

Chapter 1. Introduction

1 Purpose and properties of Carbohydrates Composition Tables

1) Purpose

Carbohydrate is an important nutrient which is mainly used as a source of energy in the body. However, the amount of carbohydrates listed in the Standard Tables of Food Composition in Japan (hereinafter referred to as “Food Composition Tables”) is the amount of so-called “Carbohydrate by difference” where the total amount (g) of water, protein, lipid, ash, etc. is subtracted from 100 g of edible portion.

The Carbohydrates Composition Tables (hereinafter referred to as “current Composition Tables”) is provided as a basic material for understanding the current status and to give consideration to the ideal future status of supply and intake of available carbohydrates, polyols and organic acids by listing their composition in food. Additionally, the current Composition Tables is expected to be utilized for a wide variety of research studies in the fields of nutrition science, food science, domestic science, life science, medicine, agriculture, etc. as well as in the clinical fields involved with various diseases.

As mentioned above, the current Composition Tables aims at providing basic data on the composition of available carbohydrates, polyols and organic acids in foods taken daily by people for a wide range of applications in various fields.

2) Properties

The current Composition Tables lists standard component values of available carbohydrates ^(Note), polyols and organic acids that are digested by human enzymes, absorbed, and metabolized, among carbohydrates existing in important foods that are consumed regularly in Japan.

It is known that these component values vary due to various factors, including the type, species, growing environment, processing method, etc. of plant/animal/fungus as raw material. The component values listed in the current Composition Tables are values considered representing the national average intake in a normal diet throughout the year in Japan, which were determined based on the analytical values of samples obtainable from markets in Japan by normal means, taking into account the variation factors for component values of carbohydrates and organic acids. In the Tables, one set of standard component values is listed for one food product in principle.

(Note) The term “available carbohydrate” is used by the Food and Agriculture Organization of the United Nations (FAO).

3) Background

For calculation of the component values of carbohydrates, FAO recommends derivation of available carbohydrates and dietary fibers through direct analysis in its Report of a technical workshop released in 2003 ¹⁾ (hereinafter referred to as “FAO Report (2003)”).

From the viewpoint of ensuring the consistency with the international movement on food composition tables and related database, the Subdivision on Resources, the Council for Science and Technology (hereinafter referred to as “Subdivision on Resources”) has promoted direct analysis of available carbohydrates as well as studies and consideration on their composition prior to the release of the Standard Tables of Food Composition in Japan - 2010 - ²⁾ (hereinafter referred to as “Composition Tables 2010”).

Additionally, the Subdivision on Resources established the Expert Committee on Food Components, decided to newly launch composition tables on the composition of carbohydrates along with the revision of the Composition Tables 2010 through discussions at the Committee, and continued to gather information on the composition of carbohydrates etc. in Japanese foods.

Thus the Standard Tables of Food Composition in Japan - 2015 - (Seventh Revised Edition) - Available Carbohydrates, Polyols and Organic Acids - (current Composition Tables) was released associated with the launch of the Standard Tables of Food Composition in Japan - 2015 - (Seventh Revised Edition) (hereinafter referred to as “Food Composition Tables 2015”) in December 2015.

2 Standard Tables of Food Composition in Japan - 2015 - (Seventh Revised Edition) - Available Carbohydrates, Polyols and Organic Acids -

The current Composition Tables shows the data of available carbohydrates and polyols per 100 g of edible portion, as well as the data of organic acids as an Annex. The name of each table is as shown below.

Table: Carbohydrate, available and polyols per 100 g of edible portion

Annex Table: Organic acids per 100 g of edible portion

1) Listed foods

(1) Classification and arrangement of food groups

The classification and arrangement of food groups are as shown below, according to the Food Composition Tables 2015.

1 Cereals, 2 Potatoes and starches, 3 Sugars and sweeteners, 4 Pulses, 5 Nuts and seeds, 6 Vegetables, 7 Fruits, 8 Mushrooms, 9 Algae, 10 Fish, mollusks and crustaceans, 11 Meats, 12 Eggs, 13 Milk and milk products, 14 Fats and oils, 15 Confectionaries, 16 Beverages, 17 Seasonings and spices

The current Composition Tables exclude 18 Prepared foods.

(2) Outlines

Listed foods are selected from the foods listed in the Food Composition Tables 2015. The selection criteria are, in principle, foods with high carbohydrate content, foods with high intake on a daily basis, foods as raw materials and representative processed foods. Here, foods as raw materials are selected from those in a form closer to the form consumed.

For organic acids, foods considered to have high organic acid content are selected from these foods, judging from various information available.

The component values are corrected by the water values in the Food Composition Tables 2015.

In the current Composition Tables, in addition to the component values selected and analyzed for foods selected by the criteria above, component values are estimated by the methods below and listed for some foods from the viewpoints of increasing the number of listed foods as much as possible and ensuring convenience for users.

[1] For foods with analytical values for “Raw” available, the composition values of “Boiled”, “Baked”, etc. per 100 g of edible portion are estimated based on them.

[2] For foods unable to be estimated by [1] above and with similar foods in food composition tables etc. available overseas, the component values were estimated using the data for the similar foods.

[3] For processed foods with known raw material blending ratio and component values of available carbohydrates, the component values are estimated through calculation using such values.

The estimated values derived by the method in [1], [2] or [3] do not reflect changes to the composition by cooking nor differences between the foods available in Japan and overseas, and therefore are listed in parenthesis. It is also described in the Remarks section that the value is an estimated value.

For the methods in [1] and [2], in principle, the estimated values are derived by correcting the

component values of available carbohydrates of the referenced food with the water content values of the listed food. The referenced food is shown in the Remarks for [1] and in the references at the end for [2].

For the method in [3], the estimated values are derived by (a): multiplying the raw material blending ratio by the amount of each available carbohydrate per 100 g of edible portion of raw material that constitutes at least 1% of total available carbohydrates for the subject food and adding them up, (b): multiplying the raw material blending ratio by the dry weight of each raw material per 100 g of edible portion and adding them up, (c): dividing (a) by (b), and (d): multiplying the dry weight per 100 g of edible portion of the subject food by (c). The raw material blending ratio used is those listed in Chapter 3 of the Food Composition Tables 2015.

As a result, the number of foods listed in the current Composition Tables 2015 is 854, of which the number of foods listed with the component values of organic acids is 96, as shown in Table 1 by food group.

Table 1 Number of foods in food group

Food group	No. of foods	
	Table: Carbohydrate, available and polyols	Annex Table: Organic acids
1 Cereals	132	–
2 Potatoes and starches	53	22
3 Sugars and sweeteners	23	–
4 Pulses	67	4
5 Nuts and seeds	34	–
6 Vegetables	165	28
7 Fruits	75	12
8 Mushrooms	44	3
9 Algae	16	3
10 Fish, mollusks and crustaceans	8	–
11 Meats	6	1
12 Eggs	18	–
13 Milk and milk products	44	18
14 Fats and oils	3	–
15 Confectionaries	121	2
16 Beverages	16	2
17 Seasonings and spices	29	1
Total	854	96

(3) Name, classification, arrangement, item number and index number of foods

The name, classification, arrangement and item number of foods conform to those in the Food Composition Tables 2015. Index numbers are newly assigned to each food. The index numbers are common with those in the Food Composition Tables 2015 etc. Since the number of foods listed varies depending on the composition table, there are index numbers that do not appear in the current Composition Tables.

Note that the component values of carbohydrates in the Food Composition Tables 2015 cannot be compared with that in the current Composition Tables even for the same foods with the same item numbers, because different samples were analyzed to determine the component values for many foods.

(4) Note on Foods

See the Note on Foods in the Food Composition Tables 2015 for each food group and each food. Matters related only with the data shown in the current Composition Tables are noted in Chapter 3 Note on Foods of the current Composition Tables.

2) Components

(1) Available carbohydrates and polyols

Available carbohydrates are starch, glucose, fructose, galactose, sucrose, maltose, lactose, and trehalose. Polyols are sorbitol and mannitol. Other available carbohydrates such as isomaltose and trisaccharides or higher (e.g., 80 % ethanol soluble maltodextrins) are shown in the Remarks. The total amount of available carbohydrates (expressed with monosaccharide equivalents) and that of available carbohydrates are also included. Honey and fermented foods contain isomaltose, but its contents are not determined in the current Composition Tables with some exceptions.

The conversion factor to monosaccharide equivalent is 1.10 for starch and 1.05 for disaccharides, according to the FAO/INFOODS Guidelines (2012)⁴⁾.

The conversion factor is 1.10 for 80 % ethanol soluble maltodextrins contained in “glucose syrup”, and 1.07 for maltotriose in isomerized sugar syrups.

Starch may contain 80 % ethanol insoluble polysaccharides (such as dextrin and glycogen) other than starch for some foods, because the applied measurement method cannot distinguish these components.

The term “starch” is used as a component name in accordance with the FAO/INFOODS Guidelines. For that, glycogen contained in Mushrooms, Fish, mollusks and crustaceans and Meats is shown as starch, and it does not mean that Mushrooms, raw Fish, mollusks and crustaceans or Meats contain starch.

See the Explanation for the outline of components. The measurement methods for these components are outlined in Table 2.

(2) Organic acids

Organic acids include 20 kinds of carboxylic acids that possess 1-3 carboxyl groups in one molecule, namely, formic acid, acetic acid, glycolic acid, lactic acid, gluconic acid, oxalic acid, malonic acid, succinic acid, fumaric acid, malic acid, tartaric acid, α -ketoglutaric acid, citric acid, salicylic acid, *p*-coumaric acid, caffeic acid, ferulic acid, chlorogenic acid, quinic acid, and orotic acid.

Foods and organic acids that require analysis are selected by referencing the information in the German composition tables⁵⁾, U.S. composition tables (oxalic acid composition tables)⁶⁾, and other information sources, because the kinds of organic acids contained vary substantially depending on the food. Additionally, the total amount of them is included. The analytical methods for these components are outlined in Table 2. See the Explanation for the outline of components.

(3) Other components

Although most of the carbohydrates in the Food Composition Tables 2015 include dietary fibers, dietary fibers are excluded from the current Composition Tables because they are included in separate items in the Food Composition Tables 2015.

Additionally, although the raffinose series of oligosaccharides (raffinose, stachyose, and verbascose) were provisionally analyzed in the report on the propriety investigation of carbohydrates in the FY2010 edition Standard Tables of Food Composition in Japan³⁾ (hereinafter referred to as “FY2010 Carbohydrates Propriety Investigation Report”), they are not shown in the current Composition Tables because these oligosaccharides are dietary fibers under the current definition by the Codex Alimentarius Commission.

Table 2 Measurement methods for available carbohydrates, polyols and organic acids

Component item	Component	Measurement method
Available carbohydrates	Starch (incl. dextrin and glycogen)	AOAC996.11. Soluble carbohydrates (glucose, maltose, maltodextrins, etc.) that affect the measured values are removed by 80% ethanol extraction.
	Glucose, fructose, galactose, sucrose, maltose, lactose, and trehalose	High performance liquid chromatography
	80 % ethanol soluble maltodextrins and oligosaccharides such as maltotriose	Subtraction method (details are shown in Notes on Foods)
Polyols	Sorbitol and mannitol	High performance liquid chromatography
Organic acids	Formic acid, acetic acid, glycolic acid, lactic acid, oxalic acid, malonic acid, succinic acid, fumaric acid, malic acid, tartaric acid, α -ketoglutaric acid, citric acid, salicylic acid, <i>p</i> -coumaric acid, caffeic acid, ferulic acid, chlorogenic acid, quinic acid, and orotic acid	High performance liquid chromatography
	Gluconic acid	Enzyme method

3) Procedure of presenting values

All the component values are listed as per 100 g of edible portion, and the method of presenting values conforms to the rules below (see Table 3). The unit of water, available carbohydrates, monosaccharide equivalents and polyols is g, and the values are shown to the first decimal place by rounding off the second decimal place. The unit of organic acids is g excluding those below, and the values are shown to the first decimal place by rounding off the second decimal place.

For *p*-coumaric acid, caffeic acid, ferulic acid and chlorogenic acid, the unit is mg and the values are shown as integers by rounding off the first decimal place. For each component, “0” indicates the value being less than 1/10 of the minimum listing value or not detected, “Tr (trace)” indicates the amount contained is 1/10 or greater yet less than 5/10 of the minimum listing value, and “–” indicates unmeasured or no information available.

Estimated values are listed in parentheses (see “2 1) (2) Outline of foods” for estimated values).

Table 3 Procedure of presenting values

Component		Unit	Decimal place in presentation	Rounding method
Water		g	1	Round off the second decimal place
Available carbohydrates	Starch, glucose, fructose, galactose, sucrose, maltose, lactose, trehalose, 80% ethanol soluble maltodextrins and oligosaccharides such as maltotriose			
Available carbohydrates; expressed in mono-saccharide equivalents				
Polyols	Sorbitol and mannitol			
Organic acids	Formic acid, acetic acid, glycolic acid, lactic acid, gluconic acid, oxalic acid, malonic acid, succinic acid, fumaric acid, malic acid, tartaric acid, α -ketoglutaric acid, citric acid, salicylic acid, quinic acid, and orotic acid	g	1	Round off the second decimal place
	<i>p</i> -coumaric acid, caffeic acid, ferulic acid and chlorogenic acid	mg	0	Round off the first decimal place
	Total	g	1	Round off the second decimal place

4) Cooking and preparation conditions

The cooking conditions used in current Tables are essentially the same as those used in the Food Composition Tables 2015. Basic cooking conditions are predetermined assuming general home cooking (small-scale cooking). Cooking methods used in the current Tables are boiled, steamed, baked, sautéed, deep-fried, breaded and fried, and floured and deep fried fish, mollusks and crustaceans, breaded and fried pork (“Tonkatsu”), floured and deep fried meats, tempura (fried with batter <=a mixture of flour, egg and water>) of sweet potato, eggplant and fish, mollusks and crustaceans, microwaved sweet corn and glazed carrot. For boiling, the resultant broth is discarded. It includes post-boiling handling such as draining in a colander or hand-squeezing after cooling.

Usually, preparation of food accompanies the addition of condiments, yet condiments are not added in the current Composition Tables except for boiled macaroni and spaghetti and glazed carrot, because it is difficult to generalize the kind and amount of condiments to be used. See the Food Composition Tables 2015 for the outline of cooking conditions for each food.

[Reference]

Explanation

1 Carbohydrates

The Nomenclature of Carbohydrates by the International Union of Pure and Applied Chemistry (IUPAC)⁷⁾ defines carbohydrates as monosaccharides, oligosaccharides (compounds in which monosaccharide units are joined by glycosidic linkages and having a defined structure) and polysaccharides (the distinction from oligosaccharides is vague; not defined by a specific degree of polymerization), as well as substances derived from monosaccharides by reduction of the carbonyl group (alditols), by oxidation of one or more terminal groups to carboxylic acids, or by replacement of one or more hydroxyl group(s) by a hydrogen atom, an amino group, a thiol group or similar heteroatomic groups, including derivatives of these compounds.

According to this definition, among the organic acids in the current Composition Tables, gluconic acid is a carboxylic acid where the aldehyde group at the C-1 of glucose is oxidized, and is a carbohydrate. While the Expert Committee on Food Components knows the presence of this definition, it decided to regard gluconic acid as an organic acid conforming to the general treatment in the Food data communities.

The chemical formula of carbohydrates is normally expressed as $C_m(H_2O)_n$. In the FAO/INFOODS Guidelines (2012)⁴⁾, the Tagname (food component identifier defined by FAO/INFOODS) of carbohydrates calculated by difference using the following formula is CHOTDF.

Carbohydrates (CHOTDF) per 100 g of edible portion

= 100 – (amount of [water + protein + lipid + ash + alcohol] per 100 g of edible portion in g)

However, “carbohydrate” in the Food Composition Tables 2015 does not correspond to the definition of CHOTDF and is a component unique to the Standard Tables of Food Composition in Japan, because it is calculated by subtracting other components (e.g., acetic acid) as well.

FAO/INFOODS recommends the use of available carbohydrates and dietary fiber as components instead of carbohydrates (by difference). The reasons why the Expert Committee on Food Components (the Committee) decided not to adopt this guideline in the Food Composition Tables 2015 include: a) the definition of dietary fiber was finalized at the Codex Alimentarius Commission, the measurement method in accordance with the definition was decided, and the Committee plans to replace the current data of dietary fiber to those conforming to the definition by the Codex Alimentarius Commission in the near future, and b) the Committee concluded that changing the energy calculation method and energy values of foods for the use during a relatively short period of time until the current data of dietary fiber are replaced is not desirable considering the continuity of the national governmental policies.

The reason why “the component values of carbohydrates in the Food Composition Tables 2015 cannot be compared with that in the current Composition Tables” described in 2 1) (3) of Chapter 1 Introduction is as shown below.

The data in the Food Composition Tables are determined based on analytical values collected over multiple years for certain foods because the component contents differ according to various factors. It is often the case that the content of components varies by years, and in such cases the variation needs to be corrected. Practically, for the case of minerals and water-soluble vitamins, their correction factors are determined so that the content of samples becomes the same as that shown in the composition tables, and correction is made by multiplying the analytical value by the correction factor (i.e. water is used for correction).

For the case of fat-soluble substances such as fatty acids and fat-soluble vitamins, their correction factors are determined so that the analytical value of lipid of samples becomes the same as that in the composition tables, and correction is made by multiplying the analytical value by the correction factor (i.e. lipid is used for correction).

For the case of amino acids compositions, their correction factors are determined so that the value of reference nitrogen of samples becomes the same as that used in the composition tables, and correction is made by multiplying the analytical value by the correction factor (i.e. reference nitrogen is used for correction).

For the case of available carbohydrates, polyols and organic acids, it is desirable to calculate the amount of available carbohydrates (by difference) in samples, determine correction factors so that it becomes the amount of available carbohydrates (by difference) in the composition tables, and to make correction by multiplying the analytical value by the correction factor (i.e., available carbohydrates by difference is used for correction). However, the current measurement method of dietary fiber become obsolete as mentioned above, and there are no analytical values determined by the measurement method defined by the Codex Alimentarius Commission. Therefore, this correction method cannot be applied.

Thus, in the current Composition Tables, correction factors are determined so that the water of samples becomes the same as that in the composition tables and correction is made by multiplying the analytical value by the correction factor (i.e. water is used for correction). This method is considered less reliable in the accuracy of correction compared with the correction method for amino acids and fatty acids. So, it is noted that the component values of carbohydrates in the Food Composition Tables 2015 cannot be compared with that in the current Composition Tables.

It is noteworthy to note that the FAO Report (2003) 1) recognizes the by-difference method as an “acceptable method” for calculating the amount of available carbohydrates. In regard to this statement, the FY2010 Carbohydrates Propriety Investigation Report 3) identified a strong positive correlation between the component values calculated by difference and that derived by direct analysis for carbohydrates and available carbohydrates.

From these, even for foods not included in the current Composition Tables, it is predictable that the carbohydrates (by difference) in the Food Composition Tables 2015 have a positive correlation with the carbohydrates determined by direct analysis.

2 Available carbohydrates

The Tagname by FAO/INFOODS for available carbohydrates is CHOAVL when measured by direct analysis of each component and summing them up and CHOAVLDF when calculated by difference. The amount of available carbohydrates by difference of FAO/INFOODS (CHOAVLDF) is calculated as follows.

Available carbohydrates by difference per 100 g of edible portion (CHOAVLDF) (g)
= 100 – (amount of [water + protein + lipid + ash + alcohol + dietary fiber] per 100 g of edible portion in g)
= Amount of (carbohydrates by difference – dietary fiber) per 100 g of edible portion in g

This concept is similar to the method for calculating Non-fibrous carbohydrates in the Standard Tables of Food Composition in Japan Fourth Revised Edition, yet Non-fibrous carbohydrates was derived by subtracting fiber, alcohol, tannin, caffeine, acetic acid, and other components from Carbohydrate by difference and is not the same as the available carbohydrates by difference defined by FAO/INFOODS (CHOAVLDF).

Additionally, it may be possible to regard the values obtained by subtracting dietary fiber from carbohydrates in the Food Composition Tables 2015 as the amount of available carbohydrates. However, due to the difference in the definition of carbohydrates mentioned above, this value does not correspond to the available carbohydrates by difference of FAO/INFOODS (CHOAVLDF) either.

In the FAO/INFOODS Guidelines (2012) ⁴⁾, the energy conversion factor for the available carbohydrates by difference is 17 kJ/g (4 kcal/g), and that for dietary fibers is 8 kJ/g (2 kcal/g).

Table 4 Available carbohydrates and polyols in the current Composition Tables

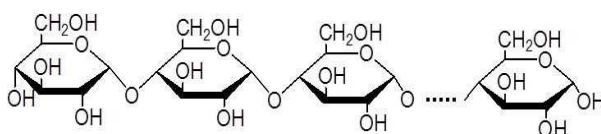
English name of component	IUPAC systematic name	Trivial name
Starch	-	-
Glucose	D - <i>gluco</i> -Hexose	D -Glucose
Fructose	D - <i>arabino</i> -Hex-2-ulose	D -Fructose
Galactose	D - <i>galacto</i> -Hexose	D -Galactose
Sucrose	β - D -Fructofuranosyl α -D -glucopyranoside	Sucrose, Saccharose
Maltose	α -D -Glucopyranosyl-(1 \rightarrow 4)-D -glucopyranose or 4- <i>O</i> - α -D -gGucopyranosyl-D -glucopyranose	Maltose
Lactose	β -D -Galactopyranosyl-(1 \rightarrow 4)-D -glucopyranose or 4- <i>O</i> - β -D -Galactopyranosyl-D -glucopyranose	Lactose
Trehalose	α -D -Glucopyranosyl α -D -glucopyranoside	α,α -Trehalose
Isomaltose	α -D -Glucopyranosyl-(1 \rightarrow 6)-D -glucose or 6- <i>O</i> - α -D -Glucopyranosyl- D -glucopyranose	-
Maltodextrin	-	-
Sorbitol	D-Glutitol	-
Mannitol	meso-Mannitol	-

(Note) IUPAC systematic names and common names are from a reference 7).

Table 5 Molecular formula and molecular weight (Mw) of available carbohydrates and polyols listed in the current Composition Tables

Starch ((C₆H₁₀O₅)_n)
Mw: 10⁵ - 10⁹

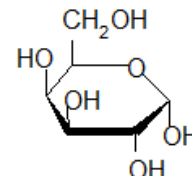
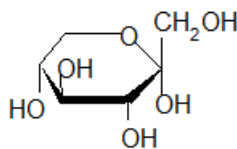
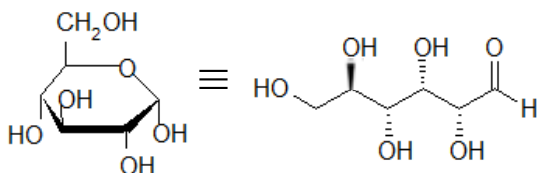
Example: Amylose



Glucose (C₆H₁₂O₆)
Mw: 180.16

Fructose (C₆H₁₂O₆)
Mw: 180.16

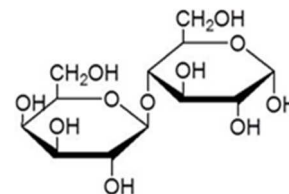
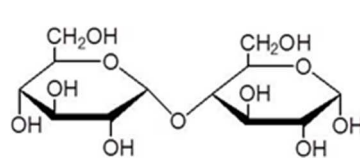
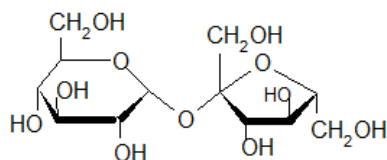
Galactose (C₆H₁₂O₆)
Mw: 180.16



Sucrose (C₁₂H₂₂O₁₁)
Mw: 342.30

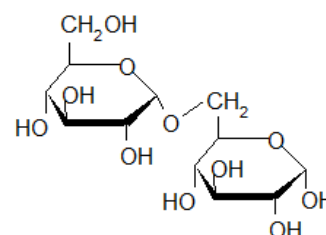
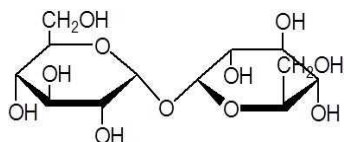
Maltose (C₁₂H₂₂O₁₁)
Mw: 342.30

Lactose (C₁₂H₂₂O₁₁)
Mw: 342.30



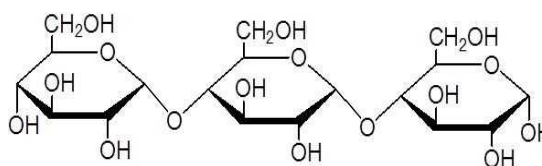
Trehalose (C₁₂H₂₂O₁₁)
Mw: 342.30

Isomaltose (C₁₂H₂₂O₁₁)
Mw: 342.30



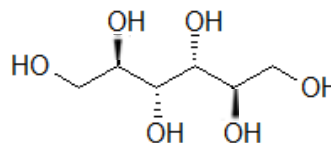
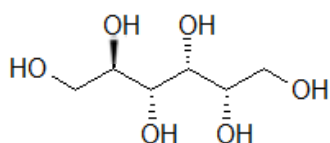
Maltodextrin ((C₆H₁₀O₅)_m)
Mw: 5.04 × 10² - 3 × 10³

Example: Maltotriose



Sorbitol (C₆H₁₄O₆)
Mw: 182.17

Mannitol (C₆H₁₄O₆)
Mw: 182.17



3 Monosaccharide equivalents and conversion factors of available carbohydrates

FAO/INFOODS accepts expressing available carbohydrates as weight or monosaccharide equivalents. The reason why the Expert Committee on Food Components (the Committee) decided to use monosaccharide equivalents in the Food Composition Tables 2015 was because the Committee judged it possible to more accurately calculate the energy of available carbohydrates by multiplying the values (g) listed as monosaccharide equivalents by the energy conversion factor applicable to available carbohydrates expressed in monosaccharide equivalents (16 kJ/g, 3.75 kcal/g).

In the conventional method, a factor of 4 kcal/g is applied to the weight of carbohydrates when converting to energy. However, the same factor is used for both monosaccharides (e.g., glucose) and polysaccharides (starch), and there is a discrepancy in the energy when compared for the same weight. For example, 100 g of starch produces 111 g of glucose and the energy produced from starch should also be 1.11 times more than that produced from 100 g of glucose, yet such correction is not made (however, FAO/INFOODS specifies the energy conversion factor for available carbohydrates expressed in weight to be 17 kJ/g (4 kcal/g)).

When converting the weight of starch and disaccharides to monosaccharide equivalents, the conversion factors based on the molecular weight (formula weight) are as shown below.

Assuming the molecular weight of hexose (glucose, fructose, and galactose) to be 180.16, that of disaccharides consisting only of hexose (sucrose, maltose, lactose, and trehalose) to be 342.30 and that of water to be 18.02, the formula weight of glucose residues in starch becomes $180.16 - 18.02 = 162.14$. Therefore, the factor for converting the weight to monosaccharide equivalent for disaccharides is $(180.16 + 180.16) / 342.30 = 1.052\dots$, and that for starch is $180.16 / 162.14 = 1.111\dots$

However, in the process of compiling the Food Composition Tables in Japan, the recommendations and guidelines by the FAO/INFOODS have always been respected to the extent possible, and from the practical viewpoints such as adoption of international standards, the committee decided to use the monosaccharide equivalent conversion factor of 1.10 for starch and 1.05 for disaccharides instead of adopting scientifically appropriate conversion factors.

The monosaccharide equivalent conversion factor for maltodextrins contained in “glucose syrup” and other foods was decided to be 1.10 and that for oligosaccharides such as maltotriose contained in various isomerized sugar syrups to be 1.07. The basis of these conversion factors are described in the section of relevant foods in Chapter 3 Notes on Foods of the current Composition Tables.

4 Polyols

While polyols are classified into carbohydrates by the definition of Nomenclature of Carbohydrates by IUPAC ⁷⁾, they are not classified into available carbohydrates in the communities of food composition tables/database. FAO/INFOODS and the Codex Alimentarius Commission use the term Polyol(s) to refer to Sugar alcohol(s).

However, the Expert Committee on Food Components decided to use the term “Sugar alcohols” instead of “Polyols” for the Japanese version of the current Composition Tables. The main reason is that “polyols” is a broader term for compounds including those other than “sugar alcohols” and use of the term “polyols” to refer to sugar alcohols is inappropriate. Due to this decision, “Sugar alcohols” is used in the Japanese version of the current Composition Tables and “Polyols” is used in the English version.

The FAO/INFOODS Guidelines (2012) ⁸⁾ specifies the energy conversion factor for polyols to be 10 kJ/g (2.4 kcal/g).

5 Organic acids

Amino acids in the Amino Acids Composition Tables and fatty acids in the Fatty Acids Composition Tables are all organic acids, and folic acid, pantothenic acid, and ascorbic acid in the Food Composition Tables also are organic acids. On top of that, organic acids listed in the current Composition Tables have various chemical structures, making it difficult to simply and accurately define the listed organic acids.

There is, however, a distinction between fatty acids and non-fatty organic acids in the communities of food composition tables/database. Taking saturated carboxylic acids as an example, those with equal to or more than 4 carbons (butanoic acid and above) are classified into fatty acids, and those with 3 or less carbons (propanoic acid or less) into organic acids. Additionally, organic acids commonly referred to as amino acids, amino acids which constitute proteins are covered by the Amino Acids Composition Tables.

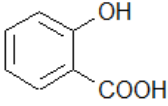
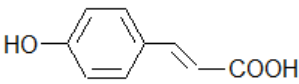
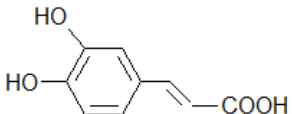
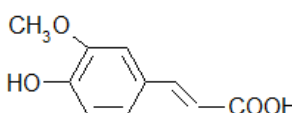
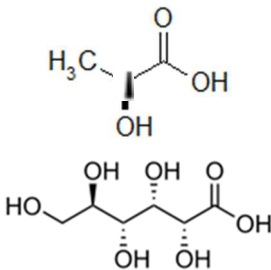
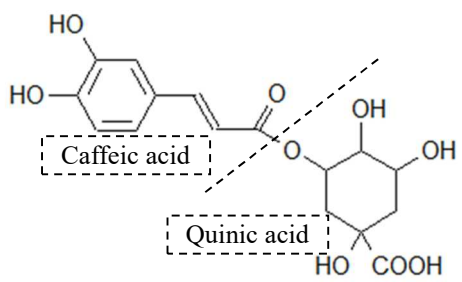
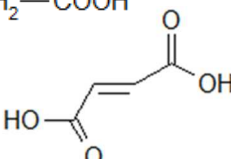
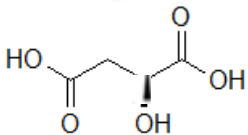
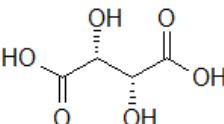
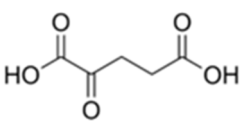
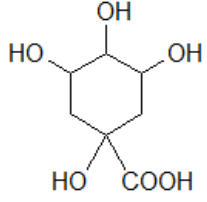
The Codex Alimentarius Commission specifies the energy conversion factor of organic acids to be 13 kJ/g (3 kcal/g), which is also used in the FAO/INFOODS Guidelines (2012)⁴.

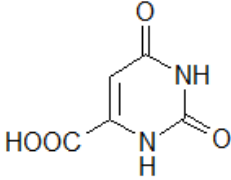
Table 6 Organic acids in the current Composition Tables

Organic acid	IUPAC systematic name
Formic acid	Methanoic acid
Acetic acid	Ethanoic acid
Glycolic acid	2-Hydroxyethanoic acid
Lactic acid	2-Hydroxypropanoic acid
Gluconic acid	–
Oxalic acid	Ethanedioic acid
Malonic acid	Propanedioic acid
Succinic acid	Butanedioic acid
Fumaric acid	(E)-Butenedioic acid
Malic acid	2-Hydroxybutanedioic acid
Tartaric acid	2,3-Dihydroxybutanedioic acid
α -Ketoglutaric acid	2-Oxopentanedioic acid
Citric acid	2-Hydroxypropane-1,2,3-trioic acid
Salicylic acid	2-Hydroxybenzoic acid
<i>p</i> -Coumaric acid	(E)-3-(4-Hydroxyphenyl)-2-propenoic acid
Caffeic acid	3-(3,4-Dihydroxyphenyl)-2-propenoic acid
Ferulic acid	(E)-3-(4-Hydroxy-3-methoxy-phenyl)prop-2-enoic acid
Chlorogenic acid	(1S,3R,4R,5R)-3-([(2E)-3-(3,4-Dihydroxyphenyl)prop-2-enoyl]oxy)-1,4,5-trihydroxycyclohexanecarboxylic acid
Quinic acid	(1S,3R,4S,5R)-1,3,4,5-Tetrahydrocyclohexanecarboxylic acid
Orotic acid	1,2,3,6-Tetrahydro-2,6-dioxo-4-pyrimidinecarboxylic acid

(Note) IUPAC systematic names are from online information

Table 7 Molecular formula and molecular weight (Mw) of organic acids in the current Composition Tables

Aliphatic carboxylic acids		Aromatic carboxylic acids	
Formic acid (CH ₂ O ₂) Mw: 46.03	$\text{H}-\text{COOH}$	Salicylic acid (C ₇ H ₆ O ₃) Mw: 138.12	
Acetic acid (C ₂ H ₄ O ₂) Mw: 60.05	CH_3-COOH	<i>p</i> -Coumaric acid (C ₉ H ₈ O ₃) Mw: 164.16	
Glycolic acid (C ₂ H ₄ O ₃) Mw: 76.05	$\begin{array}{c} \text{CH}_2-\text{COOH} \\ \\ \text{OH} \end{array}$	Caffeic acid (C ₉ H ₈ O ₄) Mw: 180.16	
Lactic acid (C ₃ H ₆ O ₃) Mw: 90.08	$\begin{array}{c} \text{O} \\ \\ \text{H}_3\text{C}-\text{C}-\text{OH} \\ \\ \text{OH} \end{array}$	Ferulic acid (C ₁₀ H ₁₀ O ₄) Mw: 194.18	
Gluconic acid (C ₆ H ₁₂ O ₇) Mw: 196.16		Chlorogenic acid (C ₁₆ H ₁₈ O ₉) Mw: 354.31	
Oxalic acid (C ₂ H ₂ O ₄) Mw: 90.03	$\begin{array}{c} \text{COOH} \\ \\ \text{COOH} \end{array}$	-----	
Malonic acid (C ₃ H ₄ O ₄) Mw: 104.06	$\begin{array}{c} \text{CH}_2-\text{COOH} \\ \\ \text{CH}_2-\text{COOH} \end{array}$	-----	
Succinic acid (C ₄ H ₆ O ₄) Mw: 118.09	$\begin{array}{c} \text{CH}_2-\text{COOH} \\ \\ \text{CH}_2-\text{COOH} \end{array}$	-----	
Fumaric acid (C ₄ H ₄ O ₄) Mw: 116.07		-----	
Malic acid (C ₄ H ₆ O ₅) Mw: 134.09		-----	
Tartaric acid (C ₄ H ₆ O ₆) Mw: 150.09		-----	
α -Ketoglutaric acid (C ₅ H ₆ O ₅) Mw: 146.11		-----	
Citric acid (C ₆ H ₈ O ₇) Mw: 192.12	$\begin{array}{c} \text{CH}_2-\text{COOH} \\ \\ \text{HO}-\text{C}-\text{COOH} \\ \\ \text{CH}_2-\text{COOH} \end{array}$	-----	
		Alicyclic carboxylic acid	
		Quinic acid (C ₇ H ₁₂ O ₆) Mw: 192.17	

		Heterocyclic carboxylic acid	
		Orotic acid (C ₅ H ₄ N ₂ O ₄) Mw: 156.10	

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IUPAC - IUBMB Joint Commission on Biochemical Nomenclature (JCBN)
Nomenclature of Carbohydrates
(Recommendations 1996)
World Wide Web version prepared by G. P. Moss
Department of Chemistry, Queen Mary University of London,
Mile End Road, London, E1 4NS, UK.
<http://www.chem.qmul.ac.uk/iupac/2carb> (Searched: April 15, 2015)
- 8) FAO/INFOODS: Guidelines for Checking Food Composition Data prior to publication of User Table /Database. Version. 1.0 (2012)