Abstract

The Nutrient Data Laboratory (NDL) develops and maintains tables of Nutrient Retention Factors and Cooking Yields. These tables are released from the National Nutrient Databank (NNDB) along with the USDA Nutrient Database for Standard Reference (SR) on NDL's Web site at www.nal.usda.gov/fnic/foodcomp. SR data for components serves as the basis for virtually all food composition applications in the United States. NDL is in the process calculating new retention factors using analytical data from the National Food and Nutrient Analysis Program. When analytical data or manufacturer's unadjusted data are unavailable for cooked foods, NDL uses recipe calculations in the National Nutrient Databank to develop the nutrient composition data for cooked food items included in SR release. NDL food specialists uses NNDB software tools to facilitate and standardize nutrient data calculations from recipes. These software algorithms incorporate weights or measures of the various ingredients as well as the nutrient data for each ingredient. Calculations take into account any changes in weight due to moisture and/ or fat gains and/ or losses through the application of standard cooking yield factors. In addition, nutrient retention factors are used to account for vitamin and mineral losses during cooking. NDL applies cooking yields and retention factors to recipe calculations to improve nutritional composition data.

Improving Nutrient Composition Data in the National Nutrient Databank by Applying Cooking Yield Data and Nutrient Retention Factors to Recipe Calculations

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Fig.1
Chocolate Cake Recipe without Applying Cooking Yield and Retention Factors

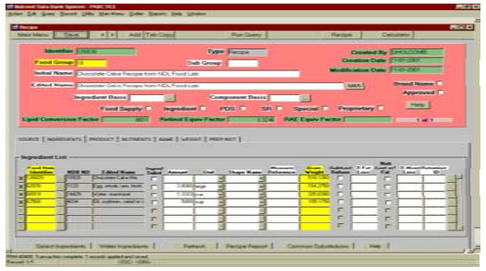

Fig.2
Chocolate Cake Recipe with Cooking Yield Data Applied

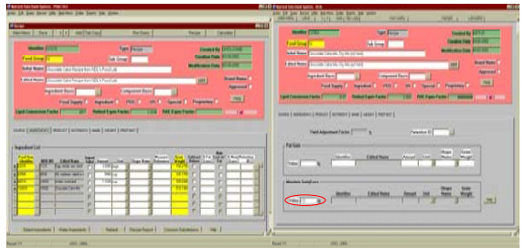

Fig. 3
Chocolate Cake Recipe with Cooking Yield and Retention Factors Applied

SR

Table 1
Comparison of Nutrients Without and With Cooking Yield Applied

Nutrient Comparison Report - Chocolate Cake Recipes

Nutrient Number	Nutrient Name	Without Cooking Yield Applied Value 1	With Cooking Yield Applied Value 2
255	Water	41.88 g	33.96 g
208	Energy	297.20 g	337.73 g
203	Protein	3.89 g	4.42 g
204	Total lipid (fat)	14.95 g	16.98 g
207	Ash	1.59 g	1.81 g
205	Carbohydrates	36.77 g	41.78 g
301	Calcium	81.10 mg	92.16 mg
303	Iron	1.85 mg	2.10 mg
304	Magnesium	26.42 mg	30.03 mg
305	Phosphorus	170.56 mg	193.82 mg
306	Potassium	154.78 mg	175.88 mg
307	Sodium	390.01 mg	443.18 mg
309	Zinc	.5583 mg	.6344 mg
312	Copper	.2370 mg	.2693 mg
315	Manganese	.2545 mg	.2893 mg
317	Selenium	9.57 mcg	10.87 mcg
404	Thiamin	.0639 mg	.0726 mg
405	Riboflavin	.2326 mg	.2643 mg
406	Niacin	.8149 mg	.9260 mg
417	Folate	27.91 mcg	31.72 mcg

Table 2
Comparison of Nutrient Values with Cooking Yield and Retention Factors Applied

Nutrient Comparison Report - Calculated Chocolate Cake Recipes

Nutrient Number	Nutrient Name	Cooking Yield Applied Value 1	Cooking Yield & Retention Factors Applied Value 2
404	Thiamin	.0726	.0581
405	Riboflavin	.2643	.2419
406	Niacin	.9260	.8334
415	Vitamin B6	.0417	.0386
417	Folate	31.72	22.58
418	Vitamin B12	.1589	.1271

Conclusion and Discussion

Cooking Yield

Cooking Yield Data were obtained from NDL's Food Lab. Three nationally known brand name cake mixes were purchased. The cake mixes were prepared and baked according to label preparation instructions. Each cake batter was weighed before pouring into cake pan. After baking, the cakes were placed on cooling racks for 25 minutes. Afterward, the cakes were removed from the cake pans, cooled for an additional 10 minutes and weighed. Changes in weight were assumed to be due to moisture loss.

Algorithm Used:

Change in Weight = Weight of baked cake – Weight of cake batter

$$\% \text{ MOISTURE LOSS} = \frac{\text{Change in weight (g)}}{\text{Cake batter weight}} * 100$$

$$\% \text{ COOKING YIELD} = \frac{\text{Weight of baked cake (g)}}{\text{Weight of cake batter(g)}} * 100$$

Table 1 illustrates how applying cooking yield data affect nutritional values. Data listed under value 1 are unadjusted, not accounting for moisture loss in food after baking. Data under value 2 resulted from applying cooking yields to recipe calculations. The total amount of water is decreased and the other nutrients are more concentrated. Therefore, data under value 2 would better represent nutrient levels calculated by recipe for a baked cake.

Cooking Yield Data for different foods are currently available in Agriculture Handbook No. 102. In the future Cooking Yield Data will be disseminated on NDL's Web site.

Table 3
Comparison of Recipe Calculated Data to Analytical Data

Nutrient Comparison Report - Chocolate Cake Data

Nutrient Number	Nutrient Name	Calculated (Recipe Program)*	Analytical (NFNAP)	Ratio
255	Water	33.96 g	34.50 g	1.016
203	Protein	4.42 g	4.67 g	0.9890
204	Total lipid (fat)	16.98 g	16.86 g	0.9928
207	Ash	1.81 g	1.80 g	0.9963
301	Calcium	92.16 mg	94.23 mg	1.022
304	Magnesium	30.03 mg	30.43 mg	1.013
405	Riboflavin	.2419 mg	.3308 mg	1.367

*With Cooking Yields and Retention Factors Applied

Nutrients calculated using the Recipe Program compared well with analytical data from The National Food Nutrient Analysis Program (NFNAP). A ratio of 1 indicates an exact match between calculated and analytical values. As seen in Table 3 ratios fell within a range of .9890 to 1.367, showing a excellent match between calculated and analytical values.

Retention

Foods when cooked are not susceptible to moisture/fat losses and/or gains only. The amount of vitamins and minerals retained will also vary. Vitamins and minerals are affected by the cooking method, the temperature and time of cooking, food matrix and the stability of the nutrient to other factors such as heat, oxygen and light. Some vitamins are easily lost in certain foods and stable in others. To calculate true retention factors, data are needed on the nutrient content of both raw and cooked foods and yields. The USDA Table of Nutrient Retention Factors is located under Food Composition Products on NDL's Web site at www.nal.usda.gov/fnic/foodcomp.

Algorithm:

$$\text{True Retention (TR)} = \frac{\text{nutrient content of cooked food (g)}}{\text{nutrient content of raw food (g)}} * \text{Yield}$$

Figure 3 shows nutrient retention factors applied to recipe ingredients to account for vitamin and mineral losses during cooking. Retention Factors for vitamins and minerals were 100 percent retained after baking, with the exception of the six vitamins listed in Table 2. Eggs when baked retain 75% folate and flour retains 70%, this accounts for the general decrease in folate value. Overall, the vitamin losses were not in large amounts. However, it is apparent that applying retention factors to a recipe will alter nutrient data. It is illustrated in Table 2 how applying cooking yield and retention factors to a recipe will give more accurate estimate of recipe calculations.