

## Original research article

### **Added sugars: Definition and estimation in the USDA Food Patterns Equivalents Databases<sup>1</sup>**

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**ABSTRACT**

The objective of this article is to define added sugars and to describe the methodology used to estimate the added sugars present in the foods and beverages found in What We Eat in America, National Health and Nutrition Examination Survey (WWEIA, NHANES), Food and Nutrient Database for Dietary Studies (FNDDS). The Food Patterns Equivalent Database (FPED) converts FNDDS foods and beverages to respective amounts of 37 USDA food patterns groups, of which added sugars is one. Added sugars are defined as caloric sweeteners that are added to foods as ingredients during food processing, during food preparation, or at the table. Sugars naturally present in milk and fruit are not added sugars, by definition. Added sugars are measured in teaspoon equivalents defined as 4.2 grams of total sugars. The FNDDS SR Links file and food label information were used to identify and estimate amounts of added sugars. The FPED provide added sugars amounts per 100 grams of each FNDDS foods and beverages. The FPED plays a vital role in nutrition monitoring and evaluating the American diet with respect to the Dietary Guidelines recommendations. Added sugars data can be used for nutrition education and food policy.

Key words: Food composition; Food analysis; Food database; Added sugars; Syrup; Caloric sweeteners; Food Patterns Equivalents Database; Dietary Guidelines for Americans; Foods and beverages

## 1. Introduction

Added sugars play an important role in the American diet. They are present in many beverages, bakery foods, dairy desserts, and candies, to name a few. On average, Americans, 2 years and over, consume 18.4 teaspoon equivalents (tsp. eq.) or 77.3 grams of added sugars from foods and beverages each day (USDA-ARS, 2014a) as documented in the What We Eat in America, National Health and Nutrition Examination Survey (WWEIA, NHANES) 2011-12 (USDA and USDHHS, 2014). However, the mean intake reported above is a significant decrease from the 21.0 tsp. eq. reported in 2003-04 WWEIA, NHANES. Similarly, substantial and significant reductions were noted among adults 20+ years and children ages 2-5, 6-11, and 12-19 years from 2003-04 to 2011-12 (Bowman et al., 2016).

Added sugars are a source of energy, but limited in beneficial nutrients (USDHHS and USDA, 2015). Because of the high prevalence of overweight and obesity among persons of all ages and ethnicity, it is recommended individuals limit intakes of foods and beverages that are sources of calories, but provide little or no additional nutritional benefits. The Dietary Guidelines for Americans (DGA) 2005 (USDA and USDHHS, 2005) provided the first recommendation for added sugars by stating that Americans should choose and prepare foods and beverages with little added sugars or caloric sweeteners. The DGA 2010 (USDA and USDHHS, 2010) recommended that Americans reduce their intake of calories from added sugars. For the first time, the DGA 2015-2020 (USDHHS and USDA, 2015) placed a quantitative recommendation on added sugar intake suggesting it not exceed 10 percent of total energy intake.

To control added sugar intake, it is important to know the foods and beverages that are appreciable sources of added sugars and how much added sugars are present in these foods and beverages. The Food Patterns Equivalents Database (FPED) have been developed for the WWEIA, NHANES foods and beverages and include data on 37 food patterns groups including added sugars (Bowman et al. , 2013a, 2013 b, 2014 a, 2014 b). The FPED data are based on per 100 grams of each FNDDS food.

The FPED can be used to monitor and to identify foods and beverages that are sources of added sugars in American diet. The purpose of this article is to describe the methodology used in the estimation of added sugars in the FPED.

## **2. Materials and methods**

### *2.1 Materials*

The Food and Nutrition Database for Dietary Studies (FNDDS) used for WWEIA, NHANES 2011-12 includes ingredients, energy, and nutrient data for each of the 8000+ survey foods (USDA-ARS, 2014b). The FNDDS-SR Links file and total sugar values are used to identify and estimate added sugars in foods. Where details on the ingredients are not available in the FNDDS, food labels and restaurant websites are used to identify ingredients of the FNDDS foods.

### *2.2 Definition of added sugars*

Added sugars are defined as sugars, syrups, or caloric sweeteners that are added to foods during food processing or food manufacturing, food preparation at home, restaurants or other food places, or added at the table (e.g., adding sugar to coffee or tea). Examples of foods that are defined as added sugars include all types of syrups, brown sugar, cane sugar, corn sweetener, dextrose, fructose, glucose, granulated sugar, high-fructose corn syrup, honey, invert sugar, lactose, malt syrup, maltose, molasses, raw sugar, sucrose, trehalose, and turbinado sugar. Additionally, fruit juice concentrates used in foods without further dilution are also considered as added sugars in the FPED. The foods that are defined as added sugars in the FPED are the same as those identified as added sugars by the U.S. Food and Drug Administration (USFDA, 2016).

There is also a definition for sugars that are not added sugars. These are sugars naturally present in dairy and fruit. Examples include lactose present in milk and fructose present in fruit and fruit juice. In FPED, these two sugars are not included in added sugars.

### *2.3 Unit of measurement*

Added sugars are measured in teaspoon equivalents (tsp. eq.) One teaspoon equivalent of added sugars is defined as 4.2 grams of sugar, the amount of total sugars present in one teaspoon of granulated sugar.

### *2.4 Estimation of added sugars per 100 grams of food*

The estimation of added sugars in the FPED is a two-step process: (1) Identification of ingredients that are defined as added sugars and (2) Computation of the amount of added sugars present per 100 grams of foods (includes beverages).

In the first step, each ingredient of a food or beverage is classified as either (a) added sugars or (b) not added sugars, using the definition above. For example, the ingredients of a strawberry smoothie are listed below as an example, and the classification of each ingredient into one of the two groups is shown.

Strawberries	- total sugars are naturally present sugars and not added sugars
Yogurt	- total sugars are naturally present sugars and not added sugars
Honey	- total sugars present are added sugars
Brown sugar	- total sugars present are added sugars
Ice cubes	- no total sugars and not added sugars

As seen above only honey and brown sugar are identified as added sugars and the sugars naturally present in strawberries and yogurt are not added sugars.

The FNDDS nutrient values are per 100 grams of FNDDS foods (includes beverages).

The total sugars values of FNDDS foods are used to compute the amount of added sugars present in foods. The gram amount of total sugars present 100 grams of an added sugars ingredient is divided by 4.2 to convert it to tsp. eq. of added sugars per 100 grams of food.

### *2.1.1 Where total sugars equal added sugars in a food or beverage*

In some foods, all of the total sugars present are solely from ingredients that are defined as added sugars. Such foods and beverages can contain either single or multi ingredients. In such case, the percent total sugars value of the food or beverages is divided by 4.2 to convert it to number of tsp. eq. (Tables 1 and 2)

### *2.1.2 Where total sugars are composed of added sugars and sugars naturally present in foods*

Many multi-ingredient foods such as muffins, cakes, cookies, fruit smoothies, pies, ice cream, and ready-to-eat cereals may contain ingredients that are added sugars in addition to fruit, fruit, juice, and dairy that contain naturally present sugars. Here, food recipes are used to compute the amount of added sugars present in 100 grams of food. Computation of added sugars present in carrot muffin is shown in Table 3.

### *2.1.3 Where unsweetened version of the same food is available*

Fruits canned in light or heavy syrups contain both added sugars and natural sugars. The added sugars come from the syrup and the natural sugars come from the fruit. To estimate the added sugars portion, total sugars value of the same fruit canned in water is needed, because this canned fruit contains only naturally present sugars and no added

sugars. The added sugar from the syrup are computed by subtracting total sugars values of fruit canned in water from that canned in different types of syrup (Table 4). The same principle is used to compute added sugars in honey roasted peanuts by subtracting the total sugars value of plain dry roasted peanuts (table 5).

#### *2.1.4 Assumptions made in fruit nectars and fruit juice drinks*

Due to a wide variability in the amount of fruit pulp present in fruit nectars, the fruit nectars are assumed to contain 40% fruit juice. The added sugars present in fruit nectars are computed by subtracting the amounts of sugars naturally present in the unsweetened fruit pulp from the total sugars values of fruit nectars.

Similarly, fruit juice drinks are assumed to contain 15 percent fruit juice with 2 grams of naturally present sugars coming from the 15% fruit juice. The added sugars present in fruit juice drinks are computed by subtracting the 2 grams of naturally present sugars from the total sugars values.

### **3 Results and discussion**

Table 1 presents selected foods that are classified as added sugars and shows the computation of added sugars in tsp. eq. using the total sugars values. Honey and maple syrup contain more moisture than granulated sugar and hence have lower tsp. eq. of added sugars than granulated sugar per 100 grams.



An example for the computation for added sugars for multi-ingredient beverages is presented in Table 2. In the example, the first three beverages are multi-ingredient. In addition to water as an ingredient, sugars or caloric sweeteners are added to the beverage along with other ingredients such as extracts or flavors. The total sugars values of these beverages come from added sugars ingredients only. Likewise, in a stinger, an alcoholic beverage, total sugars present in the 72 proof crème de menthe is the only source of added sugars. Hence, total sugars are converted to added sugars.

Table 3 presents an example for the computation of added sugars in carrot muffin, a food that contains both added sugars as well as natural sugars. The sugars present in carrots and milk are not added sugars. The sugars present in brown sugar and granulated sugars are added sugars. Here only the amount of sugars coming from brown sugar and granulated sugars are computed as added sugars. There are 5 tsp. eq. of added sugars present in 100 grams of carrot muffin.

The added sugars present in pineapple canned in light or heavy syrups are computed by subtracting the sugars naturally present in pineapples canned in water pack (Table 4). Pineapple canned in light syrup contains 1.2 tsp. eq. and pineapple canned in heavy syrup contains 2.2 tsp. eq. of added sugars per 100 grams.

Honey roasted peanuts contain 2.4 tsp. eq. of added sugars per 100 grams (Table 5). It is computed by subtracting total sugars naturally present in dry roasted peanuts from total sugars present in honey-roasted peanuts.

By using the assumption that nectars contain 40 percent fruit pulp, mango pulp contains 5.4 grams of natural sugars that are not added sugars by definition. The remaining sugars is added sugars. Hence, mango nectar contains 7.1 grams or 1.66 tsp. eq. of added sugars per 100 grams (Table 6).

Fruit juice drinks are assumed to contain 15 percent fruit juice or 2 grams natural sugars. The remaining 6 grams (1.4 tsp. eq.) are added sugars (table 7).

#### **4 Conclusion**

The computation of added sugars presents in the FNDDS in foods and beverages is a complex process. Because total sugars comprise both natural and added sugars, it is essential to distinguish between them. It requires a thorough understanding of the ingredients of the foods and beverages and food composition.

The added sugars data provided in the FPED have many applications in nutrition and epidemiological research; food and nutrition policy; and dietary guidance. At the consumer level, the added sugars data serve as a valuable tool which consumers can use to assess and limit their own added sugars intakes. The FPED data were used to inform the 2015 Dietary Guidelines Advisory Committee (Dietary Guidelines Advisory Committee 2015, 2015) about the sources of added sugars in major foods and beverages in the American diet. One of the Healthy People 2020 (USDHHS-ODPHP, 2010) Nutrition and Weight Status goals is to reduce consumption of calories from added sugars

and the FPED can be used to track added sugars consumption of Americans. Added sugars data can be used by nutrition educators to provide dietary guidance.

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Table 1. Selected list of foods where the only ingredient present is defined as added sugars

Food	Percent total sugars	Added sugars (tsp.eq.)
Granulated sugar	99.8	23.8
Honey	82.1	19.5
Maple syrup	60.5	14.4

Table 2. Selected multi-ingredient foods where total sugars come only from ingredients that are added sugars.

Beverage	Percent total sugars	Added sugars (tsp.eq.)
Sweetened green tea	5.5	1.3
Carbonated root beer	10.6	2.5
Soft drink, cola type	9.0	2.1
Stinger	22.7	5.4



Table 3 Added sugars estimation in carrot muffin\*

Ingredient	Amount need to prepare 100 grams of muffin (g)	Total sugars from ingredient (g)	Added sugars (tsp.eq.)
Wheat flour	25	0.0	0
Vegetable oil	11	0.0	0
Carrots	22	1.0**	0
Milk	25	1.2**	0
Brown sugar	15	14.3	3.4
Granulated sugars	6.7	6.7	1.6

\* Selected ingredients are listed. Amounts rounded. 14% moisture lost in cooking. Total added sugars=5.0 tsp. eq.

\*\* Not added sugars

Table 4. Estimation of added sugars present in pineapple canned in light or heavy syrups

Canned fruit	Total sugars (g)	Difference in total sugars from waterpack* (g)	Added sugars (tsp.eq.)
Pineapple canned in waterpack	7.5*	0.0	0.0
Pineapple canned in light syrup	12.6	5.1	1.2
Pineapple canned in heavy syrup	16.9	9.4	2.2

\* The 7.5 grams of sugars present in pineapple canned in waterpack are natural sugars

Table 5. Estimation of added sugars present in honey roasted peanuts

Roasted peanuts	Total sugars (g)	Difference in total sugars from dry- roasted peanuts (g)	Added sugars (tsp.eq.)
Dry roasted peanuts	4.2*	0.0	
Honey roasted peanuts	14.2	10.0	2.4

\* The 4.2 grams of sugar present in dry roasted peanuts are natural sugars

Table 6. Estimation of added sugars present in mango nectar

Fruit product	Total sugars (g)	Difference in total sugars (g)	Added sugars (tsp.eq.)
Mango nectar	12.5		
40% mango pulp	5.4		
Added sugars in mango nectar		7.1	1.66

Table 7. Estimation of added sugars present in fruit juice drink

Fruit product	Total sugars (g)	Difference in total sugars (g)	Added sugars (tsp.eq.)
Fruit juice drink	8.0		
15% fruit juice	2.0		
Added sugars in Fruit juice drink		6.0	1.4