9

Projected Aspartame Intake: Daily Ingestion of Aspartic Acid, Phenylalanine, and Methanol

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The safety assessment of any food additive requires a knowledge of the pharmacology and toxicology of the additive and information regarding exposure. Population exposure is generally difficult to determine for a new compound and cannot be accurately established before its introduction. For this reason it is important to ensure that estimates of exposure be conservative. Usually this means consciously overestimating rather than underestimating intake exposure.

Elsewhere in this volume there is extensive discussion of the metabolism and toxicology of aspartame and its degradation products phenylalanine, aspartic acid, methanol, and diketopiperazine. These extensive studies demonstrate that high doses of aspartame are well tolerated. However, it is important to estimate the probable range of aspartame intake that might be anticipated.

We have used two approaches to estimate exposure to aspartame or its metabolites. The simplest involved the assumption that aspartame would replace the apparent per capita sugar intake. The per capita caloric sweetener intake was calculated, on the basis of disappearance, to be 156 g/day (1). Using a sweetener ratio of 180:1, this yields a daily estimated aspartame intake of 867 mg/day. Actual intake would be somewhat lower, since it is recognized that disappearance data overestimate consumption and not all of the sweetener applications can be replaced by aspartame.

The second approach used to project aspartame intake involved developing a menu containing generous amounts of added sugars and assuming the substitution of aspartame for the added sweeteners. This menu is shown in Table 1. In Table 2

Table 1 Daily Menu Used to Estimate Potential Aspartame Intake

Meals	Snacks
Breakfast	
6 fl oz breakfast beverage[a]	
1 oz sugar-sweetened cereal[a]	
½ banana	
½ cup milk	
1 slice toast	
1 teaspoon margarine	
1 cup coffee	
3 packets sugar[a]	1 fresh apple
Lunch	
½ cup pea soup	
1 sandwich	
3 slices bologna	
1 oz cheddar cheese	
2 slices bread	
1 teaspoon mustard	
2 lettuce leaves	
1½ oz potato chips	
8 fl oz soft drink[a]	2 sticks chewing gum[a]
½ cup vanilla pudding[a]	8 fl oz soft drink[a]
Dinner	
1 fried chicken leg	
½ cup peas and carrots	
½ cup mashed potatoes	
1 slice bread	
1 teaspoon margarine	
1 cup milk	
½ cup gelatin dessert[a]	
1 peach half	
2 tablespoons whipped topping[a]	
1 cup tea	
2 packets sugar[a]	8 fl oz soft drink[a]

[a]Foods and beverages in which aspartame could substitute for sucrose or corn sweeteners.

are shown the calculated values for the menu containing sweeteners or aspartame. This menu provided 2800 kcal and 260g of total sugars. Of this amount, 190 g was added sugar which conceivably could be substituted by aspartame. Using the 180:1 ratio of aspartame sweetness to sucrose sweetness, total substitution would result in a daily intake 1056 mg of aspartame. However, the sweetness ratio varies

Table 2 Nutrients Provided by Menu Before and After Replacement of Added Sweeteners by Aspartame

	Menu with sucrose	Menu with aspartame	Percent difference
Energy	2800 kcal	2200 kcal	-21
Protein	86 g	88 g	+2
Carbohydrate	396 g	225 g	-43
Total sugars	261 g	71 g	-73
Phenylalanine	4.0 g	4.4 g	+10
Aspartic acid	7.3 g	7.6 g	+4
Methanol	–	75 mg	–

from product to product. This menu provides about 750 mg of aspartame when the level typical for each product application is used for the potential aspartame-containing foods.

Both of these approaches yield similar values for aspartame intake and can be used to estimate the phenylalanine, aspartic acid, and methanol exposures. The metabolism of aspartame yields, on a weight basis, approximately 50% phenylalanine, 40% aspartic acid, and 10% methanol. Using the menu approach and the typical aspartame level for each food, the estimated intake of aspartame would result in 10 and 4% increased intakes of phenylalanine and aspartic acid, respectively, and an added methanol exposure of 75 mg.

On the basis of disappearance data, the estimated potential aspartame intake of 867 mg would translate to an increased daily consumption of 433 mg of phenylalanine, 347 mg of aspartic acid, and 87 mg of methanol. For comparison, the phenylalanine and aspartic acid daily intakes were estimated from data collected as part of the 1977-1978 U.S. Department of Agriculture Nationwide Food Consumption Survey (2). Amino acid levels were calculated for the average amount consumed for each of the 44 food groups reported in the survey. When a group represented several foods with different amino acid levels, an average was used (e.g., corn, oats, rice, wheat for cereal grains) or one form was selected as representative (e.g., chicken broiler or fryer, flesh only, roasted for all chicken).

Household measure equivalents were determined for the foods from the 44 groups using weights and measures from the U.S. Department of Agriculture (3-10). For this purpose the 44 groups were collapsed into 17 categories (Table 3). This approach yielded estimates of 3.6 and 6.8 g for daily phenylalanine and aspartic acid intakes, respectively. Combining these data, replacement of all sweeteners with aspartame would increase phenylalanine intake by 12% and aspartic acid intake by 5% and would add 87 mg of methanol to the diet.

It is clear from these estimates that aspartame is not likely to alter amino acid intake appreciably. Similarly, the added methanol burden is insignificant. Methanol, which is formed by enzymatic splitting of pectic substances, is a component

Table 3 Average Intake per Individual in a Day

6.7 oz	Meat, poultry, or fish
1½ cups	Milk
½ oz	Cheese
½	Egg
1 oz	Legumes, nuts, or seeds
Equivalent of 4 slices	Bread (includes other baked goods)
½ oz	Ready-to-eat cereal
½ cup	Pasta or other grain mixtures
½	Potato
1 cup	Vegetables
½ cup	Fruit or fruit juice
2 teaspoons	Table fat or salad dressing
1 cup	Soft drinks or fruit drinks
¼ cup	Beer or ale
Equivalent of 2 tablespoons	Sugar, candy, or other sweets
1½ cups	Coffee (6 fl oz cup)
2/3 cup	Tea (6 fl oz cup)

Source: Adapted from *The USDA Nationwide Food Consumption Survey 1977-78, Preliminary Report* No. 2, Food and nutrient intakes of individuals in 1 day in the United States, Spring 1977, Tables 1.1a, 1.2a, 1.3a, 1.4a, and 1.5a.

of many fruits, vegetables, and wines. The amount of methanol contributed by these foods in the course of a day would likely exceed any contribution from aspartame (11-17).

It should be emphasized that these estimates are by design high. Actual intakes of aspartame will certainly be less, probably closer to 50% of the values we have estimated.

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