RECIPE CALCULATIONS vs ANALYTICAL VALUES

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INTRODUCTION

Nutrient data in Agriculture Handbook No. 8 and the nutrient data bases are continually being expanded and improved by the addition of new laboratory data from our contracts and from other sources including industry, universities, and the literature. However, limited nutritional analyses have been conducted on the various mixed dishes for which the Human Nutrition Information Service (HNIS) must provide nutrient values in food consumption surveys or for other purposes. Therefore, it is necessary to calculate nutritive values through the use of recipe programs.

This paper presents results of a comparison of direct nutritional analyses of mixed dishes with nutritional values calculated by our recipe program. The question is how reliable and how accurate are calculated values?

First, just a brief review of the seven basic steps in recipe calculation. In 1985, Betty Perloff of Human Nutrition Information Service, Nutrient Data Research Branch, described the procedures for recipe calculation for the Nationwide Food Consumption Survey. Since then the procedure has been incorporated into the National Nutrient Data Bank System and is used extensively.

RECIPE CALCULATION METHOD

The seven basic steps in recipe calculations are-

1. Determining weight in grams of each ingredient,

2. Determining nutrients in the specified weight of each ingredient from the Standard Reference File,

3. Applying retention factors to vitamin and mineral values when losses may occur during cooking,

4. Determining total uncooked weight of the recipe by summing weights of ingredients,

5. Determining nutrients in the total recipe by summing nutrient values for the ingredients,

6. Adjusting the total values to account for changes in moisture and fat during cooking, and

7. Converting nutrient values for the total recipe to the 100-gram basis. Steps 2 through 7 are performed by the computer program.

This study 1) checked the recipe program using analyzed values for individual ingredients compared with the analyzed values for the prepared mixed dishes and 2) tested the recipe program using nutrient data in the standard reference data base compared with the analyzed values for the prepared mixed dishes.

PROCEDURES

RECIPE CALCULATIONS vs. ANALYTICAL VALUES

Chicken tetrazini (Table 4): The recipe called for cooked skinless chicken breast, pimentos, cheddar cheese, canned mushroom soup, cooked spaghetti, fresh onion, margarine, and a little table wine. Soup, water, cheese, and table wine were blended and heated with the cooked chicken and cooked spaghetti. Again there was close agreement between analytic and calculated values (Method A) except for vitamin B-12, cholesterol, and copper. Vitamin B-12 in the analyzed dish was low and near the level of detection for analysis. Cholesterol values for the analyzed dishes were lower than those calculated from analyzed ingredients.

Chili with beans (Table 5): This recipe called for lean ground beef, chopped onion, chopped celery, canned stewed tomatoes, tomato sauce, and canned kidney beans with salt and chili powder for seasonings. The raw ground beef, onion, and celery were browned and excess fat drained. The tomatoes and tomato sauce were added to the meat mixture and cooked to make a sauce. Beans were added and the mixture heated for some time. Note that there was only a 5 percent difference in cholesterol between the analyzed dish and Method A. Some steps in preparation such as extra long cooking may have caused some additional thiamin losses beyond what was calculated by the recipe program. Sodium, potassium, and phosphorus are higher in the analyzed dish than in the calculation from analyzed ingredients.

Beef loaf (Table 6): The beef loaf was made using lean ground beef, soft bread crumbs, whole milk, raw egg, and salt and pepper and was cooked in a conventional oven for 1 1/2 hours at 350'F. Melted fat was drained off. Fat and cholesterol were off by about 40 to 50 percent. Iron, magnesium, and copper values were off by up to 20 percent. Sodium, phosphorus and potassium were also higher in the analyzed dish than in the calculation from analyzed ingredients, Method A.

CONCLUSIONS

In this study, the laboratory analyzed each of the individual ingredients for six dishes and the six prepared cooked dishes for all of the nutrients. The NDB recipe program was run using the analyzed values for the ingredients to calculate the nutrients in the prepared dishes. Nutritive values for mixed dishes calculated by our recipe program are generally in close agreement with values determined by direct analysis of the dishes. Copper was higher in all but one of the analyzed dishes than the calculations predicted. Is it possible that there was a copper contamination problem? In contrast, calculated values for sodium, potassium, and phosphorus for four of the dishes compared favorably with values from analysis. Some adjustments in retention values for sodium, potassium, and phosphorus may be needed for dishes made with ground beef, since analyzed beef loaf and chili with beans were higher in these minerals compared to the calculated values.

Vitamin B-12 values were low and near the level of detection for several of the analyzed dishes - hinting at some losses during analysis for this unstable vitamin, possibly during preparation of the sample for nutrient analyses.

Problems in analyses of fat, especially in raw meat, continue to occur as shown by inconsistent fat values for the two dishes using meat. Whenever cholesterol was present in a mixture, the analyzed dish value was lower than the value calculated from analyzed ingredients. No losses in cholesterol with cooking have been reported in the literature. However, problems in cholesterol analysis have been reported. Scientists have postulated that the problems are extraction, formation of cholesterol oxides, or interference of plant sterols.

Problems in analyses of cholesterol in mixtures were reported at this conference in 1982 by Mary Marshall of USDA. She reported that the cholesterol values in mixed diets for

human studies were considerably lower than the values in diets calculated from Handbook No. 8 values. For most nutrients, analyzed and calculated values were comparable. We believe the differences shown here for cholesterol, copper, and vitamin B-12 are more likely to be a result of problems with analytical analysis of mixed dishes rather than problems with recipe calculations. More research is needed to study the variability in retention of sodium, potassium, and phosphorus in meat mixtures. Meanwhile, we would like to assume that calculated values are "more accurate and reliable" than analyzed values for mixed dishes.

REFERENCES

Marshall, Mary Chemical Analyses vs. Computerized Assessment of Human Diets. Proc. Seventh National Nutrient Data Bank Conference, 1982. pp. 45-85.

Perloff, Betty P. Recipe Calculations for the NFCS Data Base. Proc. Tenth National Nutrient Data Bank Conference, 1985. pp. 11-21.

Comparison of nutrients in macaroni and cheese by direct analyses and by two methods of calculation

Nutrient	Analyzed	Calculated	
		Method A[1]	Method B[2]
	Table 1		
Proximates			
Water (g)	62.0	62.2	60.3
Protein (g)	8.2	7.8	7.9
Fat (g)	10.2	10.3	10.5
Carbohydrate (g)	17.6	18.1	19.2
Cholesterol (mg)	16.5	24.6	21.4
Minerals			
Calcium (mg)	176	167	162
Iron (mg)	1.0	.9	1.0
Magnesium (mg)	17	16	16
Phosphorus (mg)	196	181	199
Potassium (mg)	97	92	127
Sodium (mg)	434	411	425
Zinc (mg)	.85	.79	.89
Copper (mg)	.070	.056	.067
Vitamins			
Vitamin C (mg)	1.2	.4	.3
Thiamin (mg)	.14	.14	.11
Riboflavin (mg)	.22	.21	.19
Niacin (mg)	1.2	1.2	.9
Vitamin B-6 (mg)	.05	.05	.06
Vitamin B-12 (mcg)	.16	.22	.18

[1]Analyzed nutrients by NDB recipe program
[2]Standard Reference Data Base by NDB recipe program

Comparison of nutrients in fried rice by direct analyses and by two methods of calculation

Nutrient	Analyzed	Calculated	
		Method A[1]	Method B[2]
	Table 2		
Proximates			
Water (g)	71.2	70.6	71.7
Protein (g)	3.3	3.1	2.9
Fat (g)	6.0	6.5	6.4
Carbohydrate (g)	18.6	18.8	17.6
Cholesterol (mg)	20.4	28.8	32.3
Minerals			
Calcium (mg)	26	25	23
Iron (mg)	1.9	1.8	2.2
Magnesium (mg)	11	10	13
Phosphorus (mg)	62	58	66
Potassium (mg)	95	94	86
Sodium (mg)	187	191	162
Zinc (mg)	.42	.41	.50
Copper (mg)	.140	.112	.104
Vitamins			
Vitamin C (mg)	4.1	5.5	3.6
Thiamin (mg)	.19	.18	.10
Riboflavin (mg)	.07	.07	.05
Niacin (mg)	1.4	1.2	1.1
B-6 (mg)	.05	.03	.06
B-12 (mcg)	<.04	.05	.07

[1]Analyzed nutrients by NDB recipe program
[2]Standard Reference Data Base by NDB recipe program

Comparison of nutrients in Spanish rice by direct analyses and by two methods of calculation

Nutrient	Analyzed	Calculated	
		Method A[1]	Method B[2]
	Table 3		
Proximates			
Water (g)	80.6	80.1	82.1
Protein (g)	1.8	1.9	1.6
Fat (g)	1.2	1.1	1.2
Carbohydrate (g)	14.6	15.6	13.5
Cholesterol (mg)	0	0	0
Minerals			
Calcium (mg)	36	38	28
Iron (mg)	2.0	2.1	1.5
Magnesium (mg)	12	12	14
Phosphorus (mg)	33	35	40
Potassium (mg)	226	179	191
Sodium (mg)	315	309	269
Zinc (mg)	.24	.21	.29
Copper (mg)	.129	.074	.112
Vitamins			
Vitamin C (mg)	10.4	10.6	15.6
Thiamin (mg)	.12	.12	.08
Riboflavin (mg)	.03	.01	.03
Niacin (mg)	1.2	1.2	1.0
B-6 (mg)	.12	.11	.10
B-12 (mcg)	0	0	0

[1]Analyzed nutrients by NDB recipe program
[2]Standard Reference Data Base by NDB recipe program

Comparison of nutrients in chicken tetrazini by direct analyses and by two methods of calculation

Nutrient	Analyzed	Calculated	
		Method A[1]	Method B[2]
	Table 4		
Proximates			
Water (g)	72.2	72.0	74.1
Protein (g)	9.2	9.1	7.5
Fat (g)	5.7	5.9	7.1
Carbohydrate (g)	11.4	12.1	10.1
Cholesterol (mg)	19.0	24.1	20.0
Minerals			
Calcium (mg)	52	55	61
Iron (mg)	.8	.7	.8
Magnesium (mg)	13	12	11
Phosphorus (mg)	88	84	85
Potassium (mg)	91	85	87
Sodium (mg)	271	265	338
Zinc (mg)	1.16	1.13	.80
Copper (mg)	.062	.041	.077
Vitamins			
Vitamin C (mg)	1.3	1.8	2.6
Thiamin (mg)	.09	.09	.06
Riboflavin (mg)	.10	.10	.10
Niacin (mg)	3.2	2.3	1.5
B-6 (mg)	.14	.12	.07
B-12 (mcg)	<.04	.09	.10

[1]Analyzed nutrients by NDB recipe program
[2]Standard Reference Data Base by NDB recipe program

Comparison of nutrients in chili with beans by direct analyses and by two methods of calculation

Nutrient	Analyzed	Calculated	
		Method A[1]	Method B[2]
	Table 5		
Proximates			
Water (g)	77.7	78.5	79.3
Protein (g)	7.4	6.3	6.9
Fat (g)	4.9	5.6	5.5
Carbohydrate (g)	7.6	8.6	7.7
Cholesterol (mg)	18.1	19.0	22.4
Minerals			
Calcium (mg)	30	29	24
Iron (mg)	1.2	1.1	1.3
Magnesium (mg)	20	18	21
Phosphorus (mg)	80	63	69
Potassium (mg)	310	247	266
Sodium (mg)	452	394	410
Zinc (mg)	1.38	1.36	1.33
Copper (mg)	.088	.093	.131
Vitamins			
Vitamin C (mg)	3.4	4.6	8.0
Thiamin (mg)	.08	.17	.07
Riboflavin (mg)	.08	.07	.08
Niacin (mg)	1.9	1.2	1.3
B-6 (mg)	.14	.09	.11
B-12 (mcg)	.34	.19	.43

[1]Analyzed nutrients by NDB recipe program
[2]Standard Reference Data Base by NDB recipe program

Comparison of nutrients in beef loaf by direct analyses and by two methods of calculation

Nutrient	Analyzed	Calculated	
		Method A[1]	Method B[2]
	Table 6		
Proximates			
Water (g)	65.0	67.2	66.1
Protein (g)	19.6	20.5	18.4
Fat (g)	8.8	4.2	9.2
Carbohydrate (g)	4.6	6.5	6.6
Cholesterol (mg)	70.2	101.2	93.0
Minerals			
Calcium (mg)	47	47	47
Iron (mg)	2.9	2.3	2.2
Magnesium (mg)	23	18	18
Phosphorus (mg)	194	145	117
Potassium (mg)	327	223	193
Sodium (mg)	424	384	386
Zinc (mg)	3.72	3.61	3.93
Copper (mg)	.079	.062	.086
Vitamins			
Vitamin C (mg)	2.0	.7	.8
Thiamin (mg)	.12	.12	.07
Riboflavin (mg)	.25	.22	.26
Niacin (mg)	4.0	2.7	2.5
B-6 (mg)	.24	.13	.10
B-12 (mcg)	1.4	1.0	1.1

[1]Analyzed nutrients by NDB recipe program
[2]Standard Reference Data Base by NDB recipe program