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CENTRAL SOYA

August 20, 2001

Lynn Larsen, Ph.D.
Division of Nutrition Science and Policy
Office of Nutritional Products, Labeling, and Dietary Supplements (HFS-800)
Food and Drug Administration
200 C Street, SW
Washington, DC 20204

Re: Further information regarding FDAMA notification on nutrient content claims for choline

Dear Lynn:

Central Soya Company, Inc. hereby submits additional information and comments concerning our FDAMA notification regarding nutrient content claims for foods that contain choline.

In this amendment, we address the following issues: 1) modify the wording of the nutrient content claims desired; 2) clarify that all sources of choline added to food must be safe and lawful and that that the food manufacturer has the responsibility to ensure safety of foods with added choline; 3) comment on rationale for adding choline to certain foods and on how the addition of choline to foods is consistent with FDA's fortification policy; 4) clarify that nutrient content claims in the notification are for use on products designed for individuals over 4 years of age; 5) provide further information on the estimated intake of choline from responsible fortification including information on choline intake from food additives and supplements.

1) Modification of wording of claims

We would like to modify the specific wording of certain claims desired, namely "good source of choline", "contains choline", "provides choline", "excellent source of choline", "rich in choline", and "high in choline" to contain one of the following descriptive statements:

"Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg." or

"Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."

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Where "[X mg]" and "[X%]" refer to milligrams of choline and percentage of Daily Value (DV), respectively. One of these two descriptive statements must be included as part of the claim. The FDAMA statute requires a notification under FDAMA to provide the exact wording of the claims desired. The exact wordings for these claims for the notification are:

"Good source of choline. Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg."

"Good source of choline. Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."

"Provides choline. Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg."

"Provides choline. Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."

"Contains choline. Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg."

"Contains choline. Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."

"Excellent source of choline. Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg."

"Excellent source of choline. Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."

"Rich in choline. Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg."

"Rich in choline. Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."

"High in choline. Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg."

"High in choline. Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."

Again, the addition of the descriptive statement is part of the claim request and as such will appear immediately adjacent to the shorter nutrient content descriptor (e.g., "provides choline", "contains choline", etc.).

We also want to modify the relative claims in the notification, namely "added choline", "more choline", "enriched with choline", and "fortified with choline" to include the following descriptive statements:

"[Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving."

Where "[Percentage 10% or greater]" is the percentage of the Daily Value in the product (must be more than 10% to be eligible for these claims), "[reference food]" refers to the name of the food to which the product is being compared, "[X mg]" refers to the milligrams of choline in the product, and "[X%]" refers to the percentage of the Daily Value in the product.

The exact wordings of these relative claims for the notification are:

"More choline. [Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving."

"Added choline. [Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving."

"Enriched with choline. [Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving."

"Fortified with choline. [Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving."

We also want to add the following relative claims as part of the notification:

"Extra choline. [Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving."

"Plus choline. [Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving."

For relative claims, the claim must be presented in its entirety or the last two sentences of the claim (i.e., "This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving.") may be placed immediately adjacent to the Nutrition Facts panel, but not in the Nutrition Facts panel.

The size of the nutrient content claim will be consistent with Sec. 101.13(f) which states that a nutrient content claim shall be in type size no larger than two times the statement of identity and shall not be unduly prominent in type style compared to the statement of identity.

The descriptive statements (e.g., "Contains [X%] of the DV of choline per serving. The DV for choline is 550 mg."; "Contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg)."; or, "[Percentage 10% or greater] more of the DV of choline per serving than [reference food]. This product contains [X mg] choline per serving which is [X%] of the DV for choline (550 mg). [Reference food] contains [X mg] choline per serving.") shall be in easily legible boldface print or type, in distinct contrast to other printed or graphic matter, and in a size no less than that required by Sec. 101.105(i) for the net quantity of contents statement, except where the size of the claim is less than two times the required size of the net quantity of contents statement, in which case the descriptive statements shall be no less than one-half the size of the nutrient content claim descriptor (e.g., "provides choline" or "more choline") but no smaller than one-sixteenth of an inch, unless the package complies with Sec. 101.2(c)(2), in which case the disclosure statement may be in type of not less than one thirty-second of an inch.

We feel the changes to these claims provide important information to the consumer that cannot be easily obtained elsewhere.

2) All sources of choline added to food must be safe and lawful

Currently, three sources of choline are affirmed as GRAS, namely lecithin, choline chloride and choline bitartrate and can be used according to current good manufacturing practice. Food manufactures, not FDA, have the responsibility to ensure the addition of choline from these or other sources are safe and are in compliance with all food safety provisions of the Food, Drug and Cosmetic Act (Act). Thus, we acknowledge that no monitoring of choline addition to foods is required by FDA. We also acknowledge that no formal response to our notification is necessary if the agency has no objection to the contents of our notification.

3) Rationale for adding choline to food and applicability to FDA's fortification policy

Choline is important for the structural integrity of cell membranes, cholinergic neurotransmission, transmembrane signaling, methyl-metabolism, and lipid-cholesterol transport and metabolism. Choline is a precursor for phosphatidylcholine, sphingomyelin, platelet-activating factor, betaine and other phospholipids. Choline speeds the synthesis and release of acetylcholine, an important neurotransmitter involved in numerous important functions in the body.

Unfortunately, there are no nationally representative estimates of intake of choline form food or food supplements. However, some inferences can be drawn about current intake of choline by looking at food intake trends of certain foods known to be high in choline. Data on food intake over the last 15-20 years indicate that foods that are typical sources of choline, namely eggs, whole milk, meat and table fats are being consumed in less amounts by Americans. USDA[1] has reported that over the last 17 or so years, the average consumption of eggs has decreased by 33% (24 to 16 g/d) in women 20 years of age and older and by 39% (38 to 23 g/d) in men 20 years of age and older. Fluid milk intake, and in particular whole milk intake, has also dropped significantly in the US adult population. Fluid milk consumption decreased 11% (151 to 135 g/d) in women and 17% (214 to 178 g/d) in men but whole milk decreased 48% (67 to 35 g/d) in women and 70% (102 to 54 g/d) in men. Low-fat and skim milk consumption has increased considerably. Beef consumption and table fat consumption also decreased from 1977-78 through 1994-95. In men 20 years of age and older, beef consumption decreased from 72 g/d to 38 g/d (47% decrease). In women 20 years of age and older, beef consumption decreased from 47 g/d to 19 g/d (60% decrease). The impact of decreased beef consumption is offset somewhat by the increase in meat consumption from mixed dishes[2] (60 to 85 g/d in women and 92 to 137 g/d in men). Over the 17 or so years examined, table fat decreased 3 g/d in both men and women (50% decrease in women and 37.5% decrease in men). On one hand, these deceases in higher fat foods are good for Americans and are consistent with recommendations from health professionals. On the other hand, as consumption of foods with higher fat content decreases in the American diet there is an increased chance of not consuming the recommended level of choline. However, direct quantification of choline intake will have to await completion of the analytical work underway to determine choline content of most foods.

As mentioned in the Fortification Policy, (Sec. 104.20) the addition of nutrients to specific foods can be an effective way to maintain or improve the overall nutritional quality of the food supply. In this policy, indiscriminate addition of nutrients is discouraged. The policy also points out that addition of nutrients to certain foods like fresh produce; meat, poultry or fish products; sugars; or snack foods such as candies and

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[1]Enns, C. W., Goldman, J. D. and A. Cook. 1997. Trends in Food and Nutrient Intakes by Adults: NFCS 1977-78,. CSFII 1989-1991, and CSFII 1994-95. Family Economics and Nutrition Review. 10(4):1-14. Can be found at http://www.barc.usda.gov/bhnrc/foodsurvey/pdf/Trends.pdf

[2] Includes mixtures having meat poultry or fish as the main ingredient, such as chicken cacciatore, beef loaf, chili con carne, venison stew, hash, tuna salad; frozen meals in which the main course is a meat, fish or poultry item; meat, fish or poultry sandwiches coded as a single item, like cheeseburger on a bun; and baby food meat and poultry mixtures.

carbonated beverages is inappropriate. We took these points into consideration when we developed the list of foods appropriate for the addition of choline. We also considered several other points listed in the Fortification Policy as we created the list of foods that are appropriate to contain additional choline. In particular, the logical sources of choline (choline chloride, choline bitartrate and lecithin) are stable in food under customary conditions of storage and distribution and are physiologically available from foods in which they are added. As we have presented in our previous amendment and this amendment, there is a reasonable assurance that consumption of foods with added choline will not result in an excessive intake of choline in the diet, even for the children 4 to 8 years of age. And, as mentioned above, the addition of choline to foods must be done in accordance and in compliance with applicable provisions of the Act and regulations governing the safety of substances in food. Finally, any claim or statements used in labeling of food about the addition of choline to a food must not be false and misleading and must comply with the Act and any applicable regulations.

4) Nutrient content claims are for products labeled for individuals 4 years and older

In our previous amendment, we stated the specific nutrient content claims for choline requested in our notification were not to be used to label products made for children less than two years of age or in infant formula. We acknowledge that Daily Reference Values (DRV) and Reference Daily Intakes (RDI) were established for adults and children 4 or more years of age. Thus, the specific nutrient content claims for choline requested in our notification are not to be used to label products specifically targeted to children less than four years of age.

5) Further comments on estimated intake of choline

After contacting Dr. Steven Zeisel's laboratory, we recalculated total choline intake from the table provided in Zeisel and Blusztajn (1994). We discovered that Dr. Zeisel's team uses 104 as the molecular weight for choline and that the values in the table need to be adjusted for the percentage of choline in phosphatidylcholine and sphingomyelin. These corrections have been made in Table 1 of Appendix A. However, even after correcting the choline content values, the percentage of choline intake in our original four indicator foods (egg, meat, nuts and table fats) represented from 25 to 36% of the total choline intake reported by the National Academy of Sciences (NAS). We acknowledge that even if we included all the foods in the table for which we had reasonable estimates of food intake from CSFII (apples, bananas, potatoes, lettuce, tomato, citrus fruits, whole milk along with egg, meat, nuts and table fats), we only provide 27 to 39% of the choline intake reported by NAS. One reason we can only account for less than 40% of the choline in the diet is due to the fact that data from Zeisel and Blusztajn (1994) do not contain information on phosphocholine or glycerophosphocholine content of the foods listed in their table. Another reason may be that other foods for which we have no analytical data or reliable intake data provide the remaining choline in the diet.

Regardless of the changes to Table 1 and the inclusion of more foods as indicators of choline intake, the estimates of current choline intake in children changed very little. We

now estimate that children 9 years of age and younger consume about 57% of the choline intake of adults and thus we estimate the current choline intake at 417 to 594 mg/d. We estimated choline intake from data available on two other age groups, namely children 5 years of age and younger and children ages 6-9 years, and found similar estimates of choline intake (410 to 572 mg/d in children 5 years of age and younger; 445 to 634 mg/d in children 6 to 9 years of age). We examined these two other groups as we acknowledge that using only the group of children 9 years of age and younger may be affected by intake data from children one to three years of age. Given the available data we feel our estimate of current choline intake of children of 417 to 594 mg/d is reasonable.

Unfortunately, we cannot provide a variation estimate associated with the estimate of current choline intake in children 9 years of age and younger. We used a similar approach as the Food and Nutrition Board (FNB) when variation estimates are unavailable, namely, we assumed that 95% (± 2 standard deviations) of requirements are covered by the estimated average plus 2 times the coefficient of variation multiplied by the estimated average. We assumed a CV of 10 percent that is ordinarily assumed by FNB when variation data on average requirements are unavailable. This does assume the data are normally distributed. Using this approach we estimated the current choline intake in most children 4 to 8 years would not exceed 713 mg/d[3]. Adding the additional intake from 95th percentile consumption of foods proposed for choline fortification from Table 3 in Appendix A (189.7 mg/d) to these values provides an estimated intake of choline that would not exceed of 903 mg/d for most children 4 to 8 years of age.

We believe this intake estimate is a truly worse case scenario as these calculations assume that all the foods proposed for added choline have 110 mg choline per serving. If all these foods had choline added at 55 mg per serving the estimated highest choline intake for most children 4 to 8 years of age would be 808 mg/d. If we assume only 50% of the foods proposed for added choline were fortified with 110 mg or 55 mg choline per serving, the highest intake of choline in most children 4 to 8 years of age would be 808 mg/d and 760 mg/d, respectively.

We also estimated the contribution to choline intake associated with the use of food additives and dietary supplements. By far, the largest contribution of food additives and dietary supplements comes from the use of lecithin as a processing aid. Central Soya has been providing customers various forms of lecithin for over 40 years. Thus, we have considerable knowledge and carefully track the amount of lecithin being sold. We estimate that over 130,000,000 pounds of lecithin is sold annually for use in foods, dietary supplements and industrial applications. In keeping with our intent to provide conservative estimates, we will assume all 130,000,000 pounds of lecithin sold annually is used exclusively in foods and dietary supplements. Thus, in this worse case scenario we estimate that only 11.7 mg of choline per capita comes from use of lecithin in foods and supplements today.[4] We also conducted an informal survey of the use of choline

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[3] Highest intake = 594 + (2 * 0.10 * 594) = 712.8 mg/d.

[4] 130,000,000 (lbs lecithin) / 280,000,000 (US population as of April 1, 2000)) X 454 (g/lb) X 0.15 (% phosphatidyl choline in lecithin on average) X 0.135 (% choline content of phosphatidyl choline) / 365 (days/year) = 11.7 mg/day per capita.

containing ingredients in dietary supplements marketed for children. In one large Midwest grocery store we identified 14 separate dietary supplement products marketed for children. Seven different manufacturers produced these products. Only one product contained an ingredient that provided any choline. This one product contained choline bitartrate. The amount of choline provided in a single supplement dose of this product was only 20 μg. Additionally, in one store of a national nutrition franchise we identified 19 separate dietary supplement products marketed for children. Five different manufacturers produced these products. Five of the nineteen products contained an ingredient that provided choline. Two products contained lecithin and four products contained choline bitartrate. In two cases the choline level was 1 mg per dose. The highest level of choline for any of these products was 12 mg per dose. We conclude that choline contributed by food additives and dietary supplements is very small and has little impact on the estimates of choline intake in 4 to 8 year old children.

Thus, we conclude choline intake in 4 to 8 year old children will not exceed the UL and that responsible addition of choline to foods is safe and should present no harm to Americans.

If you have any questions regarding the contents of this amendment, please contact us.

Sincerely,

Gregory Paul

Gregory L. Paul, Ph.D.
Director Nutrition Science

Terrence E. Quinlan
Corporate Counsel

APPENDIX A.

INTRODUCTION

This document provides further information about the impact of choline fortification on choline intake by Americans with particular emphasis on children 4 to 8 years of age. This age group has a narrow range between their Tolerable Upper Intake Level (UL) of 1000 mg/d as reported by the Food and Nutrition Board (FNB) in Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B_6, Folate, Vitamin B_{12}, Pantothenic Acid, Biotin, and Choline and.the adult Adequate Intake of 550 mg/day that serves as the basis for the nutrient content claims in our notification.

To estimate the impact of fortification, various food/food groups were identified as logical carriers for choline. These food/food groups were yogurt, milk-based fluids, egg substitutes, meat substitutes, whole wheat breads, multigrain breads, muffins, bars, and salad dressings (regular and low-calorie). To model the impact of fortification, the food nutrient database was modified such that the above-mentioned foods contained either 55 mg choline per serving or 110 mg choline per serving. The intake profile (amount and frequency) by individuals in USDA's Continuing Survey of Food Intakes by Individuals (CSFII), 1994-1996 and 1998 was then used to calculate the additional choline intake from fortification of the above-mentioned foods with either 55 or 110 mg choline per serving.

We also updated our estimates of current choline intake (prior to fortification) in children ages 4 to 8 years. As mentioned in our last amendment no data were provided for choline intake of children in the FNB report. Since CSFII and other databases do not contain choline content of foods, we needed to make a series of assumptions to generate an estimate of choline intake in children. Choline intake was estimated to be 730 to 1040 mg/d in adults consuming a typical U.S. diet according to the FNB report. In our first amendment we estimated choline intake in children by developing a ratio of choline intake between adults and children ages 4 to 8 years for four foods – total meats, eggs, nuts and table spreads. These foods were selected as they all had greater than 0.1 mg/g of choline as reported in our FDAMA notification. We assumed all meats had 0.479 mg/g choline (even though the only meat reported by Zeisel and Blusztajn was beef steak). We also assumed all table spreads were butter (0.164 mg/g choline) and we used the peanut value (0.418 mg/g) to estimate choline from nuts. The adult intake (males and females 20 years and older) data came from USDA's CSFII 1994-1996, while the children (ages 9 and below) intake data came form USDA's CSFII 1994-96, 1998.

Subsequently, after discussing with Dr. Steven Zeisel's laboratory we found that our calculations of total choline content needed to be modified. To obtain the correct total choline content, we needed to use a molecular weight of choline as 104 and to adjust for the choline content of phosphatidylcholine and sphingomyelin. Table 1 provides a corrected copy of the choline content of certain foods. With these corrected choline

content values we developed a ratio of choline intake between adults and children based on as many of the foods as possible. We were able to find relevant intake information for eleven foods (apples, bananas, potatoes, lettuce, tomato, citrus fruits, whole milk along with egg, meat, nuts and table fats). We made similar assumptions as in our last amendment as mentioned above and we also assumed that the choline content of iceberg lettuce would apply to all lettuce and lettuce based salads and that the choline content of oranges would apply for all citrus fruit.

RESULTS

As in our first amendment we combined information from males and females into one adult value. We completed this for all the foods for which intake data were available and totaled the choline intake from these foods for both adults and children (Table 2a and Table 2b, respectively). As presented in Table 2c, we then calculated a ratio of choline intake from these indicator foods among adults and children (0.571). Thus, it appears children 4 to 8 years of age consume about 57% of the choline from these foods as adults. Applying the same logic across all foods, then total choline intake in children ranges from 417 to 594 mg/d.[5] We also calculated the ratio of choline intake for children 5 years of age and younger and for children 6-9 years of age (data not provided). The ratios were 0.549 and 0.609, respectively. These ratios would result in estimated choline intake in children 5 years of age and younger of 410 to 572 mg/d and in children 6 to 9 years of age of 445 to 634 mg/d. We acknowledge that using data only from children 9 years of age and younger might underestimate intake slightly as children younger than 4 years of age, which consume less food, are included. However, as can be seen from the data from 6 to 9 year old children, which may slightly over estimate intake as 4 and 5 year old children are not included, the estimated choline intake is only higher by 28 to 40 mg/d.

The impact on choline intake of fortification of the certain foods at two different levels, 55 or 110 mg/serving were presented in Tables 2 through 5 in our first amendment. While we provided data for fortification of these foods at 55 mg/serving we only discussed estimates of additional choline intake from fortification of certain foods at 110 mg/serving. Also, for reasons mentioned above we limited our discussion to the impact of choline fortification at 110 mg/serving on children 4 to 8 years of age. As presented in Table 3 of the Appendix (Table 4 in the Appendix of our previous amendment), the average increase in choline intake from all the foods to be fortified with choline was 42.3 mg choline per day for children ages 4 to 8 years of age. The 95th percentile of additional choline intake in these children was 189.7 mg/d.

Unfortunately, we cannot provide a variation estimate associated with the estimate of current choline intake in children 9 years of age and younger. When FNB has limited data and does not have an estimate of variability in average requirements, a coefficient of variation (CV) of 10 percent is ordinarily assumed (See Introduction to Dietary Reference

[5] Calculated as 730 mg/day * 0.571 = 416.6 mg/day and 1040 mg/day * 0.571 = 593.5 mg/day.

APPENDIX A.

Intakes of the FNB report). NAS applies this estimate of variation to estimates of average requirements when necessary. We propose to use the same approach regarding estimating choline intake. Namely, we assume that 95% (± 2 standard deviations) of intakes are covered by the estimated average intake plus/minus 2 times the CV (10 percent) multiplied by the estimated average intake. This does assume that estimated choline intake is normally distributed. To estimate the highest intake of most children 4 to 8 years of age, we took the highest estimate of choline intake from the indicator foods (594 mg/d) and added 2 times the estimated CV multiplied by the highest estimate of intake yielding 713 mg/d[6]. Adding this value to the additional choline intake from 95th percentile consumption of foods fortified with 110 mg choline per serving from Table 3 (189.7 mg/d) yields an estimated highest intake of choline for most children 4 to 8 years of age of 903 mg/d. We believe this is a truly worse case scenario as these calculations assume that all the foods we propose for choline fortification have choline added at 110 mg/serving. If all these foods had choline added at 55 mg per serving, the estimated highest choline intake for most children 4 to 8 years of age would be 808 mg/d (713 mg/d + 95 mg/d). If we assume only 50%[7] of the foods we propose for added choline were fortified with 110 mg or 55 mg choline per serving, the highest intake of choline would be 808 mg/d and 760 mg/d, respectively. All of these estimates of choline intake in children 4 to 8 years of age are less than the UL established for this age group of 1000 mg/d.

In our notification, we have made various assumptions to obtain an estimate of choline intake for children 4 to 8 years of age. Moreover, many of the assumptions made herein were very conservative (e.g., assuming that all proposed foods for choline fortification would contain 110 mg choline per serving). Thus, we are confident that the addition of choline to certain foods at 110 mg/serving will not exceed the UL for choline for children 4 to 8 years of age.

[6] Highest intake = 594 + (2*.10*594) = 712.8 mg/d.

[7] This is still a very high percentage, as there are very few food products in any of these food categories that currently have any fortification.

APPENDIX A.

Table 1. Choline content of certain foods

Product	Concentration, µmole /kg			Choline Content mg/g			Total Choline Content, mg/g	RACC, g	Total Choline per RACC, mg
	Choline	Phospha-tidylcholine	Sphingo-myelin	Choline	Phospha-tidylcholine	Sphingo-myelin			
Apple	27	280	15	0.0028	0.0291	0.0016	0.0335	140	4.69
Banana	240	37	20	0.0250	0.0038	0.0021	0.0309	140	4.32
Beef Liver	5831	43500	1850	0.6064	4.5240	0.1924	5.3228	85	452.44
Beef Steak	75	6030	506	0.0078	0.6271	0.0526	0.6875	85	58.44
Butter	42	1760	460	0.0044	0.1830	0.0478	0.2352	14	3.29
Cauliflower	1306	2770	183	0.1358	0.2881	0.0190	0.4429	85	37.65
Corn Oil	3	12	5	0.0003	0.0012	0.0005	0.0021	14	0.03
Coffee	90	34	23	0.0094	0.0035	0.0024	0.0153	240	3.67
Cucumber	218	76	27	0.0227	0.0079	0.0028	0.0334	85	2.84
Egg	42	52000	2250	0.0044	5.4080	0.2340	5.6464	50	282.32
Ginger ale	2	4	3	0.0002	0.0004	0.0003	0.0009	240	0.22
Grape Juice	475	15	5	0.0494	0.0016	0.0005	0.0515	240	12.36
Iceberg Lettuce	2930	132	50	0.3047	0.0137	0.0052	0.3236	85	27.51
Margarine	30	450	15	0.0031	0.0468	0.0016	0.0515	14	0.72
Milk (bovine, whole)	150	148	82	0.0156	0.0154	0.0085	0.0395	240	9.48
Orange	200	490	24	0.0208	0.0510	0.0025	0.0743	140	10.40
Peanut Butter	3895	3937	9	0.4051	0.4094	0.0009	0.8155	32	26.09
Peanuts	4546	4960	78	0.4728	0.5158	0.0081	0.9967	30	29.90
Potato	511	300	26	0.0531	0.0312	0.0027	0.0870	110	9.58
Tomato	430	52	32	0.0447	0.0054	0.0033	0.0535	85	4.54
Whole wheat bread	968	340	11	0.1007	0.0354	0.0011	0.1372	50	6.86

Adapted from Zeisel and Blusztajn (1999). Molecular weight of choline used was 104.

APPENDIX A.

Table 2a. Choline intake of indicator foods in Adults

ADULTS					
Estimated Choline intake, mg/d	730-1040				
Percent of Population		Percent of Adults			
Males, 20+ years	0.339	0.479			
Females, 20+ years	0.368	0.521			
Intake of Indicator Foods, g/day					
	Males, 20+	Females, 20+	Total Adult Intake[1]	Choline Content, mg/g	Choline Intake. mg/day
Total Meat	269	166	215.4	0.6875	148.1
Eggs	24	16	19.8	5.6464	112.0
Nuts	4	6	3.5	0.9967	3.5
Table Fats	5	4	4.5	0.2352	1.1
Apples	17	17	17.0	0.0335	0.6
Bananas	19	18	18.5	0.0309	0.6
Lettuce	18	17	17.5	0.3236	5.7
Citrus Fruit	11	12	11.5	0.0743	0.9
Whole Milk	52	33	42.1	0.0395	1.7
Potatoes	80	51	64.9	0.0870	5.6
Tomatoes	38	29	33.3	0.0535	1.8
				TOTAL	281.6

[1] From CSFII, 1994-1996 Tables 9.2, 9.3, 9.4, 9.5 and 9.6.

APPENDIX A.

Table 2b. Choline intake of indicator foods in children nine years of age and under[1]

Intake of Indicator Foods, g/day			
	Children 9 years of age and under	Choline Content, mg/g	Choline Intake, mg/day
Total Meat	110	0.6875	75.6
Eggs	12	5.6464	67.8
Nuts	4	0.9967	4.0
Table Fats	2	0.2352	0.5
Apples	27	0.0335	0.9
Bananas	15	0.0309	0.5
Lettuce	3	0.3236	1.0
Citrus Fruit	8	0.0743	0.6
Whole Milk	153	0.0395	6.0
Potatoes	37	0.0870	3.2
Tomatoes	12	0.0535	0.6
		TOTAL	160.7

[1]From CSFII 1994-96 and 1998 Tables 10A, 11A, 12A, 13A, and 14A.