61528 1 package 46.8

The file which is most likely to have the most food changes is the Survey Nutrient File. Since the nutrient values for a survey food are represented by a recipe, the nutrient values will include the combination of food changes to each component of the recipe.

As shown in Table 5 this includes food changes to ingredients, the gram weight and nutrient values for PDS and Survey foods which are used as ingredients, retention factors, moisture and fat changes and type of fat.

Table 5

POTENTIAL SOURCES OF FOOD CHANGES TO SURVEY NUTRIENT VALUES

Recipe components:

- Ingredients
  - Adding and deleting ingredients
  - Changing ingredients and ingredient amounts
  - PDS foods - gram weight and nutrient values
  - Survey foods - gram weight and nutrient values
- Retention Factors
- Moisture and fat changes
- Type of fat

Food changes to different recipe components could occur at any time and in many different combinations. Some food changes, such as a vitamin fortification in a cereal, may change only the value for a single nutrient, while others, such as a change in an ingredient in a recipe, may change all the nutrient values.

Table 6 shows an example of a breakfast cereal which has food changes occurring on three different dates affecting five nutrients. Food changes result from real differences in the food while data changes result from improvements in food composition data. In this food, the changes are due to fortification and reformulation. The Vitamin A value, nutrient code 392, decreases on 04/01/1989 from 1324 to 794. The Vitamin C value, nutrient code 401, increases from 53.0 to 211.6 on 04/01/1987. The values for saturated fat, monounsaturated fat and polyunsaturated fat, nutrient codes 606, 645 and 646, change on 10/01/1989. The rest of the nutrient values remain the same.

Table 6
SURVEY NUTRIENT FILE
MULTIPLE FOOD CHANGES TO NUTRIENTS

Survey Code	Nutrient Code	Nutrient Amount	Starting Date	Ending Date
5721300	392	1324.0	04/01/1985	03/31/1989
5721300	392	794.0	04/01/1989	12/31/2010
5721300	401	53.0	04/01/1985	03/31/1987
5721300	401	211.6	04/01/1987	12/31/2010
5721300	606	0.81	04/01/1985	09/30/1989
5721300	606	0.82	10/01/1989	12/31/2010
5721300	645	0.37	04/01/1985	09/30/1989
5721300	645	0.42	10/01/1989	12/31/2010
5721300	646	0.52	04/01/1985	09/30/1989
5721300	646	0.58	10/01/1989	12/31/2010

Table 7 shows a simple selection command using the date of intake as the criteria used to select records. Using the Survey Nutrient File, records are selected for food code equal to 5721300; nutrient codes equal to 392 (Vitamin A), 401 (Vitamin C), 606 (Saturated Fat), 645 (Monounsaturated Fat) and 646 (Polyunsaturated Fat); and starting date less than or equal to the date of intake and ending date greater than or equal to the date of intake.

Table 7

SURVEY NUTRIENT FILE
DATA SELECTION PROCESS

Use survey nutrient file

Select the records with food code = 5721300 and

nutrient code = 392 or 401 or 606 or 645 or 646 and

starting date <= intake date and ending date >= intake date

Substituting in different dates for the intake date will retrieve different nutrient values as shown in Table 8. In this example, none of the nutrients changed value more than once. However, that can and certainly will happen.

Table 8

SURVEY NUTRIENT FILE

DATA SELECTION RESULTS

Date of Intake	VIT A 392	VIT C 401	SAFA 606	MUFA 645	PUFA 646
03/15/1987	1324.0	53.0	0.81	0.37	0.52
03/15/1989	1324.0	211.6	0.81	0.37	0.52
06/15/1989	794.0	211.6	0.81	0.37	0.52
10/15/1989	794.0	211.6	0.82	0.42	0.58

These examples from the survey codebook and nutrient files clearly demonstrate the critical role that dates now play in retrieving data from the Survey Nutrient Database System for Trend Analysis. Dates must now be used to select both food and nutrient data. When there are multiple records for a data item and no selection based on dates is done, which record is selected or how many records are selected may depend on the software used, how the retrieval is programmed, the indexing of the data file, and the physical order in which the records are stored. If dates are not taken into account, an incorrect record may be retrieved and the wrong value used.

However, there may be times when all the records are required. When this is done, provision must be made for the retrieval of multiple values and decisions made as to how the multiple values are processed.

Version data bases can be extracted for any date. However the date used must always be a single date to insure that multiple values are not retrieved. For example, there are many ways a version data base could be set up for the calendar year 1993. The data could be selected based on the beginning, ending or middle of the year. Data could be selected based on the values in effect for the longest time period during the year or other more complex algorithms using weighted times, etc.

These are just a few examples of how the improvements in the Survey Nutrient Database can be used in other systems. The conversion of the codebooks from word processing to database files is a major step which now provides more data in a format which is much easier to use. Adding the fields and data to monitor food and data changes over time represents a substantial amount of work which will produce a more comprehensive database which can be used in either a continuous or version format. These new formats also provide the flexibility needed to adapt to changing needs for food and nutrient data in the future.

International & Ethnic Foods Databases

Nutrient Composition Of Selected Ethnic Foods

Lisa L. Oehrl, Southern Testing Laboratories

This paper provides an insight into how the Nutritional Labeling Laboratory at Southern Testing organized the task of providing data a contract sponsored by the Human Nutrition Information Service (HNIS) of the USDA.

Southern Testing and Research Laboratories is an independent contract lab that has worked closely with HNIS for several years analyzing food products. This paper covers one of the current contracts dealing specifically with a variety of ethnic foods. The data is preliminary as samples are still being actively analyzed, especially fresh items where spring sampling is being done.

The first step is always to acquire the food products or ingredients for recipes to be tested. This requires making trips to places where people of the ethnic communities shop. Stores are usually in low rent areas such as the Super Duper store, a small grocery in a neighborhood largely populated with low income families in Wilson. This store has a very small selection of general grocery items at inflated prices. Much of the glass in the freezer cases is broken out and replaced with plywood. It does however have a large meat selection and provides a source of meat cuts to make stocks as well as chicken feet.

Stores are often converted from some previous use and are small and are usually not very clean. Merchandise is expensive compared to main stream groceries, is often of poor quality and is out dated. The proprietor of an Asian market in Raleigh, North Carolina, offered me frozen fish in a package dated 1988.

Stores often serve as a social gathering place and offer more than groceries. La Panadaria, a converted hardware store in Wilson caters to the large population of Hispanic migrant workers in the area. It has no shelves and merchandise is arranged in rows on the floor. Fresh baked goods are available as is clothing, decorative items and music tapes. Like many small ethnic food stores, it is a family run business. Norma, the owner is from the Hondouras. Her father makes weekly runs to Florida for fresh produce.

After the samples have been acquired, preparation is often required. This involves following instructions provided by HNIS, following package instructions, or simply trimming away inedible portions. Samples are weighed for designated serving size and refuse. Dimensions are also taken at this time. Cup measurements are made by spooning sample into measuring cups, leveling with a knife blade and weighing. Once all serving size information has been obtained, the samples are homogenized using a large commercial type food processor whenever possible. This is a very crucial part of the preparation process. A thorough homogenate is necessary to insure a representative sample and reproducibility. Blenders are sometimes required for very wet samples and hard materials such as dried shark fin or raw lentils were homogenized using a hammer mill. After grinding, the samples are split into two parts. One is packed into a polyethylene screw topped bottle, flushed with nitrogen, sealed and placed in frozen storage. The other is packed in some convenient form and held in a cooler to be used for the analysis. All analyses are performed using current AOAC procedures unless directed otherwise by HNIS. For this particular contract, alternative methods have been provided for carotenoids, total dietary fiber and total folates. As soon as possible after homogenization, samples are assayed for carotenoids, vitamin C and folates to avoid losses during storage.

The rest of this paper is concerned with some typical examples of the data we have acquired and discusses some of the conclusions that can be drawn.

In preparing to assay samples, especially for vitamins and minerals, it is often necessary to establish dilutions factors. In some cases, one can go to the literature and base dilutions on values found there. For example, banana and serrano peppers were assayed. The values found for the minerals present compare closely to those given in USDA Handbook 8 for hot chili and sweet peppers as shown in Table 1 below. Using literature values as a guide for dilution for these samples did not necessitate many repeats.

Table 1.		**Peppers**		
	Calcium (mg/100g)	**Iron** (mg/100g)	**Phosphorus** (mg/100g)	**Potassium** (mg/100 g)
Banana	18	0.72	37	367
Serrano	10	0.45	37	299
Hot, chili[1]	10	1.2	25	
Sweet[1]	9	0.7	22	213
[1]Values from USDA Handbook 8				

Broccoli is an example of a product which proved differently. Except for potassium, the spread between mineral values was much wider for Chinese broccoli compared to the common type (Table 2). This problem was most troublesome in the analysis of samples for the microvitamins. The procedures for Vitamin B6 and B12, folates and pantothenates require a series of exacting dilutions to avoid overgrowing the organisms or insufficient growth. Lack of literature data often resulted in the necessity to do trial analyses before an acceptable dilution was found to give reproducible results.

For some samples, several brands of the same item were sampled. In some cases, the samples were found to be very similar despite differences in sources. An example of this is halavah (Table 3), a confection made from crushed sesame seeds and tahini that is popular in the Middle East. Sample 1 was cut from a block in the store and sample 2 is from individually wrapped single serving pieces. From the standpoint of proximate composition, they are nearly identical. In this case, one sample served as a dilution guide for the other.

Table 2.	**Cooked Broccoli**				
	Calcium (mg/100 g)	Iron (mg/100 g)	Phosphorus (mg/100 g)	Potassium (mg/100 g)	Sodium (mg/100 g)
Chinese	72	0.38	37	250	6.2
American[1]	88	0.8	62	267	10
[1]Values from USDA Handbook 8					

Table 3.			**Halavah**			
	Moisture (g/100 g)	Nitrogen (g/100 g)	Fat (g/100 g)	Ash (g/100 g)	Carbohydrates (g/100 g)	TDF (g/100 g)
Sample #1	4.7	2.2	36	1.7	44	4
Sample #2	6.2	2.1	33	1.9	46	5

A case where this was not so true was oyster sauce, a condiment and base used in oriental cooking. These two samples proved to be very different in moisture content which affected the other proximate components as seen in Table 4. Consequently, values of the vitamins and minerals were different as well.

Table 4.	**Oyster Sauce**					
	Moisture (g/100 g)	Nitrogen (g/100 g)	Fat (g/100 g)	Ash (g/100 g)	Carbohydrates (g/100 g)	TDF (g/100 g)
Sample #1	86	0.27	0.32	6.9	5.1	0.2
Sample #2	75	0.16	0.17	8.1	16	0.4

Cooking also has an effect on nutrient composition as many researchers have found. This held true for items in this study as well. Table 5 shows the decrease in vitamin content for collard greens with cooking. In the case of every vitamin, significant losses were found. Length of cooking affects nutrient losses. Therefore, the individuality of cooks and taste makes the development of representative values for cooked products more difficult.

Table 5.	**Collard Greens**				
	Vitamin C (mg/100 g)	Thiamin (mg/100 g)	Riboflavin (mg/100 g)	Niacin (mg/100 g)	bCarotene (mg/100 g)
Raw	44	0.03	0.28	0.91	1120
Cooked	6	0.02	0.06	0.31	1000

Following recipes provided by HNIS, a variety of stocks were produced for this study. It was found that their proximate composition is fairly similar with the beef being slightly lower in fat because it was easier to skim (Table 6). The carbohydrate contribution is probably due to the tomatoes added. Vitamins were present at low levels in all three preparations as expected by the high moisture content but rather different for each meat especially in terms of niacin and riboflavin as seen in Table 7.

Table 6.	**Stocks from Recipes**				
	Moisture (g/100 g)	Protein (g/100 g)	Fat (g/100 g)	Ash (g/100 g)	Carbohydrates (g/100 g)
Beef	95	3.0	0.02	0.94	1.5
Chicken	93	3.5	1.4	0.96	1.0
Fish	97	2.0	1.2	0.76	0.0

Table 7.	Stocks from Recipes				
	Vitamin C (mg/100 g)	Thiamin (mg/100 g)	Riboflavin (mg/100 g)	Niacin (mg/100 g)	bCarotene (mg/100 g)
Beef	<0.10	0.05	<0.01	0.98	<1.0
Chicken	1.2	<0.002	0.101	2.1	<1.000
Fish	0.22	0.06	0.07	0.91	<1.000

In general, as the study progressed, it was seen that each sample had to be considered individually. Some assumptions can be made regarding dilution but trial and error is usually the rule. Sampling has not been an easy task due to geographic location. Several trips to the Baltimore-Washington areas were made, as well as forays as far as Texas and California. Southern Testing is fortunate to have a diverse group of employees despite its relatively small size and they have generously provided tips on finding samples and in sample preparation.

The author would like to thank HNIS for sponsoring this research. Technical assistance was provided by Michelle F. Styles, Pam Gould, Elizabeth Petway, Catherine Morrissey, Jerry Fain, Christy Wilson, Robbie Pullen, Marjorie Boykin, Rhonda S. Howell, Connie Collins, Tammy Brister, Timothy Harvey and Debra Newby of Southern Testing and the staff of HNIS' Nutrient Data Reseach Branch.

The Mexican Database And Its Use In The CRSP Project

Jeffrey R. Backstrand. University of Connecticut, Storrs CT

The sociocultural, economic, and biological characteristics of food consumption are substantially different in rural, developing populations as compared to urban or industrialized ones. Therefore, the measurement of food and nutrient intake is also substantially different in character. Issues include core foods, meal structure, food preparation, water content of cooked foods, and bioavailability issues. This paper discusses the nature of eating in six communities in rural Mexico and those methods employed by the Mexico Nutrition CRSP to measure and analyze individual intakes of food and nutrients. The Mexico Nutrition CRSP, and its sister projects in Kenya and Egypt, were large prospective studies of the effect of food intake on human function (USAID Grants DAN 1309-A-00-9090-00 and DAN 1309-SS-1070-00). Mexico CRSP personnel collected prospective dietary data using a combination of food record, food weighing, and recall. Intake of *tortillas*, which usually provide between 50 and 70% of dietary energy, was measured by using a combination of food record and food weighing. Most other foods were consumed in the form of recipes that were composed of several foods. Nutrient intakes were calculated using a modified version of the INNSZ (National Nutrition Institute of Mexico) nutrient database. This database contained information on 458 foods and their estimated content for 14 nutrients plus phytate and fiber. Because of extremely high intakes of fiber and phytate (from *tortillas*), issues of bioavailability were found to be of central importance in effecting several human functions, including growth and cognitive performance.

FAO and Food Databases for Developing Countries.

G.P.Sevenhuysen, Foods and Nutrition, University of Manitoba, Winnipeg, Canada.

Many laboratories, agencies and institutions in industrialised and developing countries are generating food composition data, but international coordination of this work has been limited. FAO contributed substantially to the knowledge and dissemination of food composition data during the 1960's and 1970's, but has not maintained that contribution. In recent years INFOODS has promoted international data bases and developed tools to help in coordinating activities in several regional centres.

The United Nations is well placed to assist such coordination. Hence, the initiative from FAO to arrange an informal 2-day meeting in February 1993 among representatives from INFOODS, Eurofoods and USDA to discuss the future role of FAO in new work on food composition databases for developing countries.

My comments will deal with the main issues considered during this meeting and conclude with plans for future activities.

Need for international food composition data:

- national food supplies incorporate increasing amounts of imported foods.
- allow cross-cultural comparisons of food and health relationships.
- reduce national efforts in updating food composition data.

Currently one of the most important needs for compositional data stems from the extensive import and export of foods. Foods that were previously common in only one region or country are now eaten in many others.

In addition, to compare the effects of diet on health in multi-national studies we need data of comparable reliability in many countries. Also, new composition data is required on fatty acid contents, fibre components, and vitamin activity for foods that were previously not important in the diet.

Lastly, international sharing of compositional data on commonly used foods will save time and effort compared to exclusively separate, national work. Being able to use reliable data about imported food items from other countries will avoid duplication of chemical analysis.

Let us now review the major issues that must be tackled in developing an international database.

The first major issue is food identification.

Major issues:

- food identification and description
- reliability of compositional data
- providing access to data for the largest range of users
- standardising management procedures

A number of systems of identification have been developed. Specific systems are usually culturally related and difficult to adapt to other cultures while the broad systems are not specific enough for most uses. No system has been adopted universally and none is likely to be adopted in the near future

There was agreement in the meeting on a minimum amount of description in food names, such as:

Minimum food description:

- local name
- scientific name
- English name where available
- part of plant or animal
- maturity
- number of samples
- recipes | mixed dishes
- description of ingredients | mixed dishes
- origin of the sample

The origin of the sample is a qualifier or descriptor in the food name.

Such descriptions are particularly useful to identify raw or single food items. Difficulties arise in identifying mixed dishes or processed foods. Guidelines have been developed by Prof. A. S. Truswell for INFOODS on food nomenclature, to facilitate international exchange of food composition data. (J.Food Comp.Anal. 1991 4:18-38).

The coding systems for international use allow us to identify many characteristics of food related to storage, processing conditions or additive use.

Coding systems:

Facetted food codes
- Eurocode 2
- Langual
- Harmonised system

Facetted food codes and Eurocode 2 use a system of categories, such as food types used to group foods for dietary studies. Langual on the other hand uses a system to group foods by unique characteristics, such as type of food, maturity, packaging materials, storage conditions and others. Though all systems use a hierarchical code structure, the Langual system uses more than one hierarchy simultaneously, which allows more precise identification and retrieval of foods by many user groups, including those concerned with food intake studies. Using Langual requires a great deal of preparation, but it can potentially provide a system for universal use.

An alternative may be the 'Harmonised Commodity Description and Coding System', used for international trade, which includes food descriptions. The system is used by many national governments to generate trade statistics and provides a basis for foods that are traded.

All systems of food identification require software to be practical. The sophistication of current software applications vary, but future development offers the potential of databases that are local in nature, yet comparable with databases in other areas.

The second major issue is ensuring the reliability of compositional data.

Major issues:

- food identification and description
- **reliability of compositional data**
- providing access to data for the largest range of users
- standardising management procedures

Nutrient values in different food composition databases are not equally reliable. When comparing such data the user needs to take data quality into account.

Deciding on comparable data quality:

- professional judgement
- criteria list
- expert system

Judgements on data quality are made on the basis of a number of criteria, such as the method of analysis, sample choice, handling, preparation, and food description. Unfortunately, this information is not recorded for much of the compositional data used in developing countries. Without documentation the user relies on the professional judgements made by others, which are known to show bias.

Using a checklist of criteria for accepting nutrient values into the database makes decisions more consistent. Ideally a comprehensive set of criteria for judgements is developed for each nutrient estimation. However, the process of making assessments is time consuming and appropriate software is needed to save time and ensure consistent application in different laboratories and countries.

USDA-NCL has in fact developed computer based expert systems for five carotenoids, selenium, and copper, which will be extended to other components.

An important change has recently been made in defining acceptable analytical methods. Until recently the AOAC (Association of Official Analytical Chemists) specified a single method to determine a given food component. Now the result of the process determines its acceptability. This result may be achieved by more than one method. This change in policy is important for developing countries where the latest equipment and associated training may not be available.

An important aspect of new analytical work concerns sampling procedures. Though sampling is part of the reliability assessment of data, the steps taken to obtain and document the food item need to receive more attention.

In addition, more interchange of samples between laboratories is needed to improve the quality of analyses. Previous inter-laboratory tests among reputable laboratories in the U.S. have shown very large discrepancies. Inter-laboratory tests are limited by the fact that reference materials are not available for all nutrients and food components. In particular reference materials for organic components (lipids, vitamins, etc.) are not available.

Users of food composition data should have clear information about the reliability of the nutrient values in the database.

Data quality scores:

- decisions on reliability should be recorded using non-consecutive letters.
- scores should reflect high and low reliability for different users.

However, opinions differ as to the use of letters or numbers to represent data quality decisions. It is assumed that number codes are seen as decisions of equal rank, while letter codes would convey only differences not rank. In addition, not all analysts agree whether the score should have a range of 3, 4 or 5 points. The INFOODS supported system in New Zealand uses codes that reflect both quality and source of data.

We should recognise that the various components of the quality score may be given different weights from country to country. For example, analysts in the U.K. for example, give a higher weight to sampling procedures that make the analytical data more representative of the national food supply.

The third major issue concerns making the data available to users.

Major issues:

- food identification and description
- reliability of compositional data
- **providing access to data for the largest range of users**
- standardising management procedures

The criteria for chosing which foods to enter in the compositional database depend on the user group expected to make use of the data.

Criteria for including foods:

- Major foods in diets of people in regions of interest
- Important contributors of components of interest
- Foods largely consumed by vulnerable groups (eg. specific age groups)

Aggregated data is acceptable to some users, such as those processing dietary data, because survey respondents generally know little about the food they eat. For example, subjects usually can not identify the original source of the food, or its precise variety/species. However other users require highly detailed descriptions, such as those conforming to regulations governing the sale or transport of food. Here the item needs to be specified in fine detail to avoid legal confusion over the product in question.

Criteria for selection of nutrients to be included in a database will differ between groups of users within each country. Important nutrients include those associated with:

1. Dietary factors in acute and chronic disease(s), including emerging important public health problems; **2.** Dietary surveys; **3.** Menu/diet formulation; **4.** Regulatory activity.

Criteria for including nutrients:
· Dietary factors in acute and chronic disease(s)
· Dietary surveys
· Menu/diet formulation·
Regulatory activity

The ideal situation is to have the largest range of nutrient information on the largest number of foods. For most purposes food composition databases should include all original and reliable data, for all foods, regardless of the amount or frequency eaten. Computer managed databases make it possible to store and maintain all data, while providing specific user groups with the service they require. In principle there is no limit to the number of nutrients that can be included in the database provided it is well designed.

Frequently food composition data is generated by University or independent research laboratories, outside Government department activities. In some countries these separate work environments prevent the new data being used in government published national food tables so that it is unavailable to most users. In many institutions or government departments few staff are assigned to food composition work, particularly when the new computerised management systems are being introduced.

A few comments about food balance sheets, which provide many planners with basic statistics about the food supply. Estimates of national nutrient availability are based on estimates of food composition. However, many of the nutrient values used are considered unreliable for most purposes and little of the data have documented or suggested origins. Not only are nutrient content values a problem, but so are the extraction rates used for various commodities. Incorrect ones are used for some foods and major improvements are needed in the factors applied to food amounts available after processing. A restructuring of food balance sheets is required to minimise the use of imputed data.

The last major issue concerns management of data.

Major issues:
· food identification and description
· reliability of compositional data
· providing access to data for the largest range of users
· **standardising management procedures**

Great progress has been made in the handling of food composition data over the last decades, but particularly important improvements have been achieved by INFOODS and the Regional Centre for Oceania in New Zealand. For example, the INFOODS supported computerised data management system is particularly flexible and allows database developers to maintain files with several functions. Within one system both archival and processing files are managed, with variable descriptive choices, data values and colour images. The preparatory work by INFOODS on food and nutrient nomenclature, as well as data exchange protocols forms the basis for such systems.

Sustained funding for food analyses and nutrient database development at high levels of complexity is a problem in many countries. Such work is frequently funded on a project basis and therefore very intermittent, with little continuity of staff activities. As a result, the use of resulting data is often less extensive than the quality of data would allow.

Such work would likely have to be associated with other activities of commercial or public interest. Food composition work related to regulatory work would receive more continuous attention and allocation of resources. Whether resources are available for new foci on non-nutrients that may have biological activity, such as non-vitamin A active carotenoids is not yet clear.

Finally I want to relay some of the actions proposed at the meeting.

Future actions:

- FAO/UNU meeting to prepare action plan
- preparation of project proposal for international collaboration
- coordinating activities for staff and equipment
- coordinating activities for data generation

The discussions at the meeting re-evaluated many aspects of food composition data generation and use, with emphasis on the larger role of FAO.

Firstly, the convening of an FAO/UNU meeting to review progress and plan activities to advance food analysis and the development of food composition data bases. The intention is to provide a comprehensive review that will lead to specific action and the formulation of an advisory committee on international food composition work. UNU and FAO expect to create a forum for the exchange of information to benefit and promote future food composition work in all regions of the world.

Secondly, the preparation of a larger project proposal to consolidate the collaborative work between active centres and regional groups for the purpose of developing food composition databases and tables for international use.

Thirdly, possible activities to coordinate staff and equipment for work in food composition were discussed, for which the implementation needs to be arranged and funded:

1. **Set guidelines for laboratory environments** and standard environment specifications to improve planning for laboratory facilities.
2. **Support work on analytical quality through promotion of techniques and reference materials.** (Support for progress on analytical quality, through dissemination of standard techniques, including inter-laboratory tests and reference materials. Many developing countries do not have protocols for even simple procedures and their work can be supported by collecting unpublished information and disseminating comprehensive publication lists)
3. Continue the work of Codex Alimentarius, USDA and AOAC International in identifying protocols for similar analytical techniques, where experience points to cheaper, but suitable, methods.
4. **Support education and training for compositional work** related to sampling, analytical techniques, and data compilation, through publications and programmes at country level. Allow sandwich training to support analytical laboratories in-country at the same time as increasing capacity to maximise local resources and maintain locally available equipment.

   Fourth, possible coordinating activities for generating food composition were discussed, again depending on opportunities for collaboration and funding:

5. Promote a review of the Bellagio pie chart as a whole. The costs for the work in relation to the results needs to be discussed in a wider forum, incorporating trade implications and issues of technology transfer.

6. **Endorse INFOODS food and nutrient identification systems and tag names**, so as to encourage more coherent development of compositional databases in different countries.
7. Support the coordination of current work, such as the proposed work of data evaluation by IUNS, as well as INFOODS initiatives, including the IFID food consumption database.
8. **Provide** assistance to the users of food composition data, by providing access to data and **publications on sampling, quality criteria**, together with software support for local applications.
9. **Provide documentation on the legal aspects** of food composition data and its use in various jurisdictions, which would assist the documentation required for food analysis and data quality.
10. Discuss food composition at the country level as part of the ICN follow-up. Not only existing regional action should be targeted, but also areas that have not participated before in activities, such as Eastern Europe. In addition, further discussions are required for action in Africa, where language and cultural divisions will determine effective regional work.

It is intended that information is used directly by active country committees and regional groups, instead of data flowing through a central institution. The concept of meeting and sharing should be applied at all levels of work. In this context, the contributions of FAO would use an existing network with strong links to government authorities. Hence FAO may be able to make important contributions to future food composition work.

Collaborations Between INFOODS And FAO To Expand Sources Of International Nutrient Data

John C. Klensin, PhD, INFOODS Secretariat, Boston MA

The food composition data scene is evolving. In terms of relationships with the data of other countries and regions, the role of the US is shifting from that of an exporter of data and methods to one in which we need to import data and need to at understand the analysis and calculation methods used by others, rather than trying to insist that they change. A series of recent decisions involving the Food and Agriculture Organization of the United Nations (FAO), the United Nations University's International Network of Food Data Systems (INFOODS), and the International Union of Nutrition Societies (IUNS) are likely to accelerate this trend. After well over a decade of absence from the field, FAO has announced its intention to return to the food composition area. FAO activities will complement work done by INFOODS over the intervening years and developing cooperative agreements between the two UN organizations will strengthen the program areas of each other them. In addition, modest increases in available resources have also permitted restarting dormant IUNS and IUNS/INFOODS efforts in data quality and terminology for foods and food components and recasting the IUNS sponsorship of CODATA to make that relationship more useful and effective. These efforts will also be coordinated with FAO as appropriate.

This paper discussed these changes and where they are likely to lead from the perspective of the North American data user. It provided an overview of the various elements of development of food composition data and how the FAO/INFOODS arrangements will alter those relationships in the next few years. It then examined how data will be located and obtained in the world this work predicts and the implications of this for the shorter term.

Use of Nutrient Databases for Nutrition Labeling

FSIS Policies for the Use of Data Bases for Labeling

Linda P. Posati, Food Safety and Inspection Service, U.S. Department of Agriculture, Washington, DC

The Food Safety and Inspection Service (FSIS), U.S. Department of Agriculture (USDA), issued a final rule, "Nutrition Labeling of Meat and Poultry Products," on January 6, 1993. The rule establishes two labeling programs. First, it permits voluntary nutrition labeling on single-ingredient, raw meat and poultry products and establishes guidelines for this voluntary program. Second, it mandates nutrition labeling on most other meat and poultry products, which are multi-component, processed products. Both the voluntary and mandatory programs have data base components.

The voluntary labeling program is similar in scope to the Food and Drug Administration's (FDA) voluntary program for fruits, vegetables, and fish. It includes fresh cuts of meat and poultry, such as sirloin steaks, chicken breasts, and whole turkeys. Ground beef that is not seasoned is also a single-ingredient, raw product falling into this category. Any product not required to carry ingredient labeling, including fresh kosher meat and poultry cuts, qualifies for the voluntary program, provided it has not been subjected to a processing procedure that would change its nutrient profile.

The category includes both frozen and previously frozen products. FSIS does not believe that freezing significantly alters nutrient content. It also includes products subjected to mechanical treatments, such as grinding, cubing, shaping, cutting, and pressing. Thermally processed products are excluded although nutrient values for foods in the voluntary category may be presented on a cooked basis. FSIS does not make a distinction between products packaged and labeled at official establishments as opposed to retail establishments. Generally, poultry products are packaged and labeled at the plant and most red meat products are cut and packaged at retail. FSIS does not believe that the site where a product is packaged and labeled has relevance to its inclusion in or exclusion from the voluntary category.

The regulations covering the voluntary program specify that the most current data base values from USDA's National Nutrient Data Bank or its published form, the Agriculture Handbook No. 8 (AH-8) series, may be used for labeling of single-ingredient, raw products. Values should be declared as published, that is, as the representative mean values. If AH-8 values are used, either on labels attached to products or on point-of-purchase materials, such as charts and posters, the products will not be subject to FSIS compliance procedures unless the manufacturer makes nutrition claims. FSIS believes this exemption from compliance testing is appropriate because the AH-8 data for meat and poultry products are based on considerable research and have been screened and accepted by USDA's Human Nutrition Information Service.

Producers are free to use their own data bases to label single-ingredient, raw products. FSIS does not discourage this practice and does believe it is useful to point out unique features of specific products. However, foods labeled with private label values will be sampled for compliance. FSIS will not certify or accept private data bases, including national values of foreign countries, for the purpose of exempting such products from compliance procedures.

Both types of data - USDA and private label values - will be used to measure substantial participation in the voluntary program. Point-of-purchase materials, including those not considered to be labeling per se, as well as labels applied to products, will be used when they meet the guidelines for the voluntary program. FSIS will first survey retail stores between July 6, 1994 and May 1995. In May, it will issue a report on findings. Afterwards, FSIS will survey for participation on the same 2-year schedule as FDA will use for fruits, vegetables, and fish. The survey will cover about 2,000 stores. If 60 percent of these stores carry nutrient information on 90 percent of 45 major cuts of meat and poultry that are specified in the regulations and which they sell, FSIS will find substantial participation. If it is not found, the Agency will initiate rule making to determine if it should mandate nutrition labeling of these food products.

The AH-8 nutrient data that may be used for the voluntary program may be composite data. Composite values are obtained when analytical data on samples are weighted through sample selection or with factors obtained from production or marketing statistics. Examples are values for "all grades" of beef or "all classes" of turkeys. FSIS makes an exception when USDA data are used on labels attached to a product which is also labeled as to grade, such as Choice beef, or as to a class of poultry, like as a young hen turkey, and AH-8 contains values for those subcomponents.

Regarding point-of-purchase information, FSIS initially proposed that nutrient values presented for single-ingredient, raw products should be those for poultry cuts with skin on and for meat cuts with external cover fat at trim levels reflecting current market practice. The additional listing of nutrients for skinless poultry cuts and separable lean of meat cuts would be optional. However, when the food is in a package with a label attached, the nutrient values would have to represent the tissues in the package. This means that data for skin off poultry could be used alone only if the cut in the package were skinless.

Shortly before publishing the final rule, the Agency received new information on consumer trimming behavior with regard to beef and pork cuts from a study measuring actual plate waste of individuals in a national sample of households. Results showed that many consumers do trim fat from meat cuts but, on average, the amount of trimmable fat eaten was too high to support a position that separable lean values would be the more appropriate values for meat. Consequently, FSIS did not change its proposed position.

In the preamble to the final rule, FSIS indicated it allows flexibility in the use of AH-8 data so different tissues for cuts can be combined allowing for their proportions by weight. This position accommodates preparing declarations for combination packs of poultry cuts and calculating different trim levels for meat cuts. It facilitates declaring beef and lamb values for 1/8 inch external fat trim, which is now the market practice, versus declaring 1/4 inch trim values currently shown in AH-8. Work is presently underway by the National Live Stock and Meat Board to develop procedures to calculate the 1/8 inch trim values from existing data on these species.

FSIS had received about 1,100 comments on its proposed rule on nutrition labeling. While almost all commenters agreed with use of AH-8 values for the voluntary program, numerous commenters requested specific allowance for use of data bases to calculate nutrient profiles for multi-component, processed products to alleviate costs. Several companies submitted data validating the accuracy of the data base approach when compared to laboratory analyses on their products. In response, FSIS issued a supplemental proposed rule on March 5, 1992 to permit use of data base values and/or recipe analysis based on data base values to develop labels for food products subject to mandatory nutrition labeling. It requested input on criteria for data bases, guidelines it could supply to manufacturers to use this approach effectively, and information about availability of data bases. The latter includes computer systems with software packages for recipe analysis, as well as data base files. Also, the Agency asked if the compliance criteria should be changed in any way if data bases are used.

Based on the responses to this supplemental proposal, FSIS concluded that use of data bases, especially computerized systems, offers a powerful tool for developing nutrient declarations when used effectively. Consequently, the Agency specifically stated in the preamble to the final nutrition labeling rule that nutrient declarations may be based on data base values, recipe analysis using data base values, direct laboratory analysis, and/or a combination of these approaches. Under the FSIS regulations for the mandatory labeling program, manufacturers are responsible for the accuracy of their label values. They may derive their label values by any means that results in compliance. FSIS does require manufacturers to maintain records to support their label declarations and to make these available to authorized Agency personnel upon request. It specified that these records may consist of laboratory results or a company may introduce the existence of a data base. Records supporting a data base might consist of company ingredient analysis, USDA or supplier data on ingredients, formulas, and calculations applied to derive values.

Regarding compliance parameters consisting of the 80/120 tolerances, both the Agency and most commenters on the proposal believe they should be the same for all multi-component, processed products regardless of data source. To allow variation based on data source, such as chemical analysis versus recipe calculation from ingredients, would be inconsistent with the intent of nutrition labeling. For this reason, FSIS will hold manufacturers of all products not exempted from compliance review to identical compliance parameters.

FSIS recognizes that the data base approach to developing label values is a potentially complex issue involving considerations about accuracy, completeness, precision, and support. It prepared a manual to provide guidance and practical information to meat and poultry product manufacturers who choose to use data base values or recipe analyses to prepare label declarations for all or selected nutrients in their products. The information presented was obtained from many sources and includes USDA publications and comments received from experienced data base developers and users in response to a supplemental proposed rule on data bases. It also contains the conclusions of an expert panel of government and industry scientists and nutritionists on the use of AH-8 and other data bases for calculation of the nutrient content of meat and meat food products.

FSIS believes that the main advantages of using good computerized data bases are that they can provide accurate values over time, offer the ability to build and tailor information, are relatively economical compared to extensive laboratory testing, and are very fast. A number of companies indicated that, because data base values reflect numerous analytical data points, they find that calculated values frequently are more accurate than an initial analytical test and that running several additional tests will verify the calculated values. Using ingredient data bases minimizes seasonal profile swings to more accurately represent average nutrient composition year-round, whereas point analysis can vary across a range, depending on the conditions that exist at the time of manufacture of the food product. These facts are consistent with FSIS policy that values on food labels should preferably reflect average nutrient values in foods over time.

Meat and poultry products that are minimally processed or contain a few standardized ingredients especially lend themselves to a national data base, such as AH-8. However, manufacturers do need to determine if generic values for ingredients are suitable or if supplier data are needed to reflect their own unique ingredients and/or specifications.

Companies generally recommended using recipe analysis to calculate nutrient content of multi-ingredient products, as opposed to using a generic finished product nutrient composition, e.g., for a pepperoni pizza, to represent their own products' profiles. Using calculated data works quite effectively in many situations, such as for products formulated from ingredients with relatively consistent or well-characterized nutrient profiles. Calculation of the nutrient content of complex mixtures, such as meals and entrees, is also possible. Most manufacturers indicated that the more complicated the formulation or processing steps and the greater the natural nutrient variability of the ingredients, the likelihood that calculated values might deviate from analytical results on the same product increases. Discrepancies most frequently occur with fat, cholesterol, sodium, potassium, vitamins A and C, and thiamin.

Manufacturers of highly formulated products suggested performing periodic laboratory analyses to check data base calculations, especially for variable nutrients. Appropriate label values for different nutrients can be constructed using either the calculated or analytical values. When laboratory results differ from data base calculations, comparisons are valuable in that they can be used to develop formulas, such as prediction algorithms or retention factors, to account for differences. Such factors and accumulated laboratory analyses, when built into data base systems, yield even more accurate nutrient values over time.

FSIS believes that significant cost savings and reduced turnaround times can be realized if accurate calculated data can be used exclusively or to supplement limited analytical data because nutritional analysis is very expensive and time consuming. A complete analysis for one product can cost up to $600 per sample and take as long as 4 weeks to process. Analyses on several or more composite samples often are conducted on a new product to insure label accuracy since a single test represents only a snapshot of the food at the time of analysis. By contrast, food industry versions of many commercial data base systems cost less than $1,000 and, with timely updates, provide years of service. The cost to have a recipe calculation performed for a business by a data base vendor or consultant runs about $50 per formulation. Consequently, nutrient data bases can offer efficiencies to manufacturers and savings to both large and small firms and ultimately to consumers. Once a computerized data base system is set up and running, a calculation for label declarations can take as little as 15 minutes to complete. This speed of information translates to an accelerated timetable for launching new products and to enhanced market competitiveness.

FSIS has described the elements of three basic criteria in its data base manual that would mark a good data base for food labeling. These are accuracy, completeness, and specificity. Systems meeting these criteria would have an accurate and up-to-date nutrient data base, be complete for the foods and nutrients of interest, and permit specificity with respect to food descriptions and processing techniques. FSIS also provided some general, common sense guidelines for the effective use of data bases. These include the following:

- It is preferable to use recipe analysis over generic values. Unless processors are fairly sure their particular products are very similar in formulation to generic items, e.g., a frankfurter, they should not select such data base items to represent their products.
- It is important to use data base ingredients that are appropriate. It is very tempting to use existing data base entries for "similar" materials when, in fact, the ingredient used is not truly all that similar.
- Processors should use exact formula quantities. They now have an increased responsibility to assure appropriate uniformity from batch to batch and to determine when a new estimation is needed due to changes in ingredient composition or processing method.
- For some food products, it is necessary to make yield adjustments for inedible portions and cooking losses or gains.
- One should track moisture and fat changes because changes in these two components affect both the final yield and nutrient composition. Most manufacturers recommend laboratory analysis for these nutrients because they are variable in finished products and their analysis is

relatively inexpensive.

- For fried foods, determining fat absorption usually requires before and after cooking analysis for fat to establish the amount typically absorbed by a particular product. Once determined, calculating values for future products requires knowledge of the level of saturation of the cooking oil since saturated fat is now a required nutrient.
- It is very important not to ignore missing nutrient values. If required nutrients are present in significant amounts in an important ingredient but are missing in the data base, manufacturers should try to obtain that information from the supplier or from other sources.
- Adjustment should be made for losses of micronutrients using either standard retention factors for different cooking methods or tailored factors for special processing losses.
- Finally, calculations should be checked for reasonableness by comparing results to analytical data on the particular product or data on comparable products from other sources. Generally, combinations of data base and laboratory analysis, if only for check nutrients, ensure the most accurate results.

FSIS strongly supports the development and use of modern data bases for nutrition labeling. It believes that use of data bases, alone or in conjunction with analytical testing, can facilitate cost effective development of accurate nutrient declarations for meat and poultry products. Responsible use of a data base will produce values that meet the requirements of the nutrition labeling regulations and provide consumers with highly useful information. FSIS encourages firms to exercise fully their prerogative to use data bases to construct labels reflecting the average nutrient levels in their products over time.

Regarding compliance with the regulations, FSIS wants to stress that it is not its intent to proceed in a punitive manner against companies if problems should arise during compliance testing. FSIS does hold all manufacturers, whether they use direct analysis or data bases, to the same compliance parameters. In the event of problems, FSIS will review company records and work with the firms responsible for the product in question, including products based on data bases or recipe analysis, to locate the source of any problem so that it can be corrected.

FDA Policy On The Use Of Databases For Nutrition Labeling

Mary M. Bender, Ph.D., CFSAN, Statistician, Division of Technical Evaluation, Office of Food Labeling, HFS-165

Nutrition labeling of food products has been regulated by the Federal Government for 20 years. Regulatory activities directed toward the development of nutrition labeling regulations were first initiated by FDA in 1970, largely in response to recommendations of the 1969 White House Conference on Food, Nutrition, and Health. In the Federal Register of August 2, 1973 (38 FR 20702), FDA promulgated regulations that required nutrition labeling for certain foods: those with added nutrients or those for which a nutrition claim was made in either labeling or advertising. Some foods, such as fresh produce or seafood, were specifically exempted. The food industry was encouraged by FDA, however, to voluntarily provide nutrition labeling for a wider variety of food products, even those foods that were exempt.

With the promulgation of the nutrition labeling regulations in 1973, FDA determined that some form of advisory assistance should accompany the regulations to assist the food industry in developing label values that would comply with the regulations. A manual describing procedures employed by FDA to evaluate compliance with the nutrition labeling regulations was prepared that same year. While the manual did not provide specific procedures to derive label values, its purpose was to assist industry in constructing label values and in understanding the regulations. FDA realized, however, that the manual was sometimes misinterpreted.

In 1978 FDA completed the first Food Label and Package Survey (FLAPS) to determine the prevalence of nutrition labeling. Data indicated that 41.9% of the processed packaged foods sold bore nutrition labeling. [For your information, that percent rose to 65.9% in 1991]. The food industry has consistently expressed interest in providing more nutrition information, but at the same time they have often cited the costs of labeling as an obstacle.

Industry wide databases were suggested as a possible means of reducing the cost of developing nutrition labeling for individual companies. FDA, USDA, and the Federal Trade Commission (FTC) encouraged this concept in a notice published in the Federal Register on December 21, 1979 (44 FR 75990), describing the agencies' policies and intentions with respect to numerous food labeling issues. In that notice, FDA, while not agreeing to approve databases, stated that it would work with industry to resolve any compliance problems that might arise for food labeled on the basis of a database that the agency had accepted. More specifically, if a product bearing nutrition labeling from a database evaluated and accepted by FDA and manufactured in accordance with good manufacturing practices was found not to be in compliance with applicable nutrition labeling regulations, the agency would work with the firm to correct the problem before initiating compliance provision actions. In addition, FDA indicated that it would continue to reexamine compliance of the nutrition labeling regulations and would consider appropriate revisions as new knowledge, data, and methodology became available. The policy given in that 1979 notice is the same that is in effect today.

With the Nutrition Labeling and Education Act expanding mandatory nutrition labeling to nearly all foods regulated by FDA, greater interest has been expressed in the creation of nutrition labeling databases. While some manufacturers of food products not currently labeled have expressed interest in using industry wide databases for some food products, other manufacturers have considered using data available from other sources as, for example, the open scientific literature as the basis for labeling their products.

The policy of the Food and Drug Administration is that the choice of a data source is the prerogative and the responsibility of the firm or organization that provides a nutritionally labeled product. The firm or organization needs to be judicious in this selection, however, to ensure that the product labeling is in compliance with the regulations for that product. FDA has developed a manual which will be of assistance in identifying data that are of sufficient quality to provide an adequate basis for nutrition labeling. Guidance has also been given for when to use average values and when calculated values using equations given in the manual should be used. Label values for indigenous and fortified nutrients that are derived from such equations have the highest probability of meeting the regulatory requirements which the agency must enforce.

The manual is entitled *FDA Nutrition Labeling Manual: A Guide for Developing and Using Databases*. You may obtain a copy, free of charge, if you send an address label to Dr. James Tanner, Center for Food Safety and Applied Nutrition, FDA, 200 C St., SW, Washington, DC, 20204.

Please remember that the submission of a database to the FDA for the purpose of nutrition labeling is voluntary. The agency has not and does not intend to prescribe exactly how an individual company is to determine nutrient content for labeling purposes. The purpose of the manual is to serve as a guide to assist industry in the task of preparing nutrient information for labels which meet the requirements of FDA regulations. A firm or organization may follow the guide or may use alternative procedures even though they are not included in the manual. If a person does choose to use alternative procedures, however, that person may wish to discuss the matter further with the agency to prevent expenditure of money and effort on activities that may later be determined to be unacceptable to FDA. The manual does not bind the agency, and it does not create or confer any rights, privileges, or benefits for or on any person.

The manual gives generic instructions for developing and preparing an acceptable database when valid estimates of nutrient content and variation are not available for the nutrition labeling of either a single or a mixed product. Today many foods are already labeled, and a great deal of information already exists regarding factors that influence nutrient variability, such as variety, season, or species. Therefore, it might be possible to reduce the number of product samples to be assayed on the basis of previous data and the knowledge of which nutrients vary. It is expected that a firm or organization will present a sound plan of action for the development of a database from a knowledge of the products and the suggestions given in the manual.

When the planning stage for the development of a new database has been completed by a developer, it would be prudent to submit a proposal to FDA for assessment of its adequacy before any resources are actually used for data collection. This precaution may circumvent wasting resources on a data collection effort that, upon review of a final report, may prove to be inadequate. The adequacy of a proposal or of an already developed database, for the purpose of nutrition labeling, will be assessed through a written proposal or written final report that must detail pertinent facts relating to the planning and execution of the study. The data on which findings are based must accompany the final report.

The Agency understands that most companies will not have sufficient information to meet all the suggested criteria listed in the manual. We view this as a "gold standard" at which to shoot. By making an ongoing diligent effort, perhaps even over 5 to 10 years, a developer may be able to provide sufficient analytical data to fully comply with the different criteria given in the manual. Databases that are accepted by FDA will require periodic updating, depending on the type of product (single or mixed) the size of the accepted database, and the demonstrated stability of the nutrients over time.

Use of data from the open literature, as well as ingredient composition or "recipe" databases, have a similar problem in that the values given are generally average values based on an undetermined number of analyses. Ingredient composition databases do not usually have information available on the quality of the data of the components, the indicators of the methods of analysis, the sampling used to obtain the data, the design and execution of quality management procedures, or the loss of nutrients during the processing and handling of a mixed product.

FDA has indicated to certain associations that if a successful model can be developed to define the relationship between ingredient composition and final product composition, that accounts for nutrient losses in processing, the results might receive acceptance. Extensive analyses of ingredients and final product composition would be required, however, to develop and validate a successful model.

Several principles relative to the development of ingredient composition databases were recommended by companies and trade associations and have now been included as general guides in Appendix A of the manual:

1. Confidence in the quality of data, supported by documentation of data sources.

Companies maintaining or using ingredient composition databases must be able to demonstrate the data source used for each type of product and each nutrient for which ingredient composition databases are utilized.

2. Proper maintenance of the database.

Companies developing or using ingredient composition databases must have procedures in place to ensure that the values in the ingredient composition databases are reviewed and updated as needed and on a regular basis.

3. Specificity with respect to ingredients, product formulations and processes.

Companies using ingredient composition databases must have procedures in place to ensure that the nutrient values are used only for specific applications. For example, a company should have a procedure to ensure that nutrient data specific for one product formulation or process are not used to prepare nutrient declarations for similar product formulations or processes, without assurance that the data are applicable to those products or processes.

4. Validation of the database.

Companies developing or using ingredient composition databases must have procedures in place to ensure that nutrient values receive reviews, audits, and confirmation through nutrient analyses as often as necessary.

Compliance Policy

I'd like to take a few minutes now to review with you how compliance is determined by the agency.

FDA compliance policy has remained unchanged over the past 20 years. An FDA inspector will collect a random sample of food units of the same code or lot, a lot being a collection of containers or units of the same size, type, and style produced under conditions as nearly uniform as possible. The sample for nutrient analysis consists of a composite of 12 subsamples (consumer units), taken 1 from each of 12 different randomly chosen shipping cases, to be representative of a lot. Unless a particular method of analysis is specified, composites shall be analyzed by appropriate methods of the Association of Official Analytical Chemists (AOAC), delineated in the *Official Methods of Analysis of the AOAC, International* (15th Edition (1990), or in the supplements issued quarterly). If no AOAC method is available or appropriate, other reliable and appropriate analytical procedures may be used.

There are two classes of nutrients defined for purposes of compliance:

Class I substances are nutrients added in fortified or fabricated foods; and

Class II substances are naturally occurring (indigenous) nutrients. If any ingredient which contains a naturally occurring nutrient is added to a food, the total amount of such nutrient in the final food product is subject to Class II requirements unless the same nutrient is also added.

A food with a label declaration of a vitamin, mineral, protein, total carbohydrate, dietary fiber, other carbohydrate, poly- or monounsaturated fat, or potassium shall be deemed to be misbranded under section 403(a) of the Federal Food, Drug, and Cosmetic Act (the act) unless it meets the following requirements:

For a **Class I vitamin, mineral, protein, dietary fiber, or potassium,** the nutrient content of the composite must be at least equal to the value for that nutrient declared on the label.

For a **Class II vitamin, mineral, protein, total carbohydrate, dietary fiber, other carbohydrate, poly- or monounsaturated fat, or potassium,** the nutrient content of the composite must be at least equal to 80% of the value for that nutrient declared on the label. Both consider an associated level of analytical variability.

There is a third group of nutritional substances that compliance regulations address as follows: a food with a label declaration of calories, sugars, total fat, saturated fat, cholesterol, or sodium shall be deemed to be misbranded under section 403(a) of the act if the nutrient content of the composite is greater than 20% in excess of the value for that nutrient declared on the label. Again, the same statement on analytical variability applies.

Compliance with these provisions may be provided by use of an FDA accepted database that has been established following FDA guideline procedures and where food samples have been handled in accordance with current good manufacturing practice to prevent nutrient loss.

Policy On Nutrient Database Development And Use

I'd like to take a few minutes now to look at some of the specifics of FDA policy on recommended database development. The development of a database is a complex task that is comprised of several general steps. Those steps include product identification and associated variability factors, development of a sampling plan, collection of the samples, analysis of the laboratory test samples, statistical analysis, and interpretation of the results. Each of the steps can be performed in several different ways, and decisions made regarding the alternatives may directly affect the available resources, data quality, and the risk of making incorrect decisions.

Information on the variability of the nutrient levels in the product is crucial. For fruits and vegetables, variables such as variety, species, season, and geographic growing area need to be determined. For mixed products and/or products requiring processing, it is important to address the issue that the nutrient content may change during the processing or during storage before sale. Information on the variability of the analytical method for the nutrients of interest is also essential. If sufficient information on variability is not available, it will be necessary to perform a pilot study or perform a literature search to obtain the necessary information before developing the sampling plan.

The process of developing a sampling plan involves the resolution of a series of interrelated tasks that may be broadly classified as follows:

- Defining the sampling objective;

- Defining the target product population;
- Developing the sampling frame;
- Selecting the sampling method;
- Selecting the analytical methods.

In using a database for the purpose of labeling, careful consideration also has to be given to the statistical methodology that is applicable in deriving label values.

To increase the chance that the data will be of the desired quality, it is essential that these tasks, as a **minimum**, be given careful consideration, and that specific questions be addressed and resolved in the planning stage of the data collection effort.

A database which would be adequate for the purpose of nutrient labeling will reflect a satisfactory degree of data quality, and hence database accuracy. Data quality (the amount of error that is contained in data) depends primarily on the effectiveness of the considerations and implementations involving the activities stated earlier for database development. Data quality can be expressed in terms of four characteristics:

- **Precision** or the magnitude of the error of the estimate;
- **Representativeness** of the sample to the population;
- **Comparability** between data obtained from different sources;
- **Completeness** or adequacy of the amount of data actually collected.

Policy On Statistical Treatment Of Data: Compliance Calculations Vs. Means And Medians

Once an acceptable amount of quality analytical data has been accumulated, a value has to be determined to go on the label which will reflect the nutrient content of the product. This number may be calculated in several ways. We will not discuss the statistical intricacies today, however. If you obtain a copy of the manual, you will read all you've ever cared to learn about the compliance calculations. I would like now to briefly comment on some of FDA's policy on the statistical treatment of nutrient data, specifically on the issue of using means or medians versus FDA prescribed calculated values.

1. Mean and median values for nutrients do not provide information about the variability of the values. Measures of variability, such as standard errors or standard deviations, cannot be placed on food labels; there is inadequate space, and consumers would no doubt be confused by them. The use of compliance calculations, on the other hand, allows the variance to be considered when developing the nutrient values used on food labels. The calculations aid the consumer by providing conservative label values in which the consumer can have a high degree of confidence.

2. The use of mean and median values may sometimes be misleading. For nutrients that are normally distributed around a mean, there is a 50 percent chance that a mean or median value

on the label would fall above, or below, the actual levels of nutrients in the food. Mean values are also influenced by extreme data points called outliers. A few low data points will pull down the mean; high, isolated data points will inflate the mean. The probability that a serving of food will actually contain mean levels of nutrients or food components decreases as the variance increases and as the number of outliers increases. As a result, nutrition labeling values based on mean or median values may provide a low level of confidence.

3. The compliance calculations suggested by FDA give the consumer reasonable assurance that substances such as vitamins, minerals, and protein will be present at levels that are at least 80 percent of label claim. Calories, fat, cholesterol, and sodium, on the other hand, will be present at levels that are no greater than 120 percent of label claim.

4. It is important that all foods in the marketplace, whether processed packaged or raw commodities, be labeled consistently. Compliance calculations have been recommended and used since 1973.

5. Consumers and nutrition professionals benefit from the improved databases developed by industry, trade associations, and other groups. The use of FDA compliance calculations provides retailers, retail trade associations and other trade associations with an incentive to continue routine analysis of foods, to analyze more samples, and to improve analytical methods. The more properly done analyses, the more clearly defined levels of nutrients in foods. In addition, more analyses lead to better variance estimates. As better estimates of the variance of nutrient levels are obtained, the values that can be used for nutrition labeling become more informative.

Policy On Confidentially Of Databases

Many companies/trade associations have objected to any lack of confidentially of submitted databases. They do not want to see the information gained through analyses of products and ingredients released through freedom of information requests or used in unacceptable ways or for inappropriate products. In addition, participating companies sharing costs associated with the development of databases do not want their data to be available at no cost to companies that did not participate in its development. Formulations that are used to produce mixed products are also regarded as confidential company information, and companies feel that this information should not be available to anyone who requests it.

The agency is aware that the development of a database is costly, and that it may contain information that is of a confidential nature. We also agree that release of a database could reveal substantial proprietary interests in documents which have been submitted to the agency. Furthermore, it has never been the agency's intent, nor does it have the resources, to maintain and manage databases that are developed by manufacturers or associations. The agency believes that the availability of a database is therefore, the primary responsibility of the developer.

We will continue with the policy of assisting the developers of databases, providing guidance to those who ask for it, and evaluating databases for the products submitted for review. Confidentiality of such data will be determined and maintained in accord with regulations.

Those database developers who choose to do so are encouraged to make their information available through such compilations as the USDA Handbook No. 8, so that all may benefit from the additional analytical information. In the long run, recipe databases will be useful after extensive information is gathered and placed in these public information compilations.

I hope this has been instructive to you and again I thank you for the opportunity to speak to you today. Please remember that we are always there to help you if you have problems or need assistance in determining how to proceed with the development of a database. Our goal is to work with you in attaining the best label possible while continuing to satisfy the regulations the agency must enforce.

Mary M. Bender, Ph.D., CFSAN, Statistician, Division of Technical Evaluation, Office of Food Labeling, HFS-165

Based upon a presentation by:

James T. Tanner, Ph.D., CFSAN, Acting Special Assistant to the Director, Office of Special Nutritionals, HFS-450

The American Institute of Baking's Model System for Nutrition Labeling of Bakery Foods

James L. Vetter, Ph.D., American Institute of Baking, Manhattan, KS

I. Introduction

A. History

Up until the present time, the cost of developing the information needed for declaring the nutrient content of bakery foods was not a serious problem. Since nutrition labeling was essentially voluntary, a company could simply not declare nutrient content on most products, if the cost was considered excessive. Enriched white bread, rolls, and buns were required to be nutritionally labeled because the term "enriched" as part of the product name was considered a claim relative to the nutritional value of the food.

Although some companies did voluntarily nutritionally label some of their products, most companies chose to not incur the cost required to develop the information needed for labeling bakery foods.

The Nutrition Labeling and Education Act of 1990 (NLEA) and its provisions for mandatory nutrition labeling of most consumer food products eliminated the option to not provide nutrition information. Furthermore, the requirement that nutrition information must be provided in labeling for unpackaged products extended nutrition labeling beyond what many of us expected when mandatory nutrition labeling was talked about prior to the NLEA and the regulations promulgated for its enforcement.

B. Need

Therefore, about the time the NLEA was signed into law, there was increasing discussion of the need for a lower cost alternative to laboratory analysis for nutrition labeling of bakery foods. There were literally tens of thousands of small bakeries (retail and in-store bakeries) that would be faced with the need to provide nutrition information for their products. Most of these bakeries would produce several hundred products and were facing costs in excess of $100,000 in order to comply with the new requirements. Faced with this type of expenditure, many operations were forced to consider shutting down. The economic burden was no less severe for the larger wholesale baking companies, even though their sales dollars might be well above the small business exemption level set by the NLEA.

AIB began to think seriously about developing a "data base" for the nutrition labeling of bakery foods. We thought this could be an excellent service to offer to the baking industry.

C. Approach

We soon realized, however, that a simple data base of nutrient content information for specific bakery foods was not going to work. The "real world" situation was much more complicated that a simple nutrient profile for chocolate chip cookies or multi-grain bread. There are too many recipes for each individual type of bakery food to allow one nutrient profile to apply to all variations of the product. There are rich, high quality chocolate chip cookies, and there are less rich, lower costing chocolate chip cookies for the shopper with economy on the mind.

Therefore, in consideration of regulatory compliance requirements, it became obvious that meaningful nutrition information for a product would have to be formula specific. Nutrient content data should be generated from information on the specific ingredients used in a specific formula. There might even have to be adjustments for changes caused by processing.

We were not sure of the degree of cooperation we might receive from ingredient manufacturers who would be expected to provide nutrient content information on the ingredients they supply to be baking industry. Also, we were not sure of the extent to which the baking industry would be willing to release formula information even under a signed nondisclosure agreement. We were sure, however, that if we decided to move ahead, we had a tremendous task ahead of us.

We began to contact ingredient suppliers and assessed their attitude toward cooperation. We asked bakers to indicate their interest by contributing to the financial cost of developing the program. Response was generally positive from both suppliers and bakers.

Our program started with a small scale feasibility study and, as we continued to get positive results, we continued to expand our program. One of our initial primary objectives was to obtain FDA acceptance of our end result for use in nutrition labeling of bakery foods. Therefore, we knew we needed FDA's input in terms of characteristics of the end product and how to demonstrate the efficacy of the system we were developing.

D. Interaction with FDA

We wanted FDA's cooperation and guidance because of its policy on data bases as stated in the Federal Register on December 21, 1979 (44 Fed. Reg. 75990): "If products bearing nutrition labeling in accordance with properly (FDA) evaluated nutrient databases and manufactured in accordance with good manufacturing practices are found not to be in compliance with applicable nutrition labeling regulations, the agency will work with the firms responsible for the product in question and with the appropriate authorities who are maintaining the applicable nutrient data base to correct the problem before initiating compliance provision actions."

We met frequently with the staff at FDA's Center for Food Safety and Applied Nutrition. We answered questions, our progress reports were critiqued, and we received advice on how to meet FDA's nutrition labeling compliance requirements. We were told early on that it would be difficult for FDA to accept our data base for labeling bakery foods if we simple sold the data base and computer software for converting formulas to nutrient content information. We needed a "system" for managing the program and ensuring its continued validity.

We received from FDA on January 6th of this year, a letter signed by Dr. Fred Shank, stating in part, "...the model system developed by AIB may be used on an interim basis for labeling purposes, provided that AIB agrees to continue working on the system to meet the above criteria. At the end of a two-year period FDA will again review the status of your model system to determine what further corrective actions might be necessary."

II. Description of AIB's System and Method of Operation

A. The System

We emphasize the term "system" in describing the service we are offering to the baking industry, because our program is indeed a system and not just a data base of ingredient information coupled with a software program for converting formulas to nutrient content information. We do, of course, have a data base of ingredients and nutrient content profiles on these ingredients. And, we do, of course, have a software program for converting formula, processing, and finished product information to nutrient content information meeting the requirements of regulations promulgated to enforce provisions of the NLEA for nutrition labeling.

In addition to these vital components, our system includes the following:

1. Technical review of nutrient content information provided by ingredient suppliers.

2. Technical review of formula, processing, and finished product information provided by bakeries using our program.

3. Technical review of end product label information generated by our computer program.

4. Continued monitoring of the system and verification of its efficacy in providing valid nutrition labeling data.

A brief discussion of each part of our system follows.

1. *Technical review of ingredient information.* A key component of our system is the nutrient content information on the ingredients used by baking companies enrolled in our program. The baking companies submit to us on our forms a listing of ingredients, brand names, and suppliers. If the ingredient is not already in our data base, we contact the supplier and request the specific information we need.

We review the information provided by the ingredient supplier to determine its suitability for incorporation into our data base. The vast majority of technical information is quite satisfactory, but we have also encountered a number of errors that might be overlooked by someone not qualified to conduct such a technical review.

a) One product was reported to have 120 g. of carbohydrate in 100 g. of the product and a calorie content of 841.5.

b) Many suppliers fail to report saturated fat in addition to total fat and the break down of total carbohydrate into sugars and total dietary fiber.

c) The total proximate analysis of one product totaled only 57%. We had no way of knowing what was in the remaining 43%.

d) The 351 calories reported for a blended product were contributed by the 39 g. of fat (39 X 9 = 351). The product reportedly had no moisture. What constituted the remaining 61% of the product? Surely some of it was protein or carbohydrate at 4 calories per gram.

e) Even though asked to provide the calories in 100 grams of product, one manufacturer reported 25.5 calories per 7.09 g.

We feel the technical review of ingredient content information is an essential part of our total system. Whenever nutrient content data for ingredients are added to a data base, the information must be screened for accuracy by a trained individual to avoid errors that could lead to false label declarations.

2. *Technical review of formula and processing information.* Bakers are asked to submit formula and processing information on our forms. This information is reviewed for completeness and obvious errors prior to processing for nutrient content calculation. Again, although the vast majority of forms are complete and correct, we still encounter a number of situations that need some type of modification before accurate nutrient content information can be calculated.

a) There is considerable confusion over determination of label serving size; this is sometimes reflected in wrong information being submitted on the forms we receive.

b) Information on yield of finished product from a batch of dough or batter is critical in calculating nutrient content of the product; our expert baking technologists are able to detect most major errors in reporting of yield.

c) Ingredients are sometimes listed with incomplete designations (dry or liquid eggs, type of sweetener in "liquid sugar", enriched or unenriched flour, etc.). These require follow-up contact with the bakery.

d) When a company submits there own version of a computerized formula sheet in place of completing our form for formula and process information, we some times find omissions and incomplete declarations.

This technical review process helps ensure the validity and accuracy of the nutrition labeling information generated by our program.

3. *Technical review of final nutrition labeling information.* Finally, before the nutrition facts information generated by our system is forwarded to the participating bakery, we provide one last technical review to ensure that no gross errors have occurred. We cannot, of course, verify the accuracy of each number, but we can certainly determine whether or not the information appears to be correct for the product in question.

B. Operation of the System

In response to requests for detailed information concerning the system, we distribute a package of information. This package includes:

1. A signed nondisclosure of proprietary information agreement. We commit to maintaining as confidential any proprietary information provided to us by a client using our service.

2. Forms and instructions for providing ingredient information.

3. Forms and instructions for providing formula and processing information. Examples of completed forms are provided to illustrate how information is to be submitted.

4. An example of a final report.

We have imposed some limitations on our system. We are providing nutrition labeling information for mandatory ingredients plus thiamin, riboflavin, and niacin only. We do not provide information for voluntary declarations such as monounsaturated fat, soluble and insoluble fiber, potassium, etc.

We are not making recommendations on the possibility of using optional formats. This is, however, a service we might provide under separate contract with a client.

We advise clients that nutrition labeling information should be recalculated if a formula or ingredient is changed in a way that might effect declarations.

The system is operational. We will increase computer input staff as needed to keep up with demand. We expect our work to peak in July and August and fall off rapidly as we approach October. This will give bakers the time needed to order and receive delivery of new packaging material before the effective date of May 8, 1994.

Following this initial surge of activity, we expect a continuing, but much lower level of activity as bakers develop and introduce new products or modify current products.

III. Current Status

A. Ingredients

At the present time, we have approximately 6000 ingredients in our data base. These are ingredients used specifically by bakeries planning to use our service. For the most part, they are listed by brand name and include various types of flours, sweeteners, shortenings, and all other ingredients commonly used in the baking industry. The data base also includes a number of formulated ingredients such as mixes, fruit fillings, icings, etc.

Ingredients that are essentially pure chemicals are listed generically. These include materials such as salt, chemical preservatives, emulsifiers, sugar, gums and other stabilizers, etc.

B. Baking Companies

Approximately 300 wholesale and large retail baking companies are currently participating in our program. Another approximately 200 companies have requested the forms and instructions. The Retail Bakers of America's program will go on stream about June 1st and will bring hundreds of smaller retail bakers into the program. We expect to end up with at least 1000 companies in the program.

C. Formulas Processed

We have processed about 2000 formulas and have recently reached an output of several hundred formulas per day. Our anticipation is substantially higher than 2000 formulas or 200 per day.

IV. Future

A. Continuing Operations

We expect activity to drop off substantially as our clients receive the information needed to have packaging or labeling material in compliance with requirements by May 8, 1994. However, we expect a continuing low level of activity as bakers develop new products, change formula for existing products, or convert to new ingredients.

We are planning to offer additional services that would utilize our data base and be of value in the development of new, improved, or modified products.

We are not anticipating a major broadening of our market beyond the baking industry.

B. Maintenance of System

An important part of our commitment to FDA in developing this model system was the continued maintenance of the system. We will keep the program operational so it can be used to update data when formula or ingredients are changed. We plan to contact suppliers on a regular basis to inquire about changes in ingredients that might effect the nutrient content information in our data base.

We plan regular communication with our bakery clients as a mechanism of relaying new information or reminders to recheck calculated labeling data.

C. Monitoring the System

Within the next month or two we hope to initiate a new series of contacts with FDA as required by the letter of acceptance of our system. One of the major items of discussion will be the mechanism for monitoring the continuing validity of our model system. We have a two year time period in which to determine what further corrective actions might be necessary in order to maintain the use of the system for labeling purposes.

V. Summary

The American Institute of Baking, with the cooperation of bakers, ingredients supplier, and most of all the FDA, has developed and is implementing a model system for determining the information required for the nutrition labeling of bakery foods. This system has been accepted by FDA for use in labeling of bakery foods. We have committed to a continuing maintenance of the system and a relationship with FDA in monitoring and improving the system.

This system not only offers the baking industry considerable relief from the economic burden of complying with the requirements of mandatory nutrition labeling, but helps fulfill one of the objectives of the Nutrition Labeling and Education Act of 1990---to provide meaningful information on nutritional characteristics of food products as a means of assisting consumers in choosing foods for a more healthy diet.

Use Of A Custom Database For Nutrition Labeling And Consumer Information

Janet Helm, MS, RD, McDonald's Corporation

Since 1973, McDonald's has made nutrition information available to help customers make informed choices. A variety of nutrition materials are offered including McDonald's Food Facts, which will be revised to be consistent with NLEA. Additionally, McDonald's was the first quick service restaurant to post complete nutrition and ingredient information with a permanent in-lobby poster.

McDonald's database is comprised of analytical analysis from Hazelton Laboratories and McDonald's suppliers. The industry version of Food Processor II is modified to include the analytical analyses of proprietary products. Data is entered for individual product components to allow for a calculated analysis of completed menu items. To maintain and update menu items, the "recipe" can be adjusted using the software program. The analytical analysis is supplemented with values from Food Processor II to complete the "recipes" (e.g., lettuce, tomatoes). Calculated analyses are frequently used for test products and to obtain an early estimate prior to the analytical analyses.

Database Considerations for In-Store Nutrition Shelf Labeling

Karen Falk, Graphic Technology Inc., Industrial Airport, Kansas

The supermarket may be the most regularly consulted resource for nutrition information because of the availability of nutrient information on the product label and the frequency with which the supermarket is visited. While product labels will soon carry consistent and more easily understood nutrition data, as a result of the new FDA labeling regulations, the interpretation of that data from "2 grams of fat" to "Low Fat", as an example, may be most effective in influencing purchases and therefore consumption.

The interpretation may be offered on the product label, or on the shelf label. When provided on the shelf label, a database must be maintained with product-specific nutrition data, which must append to data usage for daily store operations. The interpretation must be based on the specific criteria as defined by the FDA (1).

Reviewed here are the mechanics of supplying nutrition information on the shelf label and the status of consumer understanding of nutrition issues. Finally, repeated studies supply proof that nutrition information presented on the shelf label is used by the consumer and does indeed influence purchase decisions.

The Basic Shelf Label

The shelf edge label, located directly under the product, is primarily in place for store operations. A supermarket may have upwards of 25,000 pre-packaged products, including non-consumables, so inventory management is feasible only with an efficient tracking system.

The key to this system is the UPC number, most commonly seen as a 10 digit number (2). The UPC, or Universal Product Code, is the number that distinguishes an individual product from another.

The first 5 digits of the number are assigned to a manufacturer by the Uniform Code Council, and identify the manufacturer of the product. The last 5 digits refer to a specific size of a specific product. The total of 10 digits identifies the manufacturer and the specific product produced by that manufacturer. The UPC number, is critical to the efficient tracking of price and inventory information, as well as nutrition information.

With 25,000 products, entering the 10 digits by hand would significantly impede supermarket activity. Efficiency, then, requires the use of the bar code. This series of lines is a representation of the UPC number. A laser beam provided by the scanner measures the black *and* white area to interpret a number. The clarity with which the bar code is printed, will determine its' scanability. When a product will not scan, the store clerk must stop to enter a series of 10 numbers by hand - they comprise the UPC number.

The UPC number is always referred to as a 10-digit number, but the Uniform Code Council refers to it as a 12-digit number - 6 digits referring to the manufacturer and 6 digits referring to the product. The 6 digits allow for the day when 5 digits are insufficient to account for all manufacturers or all of the products they manufacturer. At present, the first and last digits of the 12-digit number are 0's, and are ignored for data processing. A total of 12 digits must be anticipated in any building database, but at this time only 10 are critical.

There is a 6 digit UPC number, referred to as the Version E UPC. It is most often used on products with labels too small to illustrate all 10 digits. The 6 digits are also representative of a 10-digit number, and based on the value of the last digit, a series of digits will automatically be inserted somewhere in the digit series to expand the 6 digits to 10 when scanned.

Since the shelf label is used primarily for store operations, the nutrition data must be attached to the flow of existing data. That is accomplished by attaching the nutrition data to the UPC number.

Considerations for the Shelf Label With Nutrition Added

On the basic label, the only information directed to the consumer is the price, and the unit price. Adding more consumer information, in the form of nutrition descriptors, requires that more attention be given to attracting the customer to the shelf-edge label. Adding color and graphics, therefore, become important enhancements to the nutrition label.

The description on the shelf label is nearly always shortened to 25 characters to fit on the small label. This shortened description becomes an additional field in the database, which must store both the full and shortened description.

Because 9% of the overall U.S. population speaks Spanish as a first language (26% in Texas and California), GTI offers nutrition descriptors in Spanish and English (3). "Bi-lingual" is a difficult issue for product manufacturers to address because of the limitations of product label size and the complete duplication of information required. For the shelf-edge label, it is feasible to provide the nutrition descriptors in Spanish as well as English.

The most important consideration for adding nutrition information to the shelf edge label, however, is the FDA-established criteria that defines each descriptor. The shelf label is seen as an extension of the product label, when nutrition information is displayed, and it is important that the same criteria apply to the shelf label descriptor as to any product label descriptor. The consumer expects and must receive consistent definitions for the terminology, wherever it is seen.

FDA Criteria for Nutrition Descriptors

The criteria for descriptors is changing with the finalization of the FDA labeling regulations, issued in January of this year (1). The enforcement date for the regulation is May of 1994. The new definitions for the 6 categories used in the GTI program, are as follows;

Calorie	Low Calorie	40 calories or less per reference serving size, as long as the serving size is over 30 grams or over 2 tablespoons. Meals or meal products are 120 calories or less per 100 grams
	Calorie Free:	5 calories or less per reference serving size.
	Sugar substitutes are excepted.	
Sodium	Low Sodium	140 milligrams or less per reference serving size, as long as the serving size is over 30 grams or 2 tablespoons. Meals or meal products are 140 milligrams or less per 100 grams.
	Sodium Free:	5 milligrams or less per reference serving size.
	Very Low Sodium:	35 milligrams or less per reference serving size.
Fat	Low Fat:	3 grams or less per reference serving size, as long as the serving size is over 30 grams or 2 tablespoons or more. Meals or meal products are 3 grams fat per 100 grams and not more than 30% calories from fat.
	Fat free:	.5 grams or less per reference serving size.
Cholesterol	Low Cholesterol:	20 milligrams or less of cholesterol, 2 grams or less of saturated fat, and 13 grams or less of total fat per reference serving size.
	Cholesterol free:	2 milligrams or less of cholesterol, 2 grams or less of saturated fat, and 13 grams or less of total fat per reference serving size.
	If fat or saturated fat is over the criteria amount, the actual amount must be declared on the label.	
Fiber	Good source of fiber:	10 - 19% of 25 grams for dietary fiber, or 2.5 to 5 grams per reference serving size.
	Excellent source of fiber:	20% or more of 25 grams, or 6 grams or more of dietary fiber per reference serving size.
	If product is not also low fat, the label must disclose total grams of fat.	
Calcium	Good Source Of Calcium:	10 - 19% of 1000 milligrams or 100 milligrams to 190 milligrams of calcium per reference serving size.
	Excellent Source Of Calcium:	20% or more of 1000 milligrams or 191 milligrams or more of calcium per reference serving size.

The change that affects every category is the serving size. The new regulation provides a list of 131 reference serving sizes. The serving size referred to in the new criteria is no longer the manufacturers' serving size but the reference serving size. "Low Calorie", as an example, must fit at least the reference serving size and if it does not also fit the manufacturers serving size, the reference serving size must appear in parenthesis behind the Low Calorie descriptor.

If a product fits the descriptor "Low Calorie", like Birdseye Asparagus, but all frozen asparagus fits the "Low Calorie" criteria, it must be referred to as a "Low Calorie Food". This part of the regulation fits every category, as does the serving size regulation.

The Database

A database, for the purpose of providing a descriptor or descriptors at the shelf edge, requires constant updating (4). New products and new product formulations enter the market daily. Too complex for any one grocer, central data handling makes nutrition descriptors at the shelf edge, obtainable by most grocery chains. The nutrition database maintained by Graphic Technology contains over 30,000 items, including regional products from across the country.

There are 13 nutrient categories on the new product label, and GTI provides shelf labels in 6 of those categories. The database, however, must accommodate many other pieces of information relating to the product, in order to provide the nutrition descriptors in the 6 categories:

- A shortened word description for the shelf label and a complete word description for reference.
- A commodity class code, which allows the implementation of "edit" checks (5) across a category of foods - this code makes it possible to compare the product with the serving size section of the regulation and the application of a term like "Low Calorie Food", when all products in the class fit into the same category.
- Easy access to the manufacturers' address and phone number - there are 800 manufacturers represented in the GTI database.
- The UPC number - several sizes of the same are represented different UPC numbers.

The 13 categories of nutrition information, therefore, are only a small part of the 110-field database. To classify a product as "Low Cholesterol", for example, amounts for cholesterol, saturated fat and total fat must be considered. Additionally, the commodity class, UPC's, and many other fields must be considered to classify a product as "Low Cholesterol" - up to 62 fields in all.

Data Collection

The source of our nutrition data is the manufacturer, either directly or indirectly. Though updated information is routinely requested, it is likely that the product will appear on store shelves before it is received from the manufacturer. Nutrition information is collected and confirmed weekly in local Kansas City stores and several grocery customers actively supply label information on new *regional* products.

The manufacturer most often supplies nutrition data in the form of the product label. Sometimes the laboratory analysis is provided.

A form is occasionally requested, for the manufacturer to complete and return. In fact, data is not accepted in this form. True for any data assembly, the greater the number of hands that touch the data, the greater the chance for error. As an example, nutrition information was supplied for a well known brand of vegetable oil, that claimed 14 grams of carbohydrate and 0 grams of fat. These figures were erroneously reversed and this error was obvious. A more obscure error of this kind, however, could have resulted in an error on the shelf label. Therefore, data is requested in label or lab analysis format.

The Store Match

The data processing that remains, is to match the nutrition data in the GTI-DDS database with the master file of the grocers' products. The items on both lists are recorded side by side where a final visual edit check compares the product description of the grocers' file with the product description in the nutrition file. Since both files have shortened descriptions, any ambiguity of description matches results in deletion of the item. Presently, between 3500 and 4000 items are matched per store.

Consumer Perceptions

Beyond the technical issues, how the customer perceives the value of nutrition information at the shelf edge, is critical. Fortunately, Giant Food Inc. and the FDA have done repeated studies of the effectiveness of nutrition shelf labeling. First, it is helpful to further understand customer perception, by determining their current level of knowledge.

According to the second annual National Nutrition Quiz conducted by the Food Marketing Institute (6), when asked about the source of cholesterol only 34% knew that it was found only in foods that come from animals. Approximately 50% thought that beef and chicken had some fiber.

A Roper poll published in 1989, reported a total of 52% of consumers examine the *food label* (nutrition panel and ingredients listing) as a source of nutrition information - more than any other source (7).

The Trends Report, published by the Food Marketing Institute (8), measures consumer attitudes about a variety of issues important to the grocery industry. Just released was the 22nd annual report. One question asked of those surveyed, was "What is it about the nutritional content of what you eat that concerns you and your family most?" The responses were, in this order, fat content 54% (up from 13% in 1985), salt content 26% (up from 19% in 1985), *cholesterol* levels 23% (up from 10% in 1985), and of all the major issues, *calories* was only 15% (up from 9% in 1985).

Consumer Reports, May 1993 (9), reported that consumer interest in fats is greater than interest in any other food component. The market has driven food technologists to produce no-fat foods, which have either no detectable fat or negligible amounts (no more than half a gram of fat per serving).

Fat replacers, according to the article, have not made the splash their manufacturers had hoped for. It was predicted that annual sales of fat replacers would quickly exceed $1 billion, but by 1992, they still had not topped $100 million.

Today, the most successful fat-free foods are Entenmann's, and other baked goods that can have an appealing texture with hardly any fat. In contrast, dairy products such as no-fat ice cream have been less successful because of the difficulty in duplicating the full flavor and creamy texture, or "mouth feel", of authentic fat. The Low Fat options, therefore, may have the most appeal.

From Trends, an important figure to any nutrition educator and to any grocer, is that 97% of shoppers cited nutrition as important to their food selection. Nearly everyone who walks through the door of the grocery store is influenced in some way by nutrition value. More importantly, this figure has changed very little in the past 5 years.

Giant Food - Repeated Studies

If the grocer is to provide assistance to the shopper looking for nutrition information, the most effective location is at the point-of-purchase where it is estimated that 65% of purchase decisions are made (10). Efforts to provide nutrition information on posters or handouts, have been able to raise awareness about certain health issues, but have not succeeded in changing purchase behavior (11).

Posters and handouts are most effective when used to support the nutrition shelf label which has been proven to effect purchase behavior. The proof comes from 2 studies; the first dated 1985 (11) and the second dated 1992 (12), conducted by Giant Foods, Inc. and the FDA *Division of Consumer Studies*. Giant, a 154 store chain based in Landover, Maryland, has posted nutrition shelf labels since 1981.

In the study, 10 stores from the Washington D.C. area which varied in size and socio-economic characteristics, were matched on the basis of those characteristics with 10 stores from the Baltimore, Maryland area. The Washington stores had a nutrition program called "Special Diet Alert" with nutrition labels posted at the shelf edge. The Baltimore stores did not have the program.

For 2 years after "Special Diet Alert" was introduced in Washington, consumer purchases were tracked through computer assisted checkout data, provided by Giant Foods. The relative market shares of these products were tracked. The pattern of differential sales trends across 16 individual food categories of shelf-marked products, increased an average of 6% over the 2-year evaluation period in the Washington D.C. stores.

A second study replicated the previous successful trial of the program in Washington, D.C. Over the 2-year evaluation period, market shares of shelf-tagged products increased 12% on average in 8 of 16 product categories that had been included in the original program trial. Data for the second section actually was collected in 1989, so in 8 years, the effectiveness had doubled.

Measuring by Market share offers a *control* for differences in store size. The length of time, 2 years, controls for other variations like seasonal differences.

Increasing market share does not indicate that more merchandise is being sold - it means that sales within product categories have shifted in favor of a brand labeled with a nutrition descriptor. A 12% increase in market share tells the grocer that he is supplying a program customers are using. If they use it, they will *return to his store to use it*, so he is building customer loyalty.

Conclusion - The Real Value of Nutrition at the Shelf Edge

Finally, shoppers of Giant Foods were surveyed at the end of the study - *31% of all shoppers said they were using the labels* with greatest use in those between ages 40 and 64.

The opportunity to capture the attention of the hurried shopper is defined in seconds and any nutrition message communicated in the grocery store must be simple, and clearly presented. Another example of an effectively communicated nutrition message is "5 a Day" (13), a program co-sponsored by the National Cancer Institute and the Produce for Better Health Foundation. Consumers are instructed to consume at least 5 servings daily of a combination of fruits and vegetables. "5 a Day" has been adopted by 85% of the major supermarket chains in the country. When it is completely adopted by the consumer, this simple message, effectively communicated at the point-of-purchase, could be instrumental in reducing cancer and heart disease.

Effecting purchase behavior, as shelf labels do, does indeed effect consumption behavior. That is the desired goal of any nutrition education program, and certainly the goal of nutrition labeling at the shelf edge. It is possibly the most universally effective form of nutrition education.

References

1. Federal Register, Part IV, Department of Health and Human Services, Food and Drug Administration. 21 CFR Part 1, et al. Food Labeling; General Provisions; Nutrition Labeling; Label Format; Nutrient Content Claims; Health Claims; Ingredient Labeling; State and Local Requirements; and Exemptions; Final Rules. Wednesday, January 6, 1993.

2. Bar Code Scanning; Reference Guide. MSI Data Corporation, Costa Mesa, CA. Copyright 1980, Second Printing 1981.

3. Bureau of the Census, 1990 Redistricting Tabulations to 1989 United States Census. Public Information Office, March 11, 1991.

4. Pennington JAT, Wisniowski LA, Logan GB. In-Store Nutrition Information Programs. J of Nutr. Educ., Vol. 20, No. 1:5-10.

5. Murphy SP. Integrity Checks for Nutrient Data. Proceedings of the 14th National Nutrient Databank Conference, June 19-21, 1989, Iowa City, IA. Stumbo PJ, ed; The CBORD Group, Inc., Ithaca, NY.

6. Food Marketing Institute. Shopping for Health, a Report on Diet Nutrition and Ethnic Foods, 1993. Research Department, Food Marketing Institute, Washington, D.C. and Research Department PREVENTION Magazine, Emmaus, PA.

7. Bender MM, Derby BM. Prevalence of Reading Nutrition and Ingredient Information on Food Labels Among Adult Americans: 1982-1988. J. of Nutr. Educ., Vol. 24, No. 6:292-297.

8. Food Marketing Institute, Washington, DC., Trends in the United States: Consumer Attitudes and the Supermarket, 1993.

9. No-Fat Foods: Less than Meets the Eye? Consumer Reports, May 1993:279-283

10. Point of Purchase Institute, Englewood, NJ.

11. Levy AS, Mathews O, Stephenson M, Tenney JE, Schucker RE. The Impact of a Nutrition Information Program on Food Purchases. J of Public Policy and Marketing, 1985, Vol. 4:1-13

12. Schucker RE, Levy AS, Tenney JE, Mathews O. Nutrition Shelf-Labeling and Consumer Purchase Behavior. J of Nutr. Educ., March/April 1992, Vol. 24, No. 2:75-81

13. 5 a Day - for Better Health", Produce for Better Health Foundation, Newark, DE.

Capstone

"Current Status, Continuing Challenges"

Carol T. Windham, PhD, *Utah State University*

Capstone: "Current Status, Continuing Challenges"

Carol T. Windham, PhD, Associate Professor, Department of Nutrition and Food Sciences, Utah State University, Logan, UT 84322-8700

Each of us is acutely aware of the increasing complexity of our food supply and how it affects our work. Today's consumer selects from foods that arrive at our markets from our own fields and streams, as well as from around the world, in a variety of fresh, processed and packaged forms. Our research in food composition and consumption is made even more complex by the tendency for more meals to be eaten outside of the home: in the workplace, the school system, at fast food and conventional restaurants. There is also the delightful addition of foods resulting from the cultural diversity of our society and the foods associated with those cultures. The concern about the relationship between food components and major public health problems - from anemia to cancer - also help explain why we feel overworked, overwhelmed, and overly-challenged.

As I worked with the program committee to organize this conference it seemed that the program that emerged was as diverse, and in some ways, as disconnected as our food supply sometimes seems to be. I wondered if some of the topics would be as transient as many of the 10,000 foods that are reported to move in - and then very quickly out - of our market place each year. Having attended most of the sessions of this 3-day conference, my perception has changed. I see something different, something less frantic emerging. Despite the diversity of topics, I sense a "coming together" to focus more realistically on what we can do now, with what we know now, and on what we must develop for the immediate future without sacrificing long-term vision.

As I was preparing to attend this conference, I looked through some of the previous Databank Conference proceedings. We have made significant progress during the last two decades. I was, however, struck by comments of Dr. Jack Filer at the 11th conference, in 1986 at the University of Georgia: "We need accurate food composition tables that are commensurate with the wide variety of foods eaten so that nutrient intake can be adequately assessed. . . . Unless the nutrient data base is accurate, little purpose is served by attempts to relate dietary intake of these nutrients to health status." (Emphasis mine). I do not disagree with his basic premise, but is appears that Dr. Filer was talking about the "ideal," which I think we have all been striving to achieve for the last 10 to 15 years:

delivering more accurate and precise data now;

providing data for every nutrient of interested to anyone;

forecasting what nutrients or food components will be wanted next by nutritionists or policy makers;

examining and re-examining food intake methods - 24-hr recalls, records, frequencies - to find out which gives the most accurate estimates;

developing and applying new and different methods to examine data - regression, log-linear, probability approaches, factor analysis, cluster analysis, pattern recognition - and determining how we interpret and compare results from such diverse techniques;

trying to deliver complex consumption data faster;

responding to new labeling regulations, with databases developed by individual manufacturers, without driving up the cost of foods or driving consumers away from the very information we believe they need in order to make informed food choices.

Kristin McNutt, in her keynote address, stressed the importance of identifying "what needs fixing now" and "who needs to fix it." She advocated addressing feasible problem areas while identifying information gaps that must be "fixed" for future investigations. Other speakers discussed the importance of identifying how food and nutrient composition data will be utilized because it is the utilization that drives analytical method development, procedures, and need for precision. Also stressed was the need to move forward with current procedures that measure components of interest, at levels that are meaningful in foods, at reasonable cost (including hazardous waste reduction), and that are in those "key foods" that are most commonly consumed by our population.

We have heard this message before. We know we cannot determine exactly what people eat nor analyze every food for every nutrient to the same precision. How then do we decide "who fixes what"? I contend that we all must be involved in the process and three components are critical: key foods, key nutrients and nutrient-related conditions or diseases.

1. What are the most critical current nutrition-related health problems?
   We can all name them: cancer, cardiovascular disease, anemia, hypertension, osteoporosis, obesity...

2. What are the nutrients and measurable components associated with these problems?
   We know many of them: calcium, iron, fatty acids, antioxidants, carbohydrates, sodium, folacin - and more information is needed on fatty acids and carbohydrates and other key components.

3. What are the "key foods"?
   We must focus on key foods:

   - those foods that are the major contributors of nutrients or components of concern;

   - those foods that provide a majority of the weight or caloric value of our diets;

   - those that are major components of Hispanic diets, Oriental diets, major foods of international trade;

   - those foods that are key to the diets of our children, our teenagers, our athletes, our elderly, and our young adults who will set the incidence rates for chronic disease in our society as they move toward middle age.

The users of food data - the scientists, policy-makers, government agencies, senators, representatives, consumers - all of us want accurate and timely composition and consumption data. Our recommendations to producers, manufacturers, and consumers all depend on these data. But, we will lose rather than gain ground if we continue the way we have, with the same, if not more limited, resources. Totally accurate analytical methods, complete composition data, and definitive food consumption data are ideals. We need to focus on what is essential to know, what is possible to do, and what is optimal to expect from our scientists, ourselves.

Appendices

Poster Abstracts

...Transferring Word Processor Files by Electronic Mail
John C. Klensin, *INFOODS*

Committees

Speakers

Exhibitors

Participants

POSTER ABSTRACTS

18th National Nutrient Databank Conference
May 23-26, 1993

Poster 1

STATE OF THE ART NUTRIENT DATABANK AVAILABLE TO PUBLIC VIA GERMAN VIDEOTEX SYSTEM; ALLOWS UPDATES OF COMMON PC SOFTWARE.

Roy Ackmann, Manfred Plath, Nutrition Information Center, University of Giessen, Germany.

Microcomputers and computer-aided nutrition programs have become vital tools for nutrition professionals and consumer educators, but they fall short in terms of timeliness and consistency. The Nutrition Information Center of the University of Giessen tackled the problem by using interactive Videotex (BTX) technology to create an easy-to-use online gateway from a user's PC to a state-of-the-art nutrient databank stored on a host computer. Users linked with the German government's Bundeslebensmittelschluessel (BLS) databank have access to analytical and computed ingredients of approximately 12,000 unique foods, including various recipe modifications and cooking preparations. The user can either use the BLS databank online to research food ingredients as in common food composition tables, or he/she can download the BLS data onto a microcomputer to update existing nutritional programs.

The BTX system is a new easy-to-use public communication services network accessed easily via normal telephone lines and displayed on any monitor. In addition to its gateway function, BTX offers brief and up-to-date nutritional information, access to literature references, and easy communication between the user and the Nutrition Information Center via electronic mail.

Poster 2

EXPANSION OF A NUTRIENT DATABASE FOR NATIVE ALASKAN FOODS

Sally Schakel, Barbara Pickering and I Marilyn Buzzard, Nutrition Coordinating Center, University of Minnesota and Elizabeth D Nobmann, Alaska Area Native Health Service, Anchorage, Alaska

A study of the relationship between the nutrient intake of the Siberian Yupik Eskimos and the incidence of diabetes, hyperinsulinemia and cardiovascular disease[1] required a nutrient database that included foods typical of this population. To meet this need, we expanded an existing nutrient database of American foods to include Native Alaskan foods. A pilot study of 92 24-hour recalls collected from Eskimos of St. Lawrence Island was used to determine foods typically consumed. From the recalls, a list of 40 foods not found in the existing database was compiled. Nutrient values for these foods were obtained mainly from the *Nutrient Value of Alaska Native Foods* by Elizabeth D Nobmann, Indian Health Service, Anchorage, and from scientific literature. Chemical analyses were performed on 14 foods for which nutrient values were not found in the existing literature.[2] Some foods were represented in the database by foods believed to be similar in nutrient content. For example, nutrient values for wild duck were used for loon, and values for duck eggs were used for murre eggs. Recipes for foods such as fried bread, agutuk and fishhead soup were provided by Alaskan nutritionists and added to the database. Before release of the database, quality control procedures were implemented to check for data accuracy and internal consistency within the database.

1 Ebbesson, S.O.E. Diabetes Risk Factors in Alaskan and Siberian Eskimos, NIH Grant DK-91-01 to the University of Alaska, Institute of Circumpolar Health

2 Funded by a grant from the Indian Health Service

Poster 3

COMPARISON OF USDA AND MANUFACTURER'S NUTRIENT VALUES FOR CONDENSED SOUP.

Carole R. Dichter, Bonnie Sherr, Chor San Khoo, Patricia Locket, Campbell Institute for Research and Technology, Camden, NJ

A comparison of USDA Handbook 8-6 (1979) nutrient values with a leading manufacturer's current mean values for the most popular varieties of condensed soup indicates significant differences and information gaps exist. For three soup varieties, Chicken Noodle, Cream of Mushroom and Tomato, the mean values for sodium on an equivalent weight basis (1 cup) are respectively 190 mg, 173 mg and 150 mg less per serving than USDA #8-6 published values. The mean values for fat and calories for Cream of Mushroom are also 25% and 19% lower respectively than the Handbook 8-6 values. New varieties of reduced sodium and low fat soups are not included in the 1979 data. The observed differences between published and mean values may reflect changes in product formulation and/or improvements in analytical methodologies. These findings underscore the need to use current brand name data for soup for national surveys, individual dietary assessments and meal planning.

Poster 4

DEVELOPMENT AND EVALUATION OF SOFTWARE FOR ESTIMATION OF NUTRIENT VALUES.

Brian J. Westrich, I. Marilyn Buzzard, Sally F. Schakel, and Paul G. McGovern, Nutrition Coordinating Center (NCC), University of Minnesota.

Software was developed that estimates nutrient values in commercial food products by mathematical optimization. The optimization methods used were linear programming (LP) and quadratic programming (QP). Dietary fiber and linoleic acid values were calculated from estimated ingredient amounts for 51 food products whose content of these two nutrients was known. Ingredient amount estimations were performed by three different nutritionists using three different methods – an existing trial-and-error method, as well as the LP and QP methods. Thus, a total of 459 ingredient amount estimations were made. Accuracy and efficiency of the three methods were compared via factorial analysis of variance. No statistically significant difference in accuracy was found between methods, but the time required to complete ingredient amount estimations using optimization methods was significantly less than the time required for the trial-and-error method ($p < 0.0001$). The degree of estimation bias, although similar for all three methods, varied as a function of the individual food products. Mathematical optimization techniques can increase the efficiency of maintaining nutrient databases.

Poster 5

MAXIMIZING DIETARY DATA QUALITY THROUGH APPLICATION OF QUALITY CONTROL FINDINGS: THE MDRD PHASE 3 STUDY EXPERIENCE.

Monica E. Yamamoto, Frani M. Averbach, Arlene W. Caggiula, Bonnie P. Gillis, Fran L. Jones, Rebecca Meehan, JoAnn Naujelis and the MDRD Study, MDRD-Nutrition Coordinating Center (NCC), University of Pittsburgh, Pittsburgh, PA.

Research studies conducted over several years typically use internal and external quality control (QC) procedures to monitor data quality. While this effort can prevent repetition of identified problems, archived data are potential reservoirs of these same problems. The Modification of Diet in Renal Disease (MDRD) Phase 3 Study, a large five-year clinical trial, implemented dietary data cleaning which incorporated QC findings. Our preliminary experience (1989-92 data) with this procedure is reported here.

The MDRD Study, sponsored by the National Institutes of Health and the Health Care Financing Administration, is designed to determine whether controlled dietary protein and phosphorus intake and/or blood pressure control will alter the progression of chronic renal disease. Search of archived MDRD dietary datasets (food records=10,861) located 1793 patient food records with food or portion choices identified through QC as potential problems. Original patient food records were retrieved from the files and codings reviewed. About 60% (n= 1075) of food records pulled required coding fixes. About 20% of these required multiple fixes. Our findings indicate that dietary data cleaning procedures which included quality control findings were important for MDRD data quality and are likely to be important for other research studies as well.

Poster 6

A COMPARISON STUDY BETWEEN TWO NUTRIENT DATABASES.

Cynthia S. Nicholson, Kathleen M. Koehler, Sharon J. Wayne, and Philip J. Garry, The University of New Mexico School of Medicine, Albuquerque, NM 87131

We compared the results of two nutrient databases as part of the adoption of a new nutrient database for the New Mexico Aging Process Study. Thirty-one 3-day food records, randomly selected from 250 records collected in 1991, were coded and analyzed using The University of Texas, Health Sciences Center's Food Intake Analysis System (FIAS), ver.1.0, 1990 and the Case Western Reserve University Nutrient Database System (CWRU), Rel.#10, 1989. Records selected were for 13 men and 18 women aged 66-88 years. All records were coded by the same trained nutritionist to control for intercoder variability. Daily totals and 3-day averages were compared for energy and 26 nutrients. Skewed distributions were transformed to achieve normality. The mean energy intake using FIAS and CWRU was 1686 kcal/d and 1656 kcal/d, respectively. The group means were not significantly different by paired t-tests for daily totals and 3-day averages for energy, carbohydrate, protein, cholesterol, fiber, total vitamin A, phosphorus and iron. The remaining 18 nutrients were significantly different ($p=<.05$) from each other in daily totals or 3-day averages or both. The FIAS output tended to be higher for all nutrients when compared to CWRU. Correlation coefficients for 27 nutrients ranged from 0.75 to 0.95 for the three day averages, except total tocopherol where $r = 0.57$. Possible explanations for the differences observed include missing values associated with the CWRU database, different version or release dates for the two databases, and differences in the number of food items available to make accurate coding decisions. (Supported by NIH AG-02049.)

Poster 7

DOCUMENTING ENTRY SUBSTITUTIONS WITH SIMILAR-FOOD CODES: EXPERIENCES FROM THE MODIFICATION OF DIET IN RENAL DISEASE (MDRD) STUDY.

Fran L. Jones, Frani M. Averbach, Arlene W. Caggiula, Bonnie P. Gillis, Rebecca J. Meehan, JoAnn A. Naujelis, Monica E. Yamamoto, and the MDRD Study, MDRD-Nutrition Coordinating Center (NCC), University of Pittsburgh, Pittsburgh, PA.

Foods consumed by Study patients are not always an exact match with database foods. The MDRD Study uses a coding system for substitutions, a "similar" field, which identifies all foods used for substitutions and specifies the original substituted food consumed. Tracking of coding substitutions is important for the several reasons which include: ensuring coding consistency; allowing for possible modification of Study datasets when precise information becomes available; and identifying foods needed for database updates. No reports are currently available on the magnitude of coding substitutions required for processing dietary data, so the MDRD Study's experience was examined for this purpose.

The MDRD Study is a nationwide multicenter clinical trial, sponsored by the NIH and HCFA, designed to determine whether the control of dietary protein and phosphorus intake and/or the reduction of blood pressure to two target levels will reduce the rate of progression of chronic renal disease. MDRD patients' diet prescriptions can be complex and their food choices often include modified usual and favorite foods, as well as newly available foods from the market place. During the MDRD Study baseline period, 2633 food records containing 139,429 food items were analyzed, 9.5% of those foods required coding substitutions. By mid-March 1993, 9,009 follow-up food records had been processed and 7.8% of the 584,784 foods reported required a similar code. Foods most often requiring coding substitutes were bakery items, fast foods, convenience items (soups and mixed dishes), and modified foods such as low fat cheeses. During follow-up, frequently reported foods requiring similar tags (e.g. 1½% low fat milk) were assigned coding guidelines to help ease data entry. Given the magnitude of coding substitutions required (nearly 60,000 food items), the ability to document their occurrence was critical to the quality of MDRD Study data.

Poster 8

DISCREPANCIES BETWEEN DIETITIAN AND CLIENT CALCULATIONS OF PROTEIN INTAKES.

Catherine A. Chenard and Linda G. Snetselaar, General Clinical Research Center and College of Medicine, University of Iowa, Iowa City, Iowa.

In a study of protein intake biomarkers, 12 normal volunteers consumed a self-selected 0.6 gram protein per kilogram standard body weight (SBW) diet for six days. Subjects kept daily food records and calculated their protein intake using food label information and patient materials designed for a multicentered trial, the Modification of Diet in Renal Disease (MDRD) study. Two dietitians independently calculated protein content of the 72 food records using the Minnesota Nutrition Data System. Protein intake calculated by both dietitians was higher (mean 11%; median 8.5%) than calculated by subjects. To determine reasons for this difference, the twenty-four food records with subject and dietitian discrepancies of 0.10 gram protein/kg SBW or greater were examined. Factors contributing to the discrepancies included protein values substituted for foods not found in food tables, insufficient food descriptor or portion size information recorded by subjects, differences among protein values found in food tables and on food labels, and food selection, portion size and protein calculation errors. Quality control of food record coding is important. Client training should include procedures for determining protein content of foods not listed in food tables, and calculating protein content of portions eaten.

Poster 9

USING FOOD RECORDS TO IDENTIFY EATING PATTERNS OF WOMEN AND MEN

BJ Scott and ST St.Jeor. Nutrition Education and Research Program, University of Nevada School of Medicine, Reno, NV 89557

The understanding of eating patterns and their relationship to overall dietary intake may provide important clues to diet-disease relationships. The purpose of this study was to examine one dimension of the eating patterns of both normal weight (N) and overweight (O) individuals. Subjects (S's) were women (W) (N n=25; O n=25) and men (M) (N n=26; O n=24) in their 20's who were participants in the RENO Diet Heart Study. Data sets were developed from detailed 7 day food records using a relational data base program and the USDA Standard Reference nutrient data set. Number of eating incidents (EI)(defined as food intake $\geq$ 30 minute intervals and/or at different locations) was used to compare S's by gender and weight classification and to examine potential relationship to diet and selected indices of CVD risk. The mean number of EI did not vary significantly by gender or weight, but men tended to eat slightly more frequently than women (5.7 vs 5.6), and obese S's ate more frequently than normal weight S's (OW=5.7; NW=5.4; OM=6.0; NM=5.5). The women and the NW tended to eat more frequently during the weekdays (Mon-Fri) than on weekends (EI: NW=5.6 vs 4.9; OW=5.8 vs 5.6: NM=5.6 vs 5.1)), while the OM had the opposite pattern (EI: 5.9 vs 6.1). The relationship of EI to calorie intake was examined, and significant positive correlations were found between EI and caloric intake for the O S's ($p \leq .01$). This was found for NM ($p \leq .05$) to be true only for the week ends. No relationship was found between EI and calorie intake for NW. Differing relationships were found between EI and % of calories from fat by gender and weight: inverse correlations were found for both NW ($p \leq .05$) and OW ($p \leq .01$), a positive relationship was noted for OM ($p \leq .05$) and no relationship was found for the NM. Overall, the OM tended to demonstrate the greatest correlations between diet and EI. Few significant ($p \leq .05$) correlations were found between EI and thirteen selected measures of CVD risk: NW – weight fluctuation (retrospective and prospective); OW – resting energy expenditure; and OM – systolic blood pressure. Further study and description of eating patterns and corresponding measures of meal composition and food choices may yield further insight about their relationship to risk factors for disease.

Poster 10

CONSISTENCY OF DIETARY DATA ENTRY USING MICROCOMPUTER SOFTWARE

Frani M. Averbach, Arlene W. Caggiula, Bonnie P. Gillis, Fran L. Jones, Deborah M. Larsen, Monica E. Yamamoto. University of Pittsburgh, Department of Epidemiology, Pittsburgh, PA.

Patient intakes are increasingly being evaluated with various types of software. To examine intake estimate consistency, one food record was entered twice by two research nutritionists with considerable coding experience using two versions of a single microcomputer program, N3 and N4. Consistency of entry included foods chosen, calculations made and resources used to support appropriate and accurate selections. Three important areas were identified that showed differences in entry. First, when several similar food items (same item description) are available on the database, how is one item selected? Second, are calculations performed by the practitioner and then entered or are exact amounts from food records entered leaving the calculations to the program? Third, when common measures or amounts recorded on food records don't match what is available, what resources are used to compute the quantities eaten? In conclusion, there are several areas where individual practitioners would have difficulties in making consistent decisions. Development of a users guide book for dietary data entry calculations and food selections, would decrease the inconsistency in entry, and increase patient compliance by providing accurate feedback.

Poster 11

TRANSFERRING WORD PROCESSOR FILES BY ELECTRONIC MAIL

John C. Klensin, Ph.D., INFOODS Secretariat

The use of programs such as WordPerfect (tm) to prepare documents and the use of electronic mail to support collaborative work are both increasing. As they do, there is increasing need to be able to combine the two, i.e., to send documents over wide area computer networks with the formatting preserved.

This informal poster will present the reasons why such document transfer, and transfer of other "non-ASCII" materials, has been a problem. Tools for encoding and decoding such documents and their strengths and weaknesses will be shown. Copies of public, or otherwise free and substantially unrestricted, versions of these tools will be available for people to copy onto their own diskettes.

Transferring Word Processor Files by Electronic Mail

John C. Klensin*

Abstract

The use of programs such as WordPerfect® to prepare documents and the use of electronic mail to support collaborative work are both increasing. As they do, there is increasing need to be able to combine the two, i.e., to send documents over wide area computer networks with the formatting preserved.

This poster presents the reasons why such document transfer, and transfer of other "non-ASCII" materials, has been a problem. Tools for encoding and decoding such documents and their strengths and weaknesses will be shown. Copies of public, or otherwise free and substantially unrestricted, versions of these tools are available from a number of locations.

The Problem

Ordinary electronic mail (the term "email" is used interchangeably below) is intended for transferring relatively unformatted messages in "ASCII text" ("EBCDIC text" on BITNET). These text forms are suitable for conventional, English-language, texts. They become problematic when characters must be included that don't appear in ordinary English, such as the ñ of Spanish, the ç of French, or any of the characters of Greek, Russian, Chinese, and so on. A number of conventions have sprung up for dealing with these characters over the years; none have been really satisfactory or generally accepted. Perhaps more important to those of us who write predominantly in English, ordinary electronic mail cannot preserve the subtle formatting information of microcomputer-based word processor files: notions of "hard" and "soft" line breaks, changes in fonts and sizes, differences between indented text and margin changes, all must be represented by conventions and then re-translated at the receiving end or lost entirely.

This problem occurs because few microcomputer-based word processing files consist of ordinary text. They contain extended "characters" to denote formatting and font changes and for other purposes. Several of them handle "soft carriage returns" by treating each paragraph as a single long line; many email systems cannot transfer such long lines.

Enhancements to email standards completed and approved within the last year and now gradually being propagated around the world are likely to provide general solutions to these problems in the long term (see "The Future", below). But, in the near term, if one wants to transfer word processor files, it is necessary to reach agreements between sender and recipient and then "code" and "decode" the files using special tools. The coding procedures make word processor files unintelligible without decoding, but forces all of the information into a form that can, with a bit of luck, be transmitted by electronic mail. The methods discussed below will continue to work even when future email enhancements make simpler alternatives available.

---

* INFOODS Secretariat, UNU, PO Box 500 Charles Street Station, Boston, MA 02114-0500. Tel: 617 227 8747. Fax: 617 227 9405. Email: Klensin@INFOODS.UNU.EDU

The author would like to acknowledge suggestions made by Sallie Fellows of the NH Department of Education for the presentation in this paper and the many people with whom these procedures have been worked out, especially Eric Poortvliet of the Wageningen Agricultural University in the Netherlands and Barbara Burlingame of the Crop Crown Research in New Zealand for their efforts and patience. Errors and confusion parts remain the responsibility of the author.

General Procedure

The procedures discussed here are presented in terms of WordPerfect for MSDOS®, since it seems to be the word processing tool most heavily used in the nutrient composition community. The general principles and coding and decoding tools are equally applicable to Microsoft Word® and other tools as long as the word processing file is self-contained (in WordPerfect, this means that you must be quite careful about, e.g., graphic boxes that reference external files). However, you must also be sure that your recipient can read whatever word processing format you use for your document.

In the Apple Macintosh® the procedures for transferring files will be similar, but the programs used will be Mac programs. The most widely-used Mac programs for encoding and decoding (steps S.3 and R.3 below) are StuffIt or other programs that produce the BinHex format.

Sending:

Before you begin, discuss with your partner the word processing package and versions you will use, the encoding methods you will use, and if you will use compression (see below). Since you must both have compatible programs (or very good conversion tools, planning ahead will save time and avoid frustration.

Step S.1: Prepare the WordPerfect file as you usually would. Note that your recipient will almost certainly have a different printer and set of fonts available (this is just how it works), so it is a good idea to give careful consideration to formatting as your document is composed. In particular, indent text with the [Indent] command, not with hard returns and tabs. Use hard page breaks only when they are strictly necessary; [BlockProtect] and [Conditional EOP] controls are strongly preferred. If you must use page numbers, indices, or tables of contents, set these up with WordPerfect facilities, not by typing page numbers in. When possible, change font size and attributes, rather than changing the base font. Your recipient will thank you. If he or she is going to edit the file and send it back, you will be much happier also.

Step S.3: Select a coding method (several are discussed below). You must choose one that is available to both you and your recipient. Use it to convert the file to coded form.

Step S.4: If necessary, transfer the now-coded file to the computer from which you send and receive electronic mail. Get it into format that you system uses for outgoing messages. Include in that message, or send separately, a note that indicates the word processing package and version, the encoding method, and, if the file has been compressed, the compression method. If you have worked things out in advance, this need not be complicated—a line like "WordPerfect 5.1, ZIPped, and BOOed" is typical—but it provides a use reminder for both of you. Then mail the message, possibly with a subject line that repeats these details.

Receiving:

Step R.1: Read the mail message and transfer it to a form from which you can download it to your PC. Then do either step R.2a or step R.2b.

Step R.2a: Download the file to your PC. Use a "program" or "ASCII" editor to delete the mail headers and other clutter. The best built-in editor of this type in MSDOS 5.0 or later is called EDIT and earlier versions provide EDLIN, but any "programmer's" or line editor will do.

If you prefer to use WordPerfect for this editing, follow these steps: (i) set very wide document margins. (ii) Read the file in as an ASCII file (TextIn/Out, DosText, 2). (iii) Delete the headers and other clutter, then save the "clean file" as an ASCII file (TextIn/Out, DosText, Save). Be sure that you don't overwrite the file you just created when you exit WordPerfect.)

--or--

Step R.2b: Edit the file on the machine where you received the email to get rid of the headers and other material. Then download the already-cleaned-up file.

Step R.3: Process the file with the appropriate decoder. If you can't figure out which decoder to use, check with the person who sent you the file. Trying to guess is feasible, but not often productive.

Step R.5: Read the decoded result into WordPerfect. Ignore messages about converting from a printer you have never heard of into your default printer; they are fairly normal (see the discussion under Step S.1 above).

The Compression Option

Alert readers will note that steps S.2 and R.4 seem to be missing above. They are optional steps, but, if the sender uses them, the receiver must too. They require additional matching software at both ends, and provide additional opportunities for things to go wrong. Hence they should be omitted: the procedures above will work without those steps.

WordPerfect files tend to be fairly large in ratio to the number of actual characters of text that will be displayed on the printed page. They become especially bloated if you use large style libraries, multiple printer setups, or complex formatting. Many electronic mail systems (especially BITNET ones) give large messages lower priority for transport than smaller ones so they take longer to be sent. And some electronic mail systems charge users by the character sent. All of the coding techniques described below tend to make coded files larger than the original WordPerfect ones. If you are concerned about size, it makes sense to "compress" the WordPerfect file before encoding it. Compression involves a different kind of file coding that reduces the space the file takes up on disk. This comes at the expense of convenience, since you must decompress it to use it. Popular compression tools include LHARC (otherwise known as LHA), a public domain tool, and PKZIP, a shareware one*.

Compression has another advantage. Popular compression programs provide automatic "integrity checks" to be sure that what you get out is the same as what you put in; the file encoders don't do as good a job of this. It you use a compression program that incorporates such checks, and the decompression process "passes", you can be reasonably assured that nothing unpleasant happened in the email transmission.

If you decide to compress, insert the following steps into the above in the obvious places:

* Tools of either type can be distributed to others, but shareware ones are not public domain: you are expected to register and pay for them if you use them. Registration is especially important with the current version of PKZIP, since registration gets you an excellent manual (the shareware documentation is a little thin) and several additional features. All public domain programs are free. Some free programs are not public domain but come with restrictions about copying, acknowledgments, or incorporation into other products.

Step S.2: Compress the WordPerfect file. If you are using PKZIP, and the WordPerfect file was called "mypaper.w51", you might type:

```
PKZIP MYPAPER MYPAPER.W51
```

This will create a new file, "mypaper.zip" that should be used in Step S.3 instead of "mypaper.w51".

Step R.4: If your correspondent used compression, then the next step after decoding will be to decompress the file. If the file was compressed with PKZIP, and, when you decoded the file, it was produced as "herpaper.zip", then you would decompress by typing:

```
PKUNZIP HERPAPER
```

to get "mypaper.w51" back. The file has now been decoded and decompressed and is ready for WordPerfect.

The Encoding and Decoding Programs

There are several different combinations of encoding and decoding programs available. The main criteria to be used in selecting them are

- You and your correspondent must have a matched pair.
- The encoding system used must be at least robust enough to survive the things that different programs and gateways do to electronic mail.

There are three sets in common use. They are *uuencode* and *uudecode*, which are used heavily in the UNIX world; a format called *BOO*, developed at Columbia University as part of the MSDOS Kermit package; and a new format called *base64*, developed as part of the recent email extensions efforts. The "seven-bit transfer encoding" format supplied with WordPerfect, and designed for the same purpose as the more common tools, has not proven to be robust over wide area network connections.

uuencode. While these programs were originally specified and developed for UNIX, there are several implementations of them for MSDOS. The encoder is usually called "uuencode", the decoder "uudecode". While widely used because it comes with most versions of UNIX, uuencoded files will not survive passage in either direction through most Internet-BITNET gateways. Files that are damaged in this way either will not decode at all, or will produce error messages or damaged data when read into WordPerfect. Consequently, this package should be used with care, and perhaps only when you understand the network path between your computer and that of your correspondent.

Syntax: uuencode WordPerfect-file Encoded-file

We suggest that the encoded-file be given the same name as the WordPerfect one, with the extension suffix ".UUE". That extension is a nearly universal convention.

Syntax: uudecode Encoded-file.UUE WordPerfect-file.W51

BOO. These programs were developed, as mentioned above, as a distribution form for MSDOS Kermit, but can be used for any "binary" file including WordPerfect ones. The characters and structure used work well through the Internet-BITNET gateways, within each network, and generally worldwide.

The only known limitation is for Latin America, where some local hosts use a character set translation that will damage these files. The encoder is called "msbmkb" (MSKermit-Boo-MaKe-Boo) and the decoder is called "msbpct" (MSKermit-Boo-PC-Translate).

Syntax: msbmkb WordPerfect-file.W51 Encoded-file.BOO

We suggest that the encoded-file be given the same name as the WordPerfect one, with the extension ".BOO". The use of that extension is a nearly-universal convention.

Syntax: msbpct Encoded-file.BOO (The name of the input file is stored in the BOO file.)

One additional advantage of the BOO programs is that a version of the decoder is available as a BASIC program in ASCII form. Virtually all versions of MSDOS come with BASIC. When your correspondent does not already have decoding programs, you can email the decoder in BASIC form in one message and send the (faster and more robust) decoder and encoder in BOO form in other messages. Your correspondent can then use the BASIC program to decode MSBPCT.BOO into MSBPCT.EXE. It can then be used to decode MSBMKB.BOO, at which point you are ready to start transferring WordPerfect files.

Base64. This form is relatively new, but has been designed to be even more robust than BOO. It provides the primary encoding used in the new MIME mail formats (see below). Several MSDOS implementations are now being tested; most should be public domain.

Some Additional Hints

Many people who use their MSDOS machines almost exclusively to run WordPerfect and similar programs don't have a systematic way of naming files. When one starts to have many versions of the same file, e.g., a WordPerfect version, a compressed version, and an encoded version, it can become difficult to keep them straight. We recommend that the suffixes (or "extensions") on files be used to distinguish the format of those files, e.g., always naming WordPerfect 5.1 files to end in ".W51", ZIP files in ".ZIP", BOO files in ".BOO", uuencoded files in ".UUE", and so on. The examples above reflect this approach.

BITNET Hosts and Internet Hosts

The discussion above makes the distinction between "BITNET" and "Internet" hosts. It has been traditional among users in much of the academic and research community to ignore the differences, and people are often confused about their own hosts and mail systems. To an increasing degree, hosts that have traditionally been connected to BITNET only have acquired Internet connections as well, some institutions have dropped out of BITNET entirely. When sending ordinary mail, the distinction is not important as long as you have a valid address: mail can be sent between BITNET hosts using an eight-or-fewer character host name; mail from BITNET hosts to Internet ones, and between Internet ones, requires a "fully qualifier domain name", usually something like INFOODS.UNU.EDU or Crop.Palm.CRI.NZ or NALUSDA.GOV. The distinction does become important when transferring coded messages or special files between system when every character and the file format are important, since passing messages between BITNET and the Internet inevitably involves some character set translations. If you know what is being used, you may be able to take advantage of it; if you don't it is better to be as careful as possible.

The Future

The electronic mail extensions efforts mentioned above include new formats for structured messages, including messages that include pictures, sound, and "applications" files, such as those of WordPerfect. These changes (most of which are known generically as "MIME") are being rapidly deployed on Internet hosts and some readers of this paper may already have access to them. For technical and stylistic reasons, things are happening somewhat more slowly in the BITNET environment, but the changes will penetrate there as well. When you and your correspondents both have access to MIME-aware mail systems, it should be possible to simply upload a WordPerfect file to the computer from which you send mail, identify the file as having come from WordPerfect in a particular version, and mail it. The mail system will then take care of everything else, including base64-encoding of the file being transmitted and decoding at the recipient end. The other importance of having base64 decoders available involves being able to extract information from a received MIME message even when your machine does not yet support MIME. Perhaps many of us will be using those tools by next year's conference.

Obtaining the Programs

The programs are available at the conference, by FTP and from an electronic mail server at INFOODS.UNU.EDU, or by sending a diskette (any reasonable MSDOS format) with a stamped, self-addressed mailer to the INFOODS Secretariat at the address specified on the first page.

National Nutrient Databank Conference Committees

STEERING COMMITTEE

Al Riley, Campbell Soup Company, Chair

Catherine Champagne, Pennington Biomedical Research Center, LSU

Ruth Matthews, USDA-HNIS

Bob Murphy, DHHS-NCHS

Suzanne Murphy, University of California, Berkeley

Sue Ann Ritchko, USDA-HNIS

Jack Smith, University of Delaware

Carol Windham, Utah State University

ARRANGEMENTS COMMITTEE

Catherine Champagne, Pennington Biomedical Research Center, LSU, Chair

Ray Allen, Pennington Biomedical Research Center, LSU

Mary Boudreau, Pennington Biomedical Research Center, LSU

Steele Burden, Burden Research Plantation, LSU

Kevin Gilley, Pennington Biomedical Research Center, LSU

Pat Marquette, Pennington Biomedical Research Center, LSU

Jeanette Noble, Pennington Biomedical Research Center, LSU

Pat Pillow, M.D. Anderson Cancer Center

Donna Ryan, Pennington Biomedical Research Center, LSU

Janice Walker, Pennington Biomedical Research Center, LSU

COMMUNICATIONS COMMITTEE

Ruth Matthews, USDA-HNIS, Chair

Emerita Alcantara, Dairy Council of Wisconsin

Maggie Clausell, University of Maryland

Joanne LaValle, The CBORD Group

DATABASE COMMITTEE

Jack Smith, University of Delaware, Chair

Barbara Burlingame, DSIR Private Bag Palmerston North

Marilyn Buzzard, University of Minnesota

Tom Hendricks, DHHS-FDA

John Klensin, MIT

Sungsoo Lee, Kellogg Company

Grace Petot, Case Western Reserve University

Won Song, Michigan State University

Phyllis Stumbo, University of Iowa

PROGRAM COMMITTEE

Carol Windham, Utah State University, Chair

Ronette Briefel, DHHS-NCHS

Marilyn Buzzard, University of Minnesota

Pat Crawford, University of California, Berkeley

Judi Douglass, TAS, Inc.

John Klensin, MIT

Ruth Matthews, USDA-HNIS

Beverly McCabe, University of Arkansas

Suzanne Murphy, University of California, Berkeley

Jean Pennington, DHHS-FDA

David Haytowitz, USDA-HNIS

Tom Hendricks, DHHS-FDA

Joanne Holden, USDA-ARS-BHNRC

Loretta Hoover, University of Missouri

Helaine Rockett, Channing Labs

Nancy Raper, USDA-HNIS

Jack Smith, University of Delaware

Won Song, Michigan State University

Phyllis Stumbo, University of Iowa

AD HOC COMMITTEE ON CITING NUTRIENT DATABASES

Suzanne Murphy, University of California, Berkeley, Chair

Loretta Hoover, University of Missouri

John Klensin, MIT

Sungsoo Lee, Kellogg Company

Janice Maras, Tufts University

Jean Pennington, DHHS-FDA

Grace Petot, Case Western Reserve University

Pat Pillow, M.D. Anderson Cancer Center

Laura Sampson, Channing Labs

Carol Windham, Utah State University

18th National Nutrient Databank Conference Speakers

Ann Albertson
Diet Study Coordinator
Nutrition Department
General Mills, Inc.
1 General Mills Blvd.
Minneapolis, MN 55426

Karen Andrews
HNIS, USDA
Federal Building, Rm. 320
6505 Belcrest Road
Hyattsville, MD 20782

Mary Bender
Food and Drug Administration
200 C St., SW
Washington, DC 20204

Jeff Backstrand
University of Connecticut
Storrs, CT 06269

Gary Beecher, PhD, Leader
Nutrient Composition Laboratory
Human Nutrition Research Center
Bldg. 161-E, Room 102
Beltsville, MD 20705

Donald E. Carpenter, PhD
Associate Director of Analytical Chemistry
Kraft General Foods
801 Waukegan Road
Glenview, IL 60025

Pat Crawford, Project Manager
NHLBI Growth and Health Study
140 Warren Hall
University of California
Berkeley, CA 94720

Karen Falk, Nutrition Specialist
Graphic Technology, Inc.
Data Documents Systems
301 Gardner Drive, P. O. Box 30
Industrial Airport, KS 66031

Alison Gardner, MS, RD
Public Health Nutrition Chief
Vermont Department of Health
1193 North Avenue
P. O. Box 70
Burlington, VT 05402

Susan E. Gebhardt
HNIS, USDA
6505 Belcrest Road
Room 312
Hyattsville, MD 20782

Ann C. Grandjean, PhD, Director
Center for Human Nutrition
502 South 44th Street, Suite 3007
Omaha, NE 68105-1065

Elizabeth Hands, President
ESHA Research
1193 Royvonne S.E.
Salem, OR 97302

Ellen Harris, Director
Nutrition Monitoring Division
HNIS, USDA
6505 Belcrest Road, Rm. 315
Hyattsville, MD 20782

David Haytowitz
USDA, HNIS
6505 Belcrest Road, Rm. 315
Hyattsville, MD 20782

Janet Helm, MS, RD, Nutritionist
Product Development/Nutrition
McDonald's Corporation
Kroc Drive
Oak Brook, Illinois 60521

Joanne M. Holden, MS, RD
USDA, ARS, BHNRC
Building 161, BARC-East
Beltsville, MD 20705

Loretta W. Hoover, PhD
Department of Food Science and Human Nutrition
College of Human Environmental Sciences
318 Clark Hall
University of Missouri
Columbia, MO 65211

Linda Ingwersen
HNIS, USDA
6505 Belcrest Road, Room 300
Hyattsville, MD 20782

Cheryl Jackson-Brown, Nutritionist
USDA Food and Nutrition Service
3101 Park Center Drive, Room 607
Alexandria, VA 22302

John Klensin, PhD
INFOODS Secretariat
P. O. Box 500
Charles St. Station
Cambridge, MA 02114-0500

Randy LaComb
HNIS, USDA
6505 Belcrest Road, Room 301
Hyattsville, MD 20782

Betty Li
Nutrient Composition Laboratory
Bldg. 161, BARC East
Beltsville, MD 20705

Kristin Marcoe
Human Nutrition Information Service
U.S. Department of Agriculture
6505 Belcrest Road, Room 311A
Hyattsville, MD 20782

Elena Martinez
Univ. of Texas School of Public Health
Box 20186
Houston, TX 77225

Ruth H. Matthews
HNIS, USDA
6505 Belcrest Road, Room 314
Hyattsville, MD 20782

Margaret McDowell
Division of Health Examination Statistics
National Center for Health Statistics
Ctr. for Disease Control & Prevention
U.S. Department of Health and Human Services
6525 Belcrest Road, Suite 900
Hyattsville, MD 20782

Pat McKinney, Program Analyst
USDA Food and Nutrition Service
Office of Analysis and Evaluation
3101 Park Center Drive
Alexandria, VA 22302

Kristen W. McNutt, PhD, President
Consumer Choices, Inc.
2272 Woodview Road, Apt. 401
Ypsilanti, MI 48198

Suzanne McPherson, PhD
University of Texas
1200 Herman Pressler Blvd.
Houston, TX 77030

Tom Melnik, DrPH, Director
Nutrition Surveillance Program, Div. of Nutrition
New York State Health Department
Corning Tower Building, Room 859
Empire State Plaza
Albany, NY 12237

Alanna J. Moshfegh, MS, RD, Director
Office of Policy Coord. & Special Projects
Human Nutrition Information Service, USDA
6505 Belcrest Road, Room 366
Hyattsville, MD 20782

Patricia A. Murphy
Department of Food Science and Human Nutrition
2312 Food Science Building
Iowa State University
Ames, IA 50011

Suzanne Murphy, PhD
University of California, Berkeley
119 Morgan Hall
Berkeley, CA 94720

Lisa Oehrl
Southern Testing and Research Laboratory
3709 Airport Road
Wilson, NC 27893

Jean A. T. Pennington, PhD, RD
Office of Food Labeling
Center for Food Safety and Applied Nutrition
Food and Drug Administration
200 C Street, SW
Washington, DC 20204

Betty Perloff
Human Nutrition Information Service
U.S. Department of Agriculture
6505 Belcrest Road, Room 368
Hyattsville, MD 20782

Grace J. Petot, PhD
Department of Nutrition
Department of Epidemiology & Biostatistics
Case Western Reserve University
Cleveland, OH 44106-4906

Linda Posati, Deputy Director
Product Assessment Division
Regulation Program, FSIS, USDA
Cotton Annex Building, Rm 305
300 12th Street SW
Washington, DC 20250

Barbara Pryor, MS, RD
Public Health Nutritionist
Division of Chronic Disease
Ohio Department of Public Health
246 N. High St.
Columbus, OH 43266-0588

Fatemah Ramezanzadeh, MS
Pennington Biomedical Research Center
6400 Perkins Road
Baton Rouge, LA 70808

Nancy Raper
HNIS, USDA
6505 Belcrest Road, Room 371
Hyattsville, MD 20782

W.M. Nimal Ratnayake, PhD
Research Scientist
Health and Welfare Canada
Food Dir/Sir F G Banting
Research Center Tunneys Pasture
Ottawa, ON, K1AOL2 CANADA

Helaine Rockett, Research Nutritionist
Channing Lab
Brigham & Women's Hospital/Harvard
Medical School
180 Longwood Avenue
Boston, MA 02115

Gustaaf P. Sevenhuysen, PhD
Department of Food and Nutrition
University of Manitoba
Winnipeg, Manitoba R3T 2N2
CANADA

Jack L. Smith,, PhD
238 Alison Hall
University of Delaware
Newark, DE 19716

Lois Steinfeldt
School of Public Health
University of Texas
1200 Herman Pressler Dr.
Houston, TX 77030

Phyllis Stumbo, PhD
Clinical Research Center
University of Iowa 157 MRF
Iowa City, IA 52242

Rose Tseng, Dean
College of Applied Sciences and Arts
San Jose State University
One Washington Square
San Jose, CA 95192

Katherine Tucker
Assistant Professor
USDA Center on Aging, HNRC
Tufts University
711 Washington Street
Boston, MA 02111

Richard Tulley, PhD
Pennington Biomedical Research Center
6400 Perkins Road
Baton Rouge, LA 70808-4124

James L. Vetter, PhD
American Institute of Baking
1213 Bakers Way
Manhattan, KS 66502

John S. White, PhD
Research & Development Division
A. E. Staley Manufacturing Co.
2200 E. Eldorado
Decatur, IL 62525

Carol T. Windham, PhD
Department of Nutrition and Food Science
Utah State University
Logan, UT 84322-8700

Collette Zyrkowski, MPH, RD
Deputy Branch Chief, Maternal and Child
Nutrition
Division of Nutrition K-25, NCCDPHP
Centers for Disease Control and Prevention
4770 Buford Highway, N.E.
Atlanta, GA 30341-3724

18th National Nutrient Databank
Conference Exhibitors

COMPANY	CONFERENCE CONTACTS
ESHA Research P. O. Box 13028 Salem, OR 97309 (503) 585-6242 (503) 585-5543 (FAX)	Elizabeth S. Hands
USDA Human Nutrition Information Service Rm 316 Federal Bldg 6505 Belcrest Rd.. Hyattsville, MD 20782 (301) 436-8491 (301) 436-5643 (FAX)	David Haytowitz
Nutrition Coordinating Center 2221 University Avenue SE, Suite 310 Minneapolis, MN 55414 (612) 627-4862 (612) 627-4191 (FAX)	Susan Narayan
Human Nutrition Center-University of Texas School of Public Health P. O. Box 20186 RAS W-606 Houston, TX 77225 (713) 792-4660 (713) 794-4877 (FAX)	Deidre Douglass
Technical Assessment Systems, Inc. 1000 Potomac St., NW Washington, DC 20007 (202) 337-2625 (202) 337-1744 (FAX)	Judi Douglass
N-Squared Computing 3040 Commercial St. SE, Suite 240 Salem, OR 97302 (503) 364-9118	Laurie North
DINE Systems, Inc 586 N. French Rd., Ste. 2 Amherst, NY 14228 (716) 688-2492 (716) 688-2505 (FAX)	Kathryn F. Dennison

Participant List

Jack Abrams
Market Research Corp. of America
2215 Sanders Road
Northbrook, IL 60062

Roy Ackmann
Nutrition Information Center
University of Geissen
Goethestrasse 55
Giessen, D-6300
GERMANY

Emerita N. Alcantara
Dairy Council of Wisconsin
999 Oakmont Plaza Dr.
Westmont, IL 60559

Ray Allen
Pennington Ctr.
6400 Perkins Rd.
Baton Rouge, LA 70808

Christine Armes
Audey L. Murphy V.A. Hospital
9001 Wurzbach Rd., No. 811
San Antonio, TX 78240

Carolyn M. Bednar
Texas Woman's University
Dept. of Nutrition and Food Sciences
P. O. Box 24134
Denton, TX 76204

Nancy Belleque
ESHA Research
P O Box 13028
Salem, OR 97309

Wendy Boehm
Healthy Innovations
418 W. Woodlawn St.
Philadelphia, PA 19144

Pam Bouchard
NutriProfile
78 Corner Ridge Road
Aurora, Ontario, L4G 6L3
CANADA

Mary Boudreau
Pennington Biomedical Rsch Ctr
6400 Perkins Rd.
Baton Rouge, LA 70808-4124

Marilyn Briggs
9920 Angel Place
Newcastle, CA 95658

Stacy Broussard
Doerle Food Services, Inc.
P.O. Box 9230
New Iberia, LA 70562-9230

Danielle Brule
Health and Welfare Canada
Nutrition Research Division
Banting Building, Tunney's Pasture
Ottawa, Ontario, K1A 0L2
CANADA

Marilyn Buzzard
Nutr. Coordinating Ctr, Univ of Minn.
2221 University Avenue, SE, Suite 310
Minneapolis, MN 55414

Sylvia Byrd
MUW
P.O. Box 651
Starkville, MS 39759

Catherine Champagne
Pennington Biomedical Research Ctr
6400 Perkins Rd
Baton Rouge, LA 70808-4124

Catherine Chenard
Univ. of Iowa Clinical Research Ctr.
157 MRF
University of Iowa
Iowa City, IA 52242

Jenny Chin
Best Foods, CPC International
150 Pierce Street
Call Box 6710
Somerset, NJ 08873-6710

Angeline Churchill
Frito-Lay, Inc.
601 Wildwood, Dock R
Irving, TX 75061

Jane Conley
Doerle Food Services, Inc.
401 W. Admiral Doyle Dr.
P. O Box 9230
New Iberia, LA 70562-9230

Annie R. Cornwell
University of Alabama at Birmingham
Nutrition Sciences Dept.
1675 University Blvd - Room 248
Birmingham, AL 35294

Nancy T. Crane
FDA/OFL/DTE (HFS-165)
200 C Street, SW
Washington, DC 20204

Ann Curran
US Army Natick RDE Center
Attn: SATNC-WTP
Kansas St.
Natick, MA 01545

Carolann Davis
Lincoln University
820 Chestnut St.
Jefferson City, MO 65109-0029

Eileen R. DeLeeuw
Utah State University
272 West 780 South
Logan, UT 84321

Darwin Dennison
SUNY at Buffalo
School of Health Related Professions
Kimball Tower - 3435 Main St.
Buffalo, NY 14214

Kathryn F. Dennison
Dine Systems, Inc.
586 North French Rd., Suite 2
Amherst, NY 14228

Barbara B. Deskins
University of Pittsburgh
110 B Pennsylvania Hall
Pittsburgh, PA 15261

Deirdre Douglass
University of Texas Health Science Center
P.O. Box 20186, Rm. RAS W606
Houston, TX 77225

Judith S. Douglass
Technical Assessment Systems, Inc.
1000 Potomac St, NW, Suite 102
Washington, DC 20007

Jacqueline Dupont
USDA, Agricultural Research Service
Building 005, Rm. 132, BARC-West
Beltsville, MD 20705

Kari Egge
Tulane Univ. School of Public Health
4624 Constance St
New Orleans, LA 70115

Alyson Escobar
USDA-HNIS
6505 Belcrest Rd, Room 353 Fed. Bldg.
Hyattsville, MD 20782

Kristin M. Ewing
USDA GFHNRC
2420 2nd Ave. N
Box 9034 University Station
Grand Forks, ND 58201

Tracy A. Fox
USDA/Child Nutrition
5927 Beech Ave.
Bethesda, MD 20817

Lois Fulton
USDA-HNIS
6505 Belcrest Rd, Rm 353
Hyattsville, MD 20782

Kerrin Futhey
Nutrition Coordinating Center
Univ. of Minnesota
2221 University Avenue SE, Suite 310
Minneapolis, MN 55414

Margaret Gee
Univ of Alberta, Food & Nutrition
308 Home Economics Bldg.
University of Alberta
Edmonton, Alberta, T6G 2M8
CANADA

Timothy J. Gilbert
Fred Hutchinson Cancer Research Ctr.
Weiss/Dating Studies, MP 381
1124 Columbia Street
Seattle, WA 98104-2092

Kevin Gilley
Pennington Biomedical Research Ctr
6400 Perkins Rd
Baton Rouge, LA 70808-4124

Marilyn J. Glandt
Marriott Management Services
Food & Beverage MIS
Dept 817.69
Washington, DC 20058

Patricia D. Godfrey
Nutrition & Food Associates, Inc.
P. O. Box 47007
Plymouth, MN 55447

Mary B. Gregoire
National Food Service Management Inst.
Univ.of Southern Miss.
Box 10077
Hattiesburg, MS 39406-0077

Maureen Griffiths
The Coca-Cola Co.
1 Coca-Cola Plaza TEC3
Atlanta, GA 30313

Dyann Groenendal
Gerber Products Company
445 State Street
Fremont, MI 49413

Lorie A. Havey
Nestle Food Company
800 North Brand Blvd.
Glendale, CA 91203
818-543-7726

Thomas Hendricks
Food and Drug Administration
200 C Street, SW
Washington, DC 20204

Teresita B. Hernandez
JWK International Corporation
7617 Little River Turnpike
Suite 800
Annandale, VA 22003

Alice Hunt
Louisiana Tech University
P.O. Box 3167
Ruston, LA 71272

Sharyn Joliat
Info Access (1988) Inc.
4 Spinney Court
Don Mills, Ontario M4T 157
CANADA

Fran Jones
University of Pittsburg
3520 5th Ave, Suite 510, MDRD Study
Pittsburg, PA 15213

Robert Juni
Consultants in International Health
305 84th St.
Stone Harbor, NJ 08247

Kathleen M. Koehler
Univ of NM School of Medicine
2701 Frontier Place NE, Rm 215
Albuquerque, NM 87131

Caroline LaGrange
611 W. Taft #3
Lafayette, LA 70503

Pao-Hwa Lin
Duke University Medical Center
P.O. Box 3487
Durham, NC 27710

Marie Lubeley
USDA-FNS
3101 Park Center Dr.
Alexandria, VA 22302

Elizabeth Macaluso
University of New Mexico
Clinical Nutrition Lab
2701 Frontier Place N.E.
Surge Blg. Rm #215
Albuquerque, NM 87131-5666

Janice Maras
Tufts University-HNRC
711 Washington Street
Boston, MA 02379

Patrick J. Marquette
Pennington Biomedical Research Ctr
6400 Perkins Rd
Baton Rouge, LA 70808-4124

Lynn A. Martin
Ochsner Foundation Hospital
2300 Edenborn #124-II
Metairie, LA 70001
504-840-9936

Renaldo R. Martinez
Univ. of New Mexico, School of Medicine
2701 Frontier Place NE
Surge Building Rm 216
Albuquerque, NM 87131-5666
505-277-4764

Beverly J. McCabe
Dietetics and Nutrition
University of Arkansas
Slot 627, 4301 W. Markham
Little Rock, AR 72207

Janet McNaughton
Mississippi State University
Food Science Dept, Drawer NH
Mississippi State, MS 39762

Tom McNees
PBRC
6400 Perkins Road
Baton Rouge, LA 70808

Diane C. Mitchell
Penn State University
Penn State Nutrition Center
417 E. Calder Way
University Park, PA 16801

Dr. Margaret C. Moore
Pennington Biomedical Research Ctr
6400 Perkins Rd
Baton Rouge, LA 70808-4124

Paul Moriarty
Lunchbyte Systems
2260 Lake Ave.
Rochester, NY 14612

Robert Morrissey
Hershey Foods Corporation
Technical Center
P.O. Box 805
Hershey, PA 17033-0805

Ellen Morton
Food Labeling News
13632 N. 58th Place
Scottsdale, AZ 85254

Susan Narayan
Nutr. Coordinating Ctr, Univ of Minn.
2221 University Avenue SE Suite 310
Minneapolis, MN 55114

Cynthia S. Nicholson
Univ. of New Mexico
Clinical Nutrition Lab
2701 Frontier Place, NE
Surge Bldg. Rm #215
Albuquerque, NM 87131-5666

Charlotte Oakley
Univ.of Mississippi
Department of Home Economics
University City, MS 38677

Lavonne L. Oenning
GCBC-Mayo Foundation
200 1st St SW
Rochester, MN 55901

Shirley Pareo-Tubbeh
Univ. of New Mexico
School of Med Clin Nutrition Lab
2701 Fronteir Place NE
Surge Bldg. Rm #215
Albuquerque, NM 87131-5666

Ruth Patrick
Pennington Biomedical Research Center
6400 Perkins Road
Baton Rouge, LA 70808

Patricia Pillow
M.D. Anderson Cancer Center
1515 Holcombe - 189
Houston, TX 77030

Manfred Plath
Nutrition Info. Center
University of Giessen
Goethestrasse 55, Giessen D-6300
GERMANY

Debra B. Reed
Research Computing
1500 University Drive
Hammond, LA 70401

Al Riley
Campbell Soup Co.
Campbell Place
Camden, NJ 08101

Mildred S. Rodriguez
Box 1298
Stillwater, OK 74076

Barbara Rossiter
Computrition, Inc.
9121 Oakdale Ave. Suite 201
Chatsworth, CA 91311

Leila Saldanha
Kellogg Company
235 Porter St
Battle Creek, MI 49016

F. Ed Scarbrough
Office of Labeling
Ctr for Food Safety & App. Nutrition
Food & Drug Admin.
200 C Street, SW
Washington, DC 20204

Patricia M. Schaaf
Stanford Medical Ctr.
General Clinical Research Center
Room H-H134
300 Pasteur Drive
Stanford, CA 94305

Sally Schakel
Nutrition Coordinating Ctr.
University of Minnesota
2221 Universtiy Ave, SE Suite 310
Minneapolis, MN 55414

Barbara Scott
Univ. of Nevada School of Medicine
Nutrition Educ. and Research Program
Reno, NV 89557

Barbara Seiley
Info Acess (1988) Inc.
4 Spinney Court
Don Mills, Ontario M4T 157
416-445-3157

Fred T. Shadko
Training Table Systems
17624 Golfview
Livonia, MI 48152

Bonnie Sherr
Campbell Soup Co.
Campbell Place
Camden, NJ 08103-1799

Joanne L. Slavin
Dept. Food Science & Nutrition
1334 Eckles Avenue
St. Paul, MN 55108

Carol Smeja
MRCA Information Serv - Nutrition Div
2215 Sanders Road
Northbrook, IL 60062
227

Elizabeth C. Smith
FDA, CFSAN, HFS-678
200 C Street, SW
Washington, DC 20204

Michele Stark
Director of Nutrition Services
Santa Clara Valley Diabetes Society
1261 Lincoln Avenue, Ste. #208
San Jose, CA 95125

Chedwah J. Stein
Nutrition and Diet Services
927 SE Rimrock Lane
Portland, OR 97267-1025

Mary Stevens
Nutrition Coordinating Ctr, Univ. Minn
2221 University Ave SE, Suite 310
Minneapolis, MN 55414

Peggy Stevenson
Antioch Unified School District
P.O. Box 768
Antioch, CA 94509

James T. Tanner
Food and Drug Admin.
Center for Food Safety & Applied Nutr.
Div. of Nutr., HFS-457
200 C Street, S.W.
Washington, DC 20204

Frances A. Tylavsky
The University of Tennessee Memphis
Dept. Biostatistics & Epidemiology
and Preventive Medicine
877 Madison Avenue
Memphis, TN 38163

Lorraine Venditto
Kraft General Foods
250 North Street
Mail Code: T22-1
White Plains, NY 10625

Pam Verdier
Nutrition Consultant
214 Cobourg St
Ottawa, Ontario, K1N 8H8
CANADA

Marti Wennemann
PBRC
6400 Perkins Road
Baton Rouge, LA 70808

Brian Westrich
Nutrition Coordinating Ctr.
2221 University Ave SE, #310
Minneapolis, MN 55414

Fran White
OLOL Tau Center - Eating Disorder Serv
815 Louray Drive
Baton Rouge, LA 70808

Esther A. Winterfeldt
Oklahoma State University
1111 W. Preston Avenue
Stillwater, OK 74075

Edward R. Wirick
Dietary Consultants
Post Office Box 88
Evans, CO 80620

Monica E. Yamamoto
Director, Dietary Data Center
University of Pittsburgh
505A Parran Hall, EPID/GSPH
Pittsburgh, PA 15261