THE FOOD COMPONENT RESEARCH DATA BASE AT THE NATIONAL CANCER INSTITUTE

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INTRODUCTION

Recent advances in nutritional research document that dietary patterns can affect the risk of developing chronic diseases such as cancer and cardiovascular illness (1,2). A diet high in fat, and in particular saturated fat, is a well-established risk factor for cardiovascular disease (1). Diet is postulated to be a factor in the etiology of about a third of all cancers (3).

Information on the nutrient composition of foods is essential in any quantitative study of human nutrition. It is required to assess the nutritional adequacy of diets, to formulate dietary modifications, and to evaluate the role of dietary factors in chronic diseases. Researchers and clinicians need ready access to food composition data of assured quality, accuracy, and appropriateness. The National Cancer Institute's (NCI) Division of Cancer Prevention and Control is developing a personal computer-based data system on food composition that serves as a research tool to its investigators in the filed of human nutrition.

The goal of the system, called the Food Component Research Data Base (FCRDB), is to enable the nutrition researcher to easily and efficiently obtain information on the nutritional contents of foods. Compared to other dietary analysis packages, the system in development at the NCI includes standardized descriptions of foods and allows great flexibility with which the user can specify information retrievals. Traditionally, food composition tables have been arranged alphabetically or by food groups. Instead of limiting the user to searches using these classifications schemes, the NCI data system allows users to retrieve information using terms related to multiple characteristics included in the description of each food. The terms comprise a multi-hierarchical facetted food description language called the Factored Food Vocabulary (FFV). (4) Since the use of FFV is integral to FCRDB, it is

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printed. CONFIGURE SYSTEM enables users to set up system parameters to match microcomputer, monitor, and printer configuration.

In the SEARCH section, users can search the database for foods with specified characteristics and then produce reports on the nutrient content of these foods. A valid search statement is a Boolean expression where the operand are either FFV factor codes, FFV factor terms, food identification numbers or set numbers, as shown is Figure 2. An on-line FFV dictionary of terms aids users selecting FFV factor terms for a search. The response time is fast: each of the two searches shown in Figure 2 was executed in under four seconds on a standard 6 megahertz IBM PC AT. Foods that have been selected as a result of the most recent search can be viewed, as in the screen which appears as Figure 3.

The REPORT OPTIONS allow users to specify what they want to include in their nutrient content reports. As shown in Figure 4, STATISTICS allows users to select the statistics to appear in the reports. By selecting COMPONENTS, users can make their choice of nutrient and food components to appear in the report. The destination of the report option is selected through OUTPUT OPTIONS. RUN REPORT runs the report.

The seventy-three nutrients and food components in Handbook No. 8 are available in the system. The SELECT COMPONENTS option displays them and allows users to choose amount them. When this option is selected, the first of the two page food component window is displayed. The screen appears as in Figure 5. The components selected can be saved as defaults for subsequent reports.

The system can produce both individual and aggregate nutrient value reports. An individual report provides the statistics for each food in the set individually, while the aggregate report groups the foods in the set together and produces statistics for the group as a whole. The individual report produced for the search requested in Figure 2 appears in Figure 6 and required three seconds to produce. An aggregate report for the same set of foods, taking five seconds to generate, appears in Figure 7. Both types of reports may be printed, displayed on the screen, or sent to a file.

Selection of the DATA MAINTENANCE option of the main menu allows users to enter and edit the FFV descriptions of foods in the data base. The screen for the entry and editing of FFV descriptor codes os shown in Figure 8. The screen displayed as Figure 9 allows users to verify food names and their FFV descriptor terms.

Table 1: FFV Factors and Terms

Factor		Terms: Approx. #	and Examples
A)	Product Type Manufacturing, consumption and functional characteristics.	170	dessert bakery product soup
B)	Food Source Animal, plant or chemical source of food or its major ingredient.	1005	sugar producing plant shellfish or crustacean
C)	Part of Plant or Animal Anatomical part of plant or animal from which a food product or its major ingredient is derived.	120	seed or kernel root, tuber or bulb skeletal meat
E)	Physical State, Shape or Form Physical state (solid, semisolid, etc.) Characteristics such as viscosity and particle size are also considered.	45	liquid with low viscosity whole, natural shape
F)	Degree of Preparation Degree of heat treatment food has had.	10	uncooked, raw partially cooked
G)	Cooking Method Cooking method used by the consumer.	30	cooked by dry heat cooked by microwave
H)	Treatments Applied (and Ingredients) Processing steps and ingredients in mixed foods.	180	fat partially removed hydrogenated pickled
J)	Primary Preservation Method	45	preserved by fermentation
K)	Packing Medium Medium in which food is packed for preservation, handling or palatability.	40	packed in broth packed in water
M)	Container or Wrapping Main container materials and form.	100	glass container metal container
N)	Food Contact Surface Container materials in direct contact with food.	60	glass plastic
P)	User Group Age and dietary prescription of the user group for which the food product is marketed.	20	human food, no age specification, regular diet infants or junior food, regular infant diet
Z)	Adjunct characteristics The grade, cut, and color of meats.	35	loin prime grade

FCRDB

Table 2: FFV Factoring Examples

Example 1: Skim milk, with vitamin A added

Code	Description
A148	Milk or milk product
B1201	Cow
C235	Milk
E123	Liquid, low viscosity, with no visible particles
F18	Partially cooked
G003	Cooking method not applicable
H199	Fortified
H248	Fat fully removed
H213	Vitamin A added
J001	Preservation method not known
K03	No packing medium used
M001	Container or wrapping not known
N01	Food contact surface not known
P24	Human food, no age specification, regular diet

Example 2: Canned evaporated whole cow's milk

A148	Milk or milk product
B1201	Cow
C235	Milk
E139	Liquid, high viscosity, with no visible particles
F14	Fully cooked
G003	Cooking method not applicable
H114	Water removed to reconstitution ratio 1 plus 1
J123	Sterilized by heat, canned
K001	No packing medium
M191	Metal container
N24	Coating enamel
P24	Human food, no age specification, regular diet

Example 3: Margarine, made from hydrogenated corn oil, sold in a plastic tub

A231	Margarine
B1379	Field corn
C190	Fat or oil
E119	Semisolid with smooth consistency
F14	Fully cooked
G003	Cooking method not applicable
H174	Hydrogenated
H199	Fortified
H213	Vitamin A added
H206	Alkalized
H197	Bleached
J100	Preserved by adding chemicals
K03	No packing medium used
M187	Plastic container, rigid or semirigid, plastic lid
N36	Plastic
P24	Human food, no age specification, regular diet

Figure 1: Main Menu

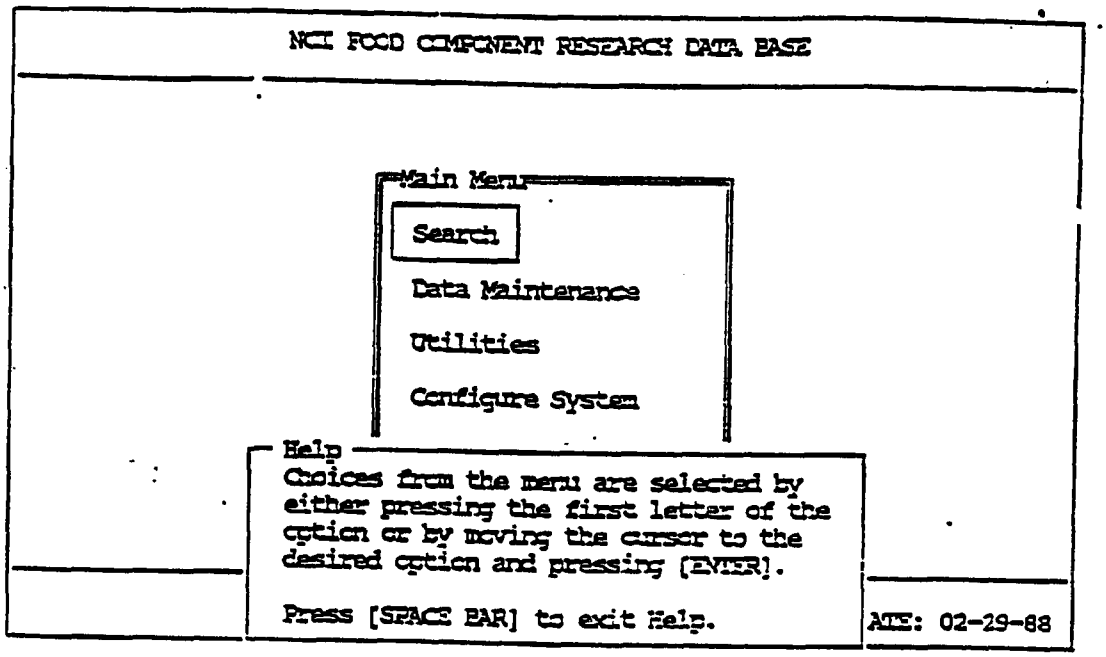

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Figure 2: Search Statements

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LAST SET #: 2                                    LAST SEARCH HITS: 12
LAST SEARCH: (a258 and b1312 and j116) and h273

SET#: 1
ENTER SEARCH STATEMENT: a258 and b1312 and j116
HITS: 44

SET#: 2
ENTER SEARCH STATEMENT: set 1 and zinc added

HITS: 12

SET#: 3
ENTER SEARCH STATEMENT:
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Figure 3: Foods Retrieved by Current Search

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LAST SET #: 2                                    LAST SEARCH HITS: 12
LAST SEARCH: (a258 and b1312 and j116) and h273

08001 ALL-BRAN CEREAL
08005 BRAN BUDS CEREAL
08026 CRISPY WHEATS 'N RAISINS
08028 40% BRAN FLAKES CEREAL, KELLOGG'S
08029 40% BRAN FLAKES CEREAL, POST
08031 FROSTED MINI-WHEATS CEREAL
08036 GRAHAM CRACKOS CEREAL
08051 MOST CEREAL
08060 RAISIN BRAN CEREAL, KELLOGG'S
08061 RAISIN BRAN CEREAL, POST
08073 SUPER SUGAR CRISP CEREAL
08152 WHEAT NUTRI-GRAIN CEREAL
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FCRDB

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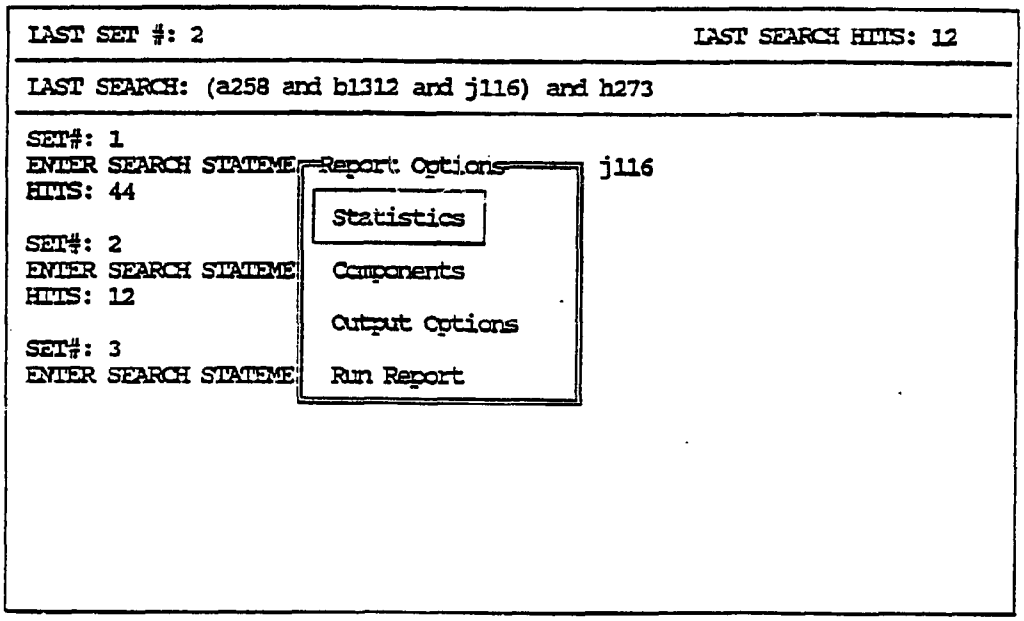
Figure 4: Report Options



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FCRDB

Figure 5: Report Component Selection

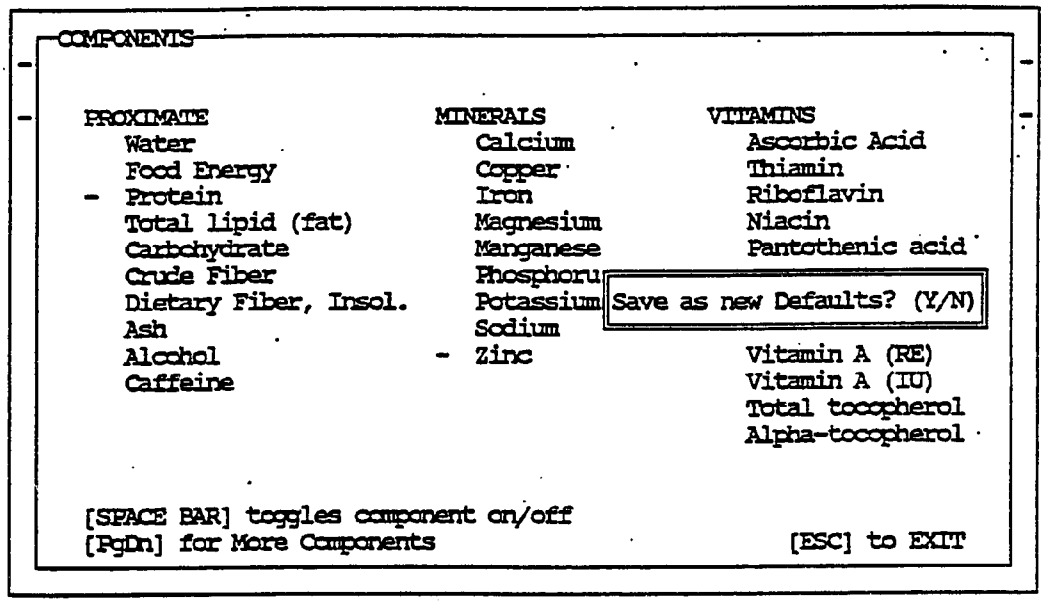

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Figure 6: Individual Report

LAST SET #: 2 LAST SEARCH HITS: 12

LAST SEARCH: (a258 and b1312 and j116) and h273

Individual Report

A: Values based on analytical data with no standard error.
B: Imputed values.
C: Values based on product label claims.

USDA-# ID Description	# OBS	Mean	Std Error	Msg
08001 ALL-BRAN CEREAL				
Protein (g)	3	14.300	.	A
Zinc (mg)	NA	13.200	.	C
08005 BRAN BUDS CEREAL				
Protein (g)	3	13.900	.	A
Zinc (mg)	NA	13.200	.	C
08026 CRISPY WHEATS 'N RAISINS				
Protein (g)	6	6.900	0.111	
Zinc (mg)	6	1.190	0.044	
08028 40% BRAN FLAKES CEREAL, KELLOGG'S				
Protein (g)	3	12.600	.	A
Zinc (mg)	NA	13.200	.	C

Figure 7: Aggregate Report

LAST SET #: 2 LAST SEARCH HITS: 12

LAST SEARCH: (a258 and b1312 and j116) and h273

Aggregate Report

A: Values based on analytical data with no standard error.
B: Imputed values.
C: Values based on product label claims.

# Miss	# OBS	Min	Max	Mean	Std Err	# A	# B	# C
Protein (g)								
0	12	6.500	14.300	10.525	2.820	9	0	0
Zinc (mg)								
0	12	1.190	13.200	7.999	4.297	0	0	11

Figure 8: FFV Entry Screen

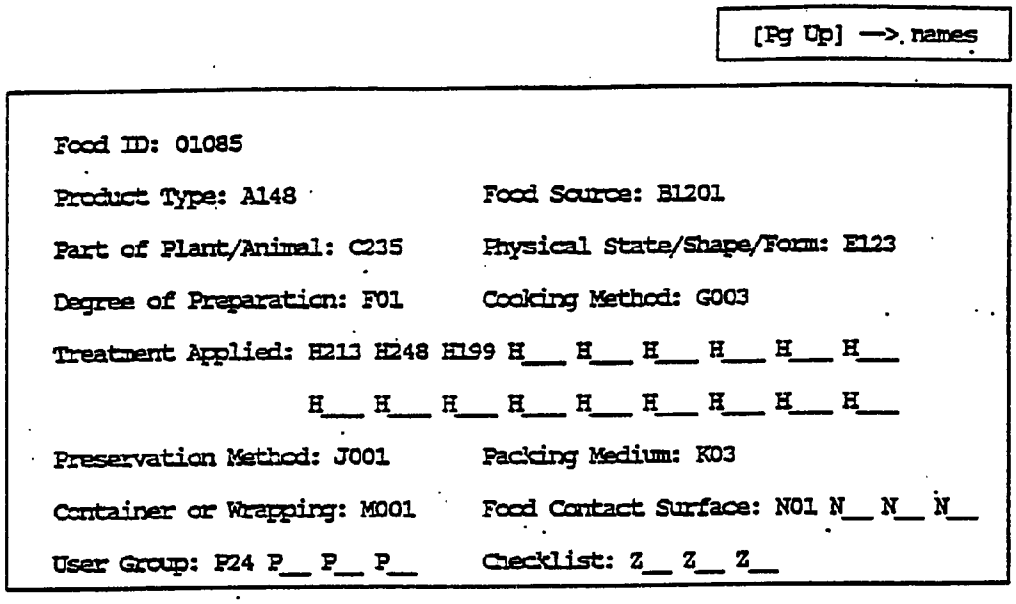
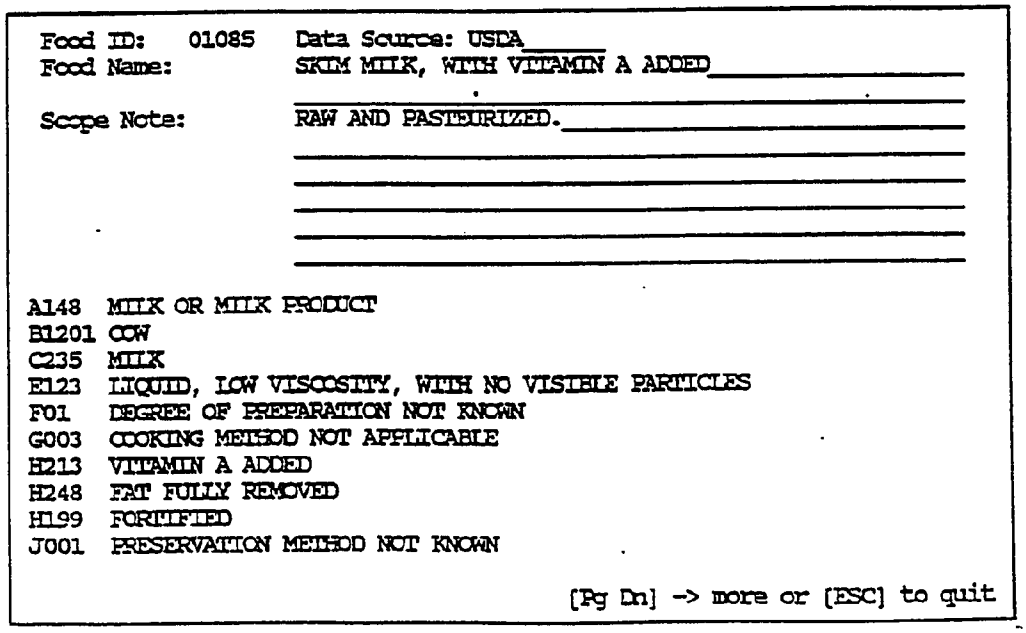


Figure 9: FFV Verification Screen



DISCUSSION

Functionally, the data system provides a working tool for the nutrition researcher to address complex questions regarding food composition. The interactive implementation on a personal computer with excellent response times makes FCRDB an easily accessible and friendly tool regardless of the level of computer expertise of the investigator. FCRDB also provides more evidence, in addition to the FDA's experience with mainframe systems, that a multihierarchical facetted food composition language such as the FFV is useful in the study of food composition and nutrition research. In fact, the usefulness of complex descriptive languages such as FFV is dependent upon the availability of facile tools such as FCRDB that minimize the complexity from the user's perspective.

Technically, this data system demonstrated that a complicated descriptive language can be used for complex retrievals on a personal computer with excellent response times. FCRDB applies current, state-of-the-are software techniques (C, windowing support, B-tree handlers) with appropriate programming and data structures (e.g., bitmaps) to achieve excellent performance on a small machine. Previous applications of the FFV require the use of mainframe computers. FCRDB is an example of optimizing a medical application for the personal computer environment by applying state-of-the-art, yet standard software techniques.

Both functionally and technically, FCRDB has a rich future. The FFV is being proposed for international standardization. The future standardization efforts will make FFV more relevant to a wider range of users and eliminate some of the current limitations in its application. Technically, the initial implementation of FCRDB included code entry because the initial emphasis was upon demonstrating that the retrieval performance on a personal computer using the FFV would be adequate. Now that that question has been eliminated, the user interface is being optimized to provide easier use for researchers not intimately familiar with FFV codes. We view the NCI data base as it exits today as a small module on which to build future expansions. Integrating it to other personal computer based food and nutrition systems at the NCI presents an exciting functional and technical challenge.

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