Chapter 1. Introduction

1 Purpose and properties of Fatty Acids Composition Tables

1) Purpose

Fatty acid is a main constituent of lipids, and is an important nutrient component with various physiological actions depending on its type.

The Composition Tables indicates the content of fatty acids in foods, provided as a basic material for understanding the current status and to give consideration to the ideal future status of supply and intake of fatty acids. Additionally, the 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 fatty acids in foods taken daily by people for a wide range of applications in various fields.

2) Properties

It is known that the content of lipid and the composition of fatty acids in food vary due to various factors, including the type, species, growing environment, processing method, etc. of plant/animal/fungus as raw material.

The current Composition Tables is created based on the analytical values of samples that have a clearly identifiable history and can be obtained from markets in Japan through normal means, by referencing literature values etc. In so doing, careful consideration is given to the component value varying factors and the wide variety of use purposes of the Tables. In the current Composition Tables, one set of standard component values is listed for one food product in principle.

Taking into account the placement of the current Composition Tables as a part of the Standard Tables of Food Composition in Japan, attention was paid on maintaining the consistency with the Standard Tables of Food Composition in Japan - 2015 - (Seventh Revised Edition) (hereinafter referred to as “Composition Tables 2015”) that was released along with the current Composition Tables.

3) Background

After the release of the Standard Tables of Food Composition in Japan Fourth Revised Edition (hereinafter referred to as “4th Composition Tables”) in 1982, the Resources Council, Science and Technology Agency (current Subdivision on Resources, Council for Science and Technology, Ministry of Education, Culture, Sports, Science and Technology (MEXT)) summarized and released the Standard Tables of Food Composition in Japan: Fatty Acids, Cholesterol and Vitamin E. - (Tocopherols) (hereinafter referred to as “4th Follow-up Composition Tables”) in 1989 as part of a follow-up survey on the components not listed in the 4th Composition Tables.

In 2005, the Subdivision on Resources, Council for Science and Technology, MEXT summarized the Standard Tables of Food Composition in Japan Fifth Revised and Enlarged Edition - Fatty Acids Section - (hereinafter referred to as “5th Enlarged Fatty Acids Composition Tables”), along with the release of the Standard Tables of Food Composition in Japan Fifth Revised and Enlarged Edition (hereinafter referred to as “5th Enlarged Composition Tables”).

The Subdivision on Resources then established the Expert Committee on Food Components and has since endeavored to expand the information related to fatty acid composition in food taking into account factors including the change in diet in recent years. As a result, the Standard Tables of Food Composition in Japan - 2015 - (Seventh Revised Edition) - Fatty Acids - (hereinafter referred to as “Fatty Acids Composition Tables 2015”) was summarized associated with the formulation of the Standard Tables of Food Composition in Japan - 2015 - (Seventh Revised Edition) in December 2015.

4) Outline of review of the 5th Enlarged Fatty Acids Composition Tables

The changes from the 5th Enlarged Fatty Acids Composition Tables released in 2005 to the Fatty Acids Composition Tables 2015 include an increase in the number of foods by 520, review of the item number, arrangement, food name of foods to be consistent with the Composition Tables 2015, and addition of index numbers to foods.

Additionally, for users' convenience, to increase the number of included foods, the component values calculated from proportions of ingredients and those estimated from the USDA(United States Department of Agriculture) National Nutrient Database for Standard Reference, Release 27, are newly added for some foods. The components are the same as those in the 5th Enlarged Fatty Acids Composition Tables except that Fatty acid 18:1 is subdivided.

The content of the 5th Enlarged Fatty Acids Composition Tables was "Table 1 Fatty Acid Composition" and "Table 2 Fatty Acid Composition of Foods (Edible Portion)". In the current Composition Tables, for users' convenience, the content is changed to "Fatty Acid Table 1: Fatty acids per 100 g of edible portion" and "Fatty Acids Table 2: Fatty acids per 100 g of total fatty acids". Additionally, "Fatty Acids Table 3: Fatty acids per g of lipid" is available on the MEXT website.

2 Standard Tables of Food Composition in Japan - 2015 - (Seventh Revised Edition) - Fatty Acids -

The fatty acids in the current Composition Tables are shown as per 100 g of edible portion (Fatty Acids Table 1) and per 100 g of total fatty acids (Fatty Acids Table 2), consistent with the Composition Tables 2015.

Additionally, the component values per 1 g of lipid are calculated, and compiled Fatty Acids Table 3, is available on the MEXT website along with Fatty Acids Table 1 and Fatty Acids Table 2.

The table preparation procedure is: the contents of fatty acids per 1 g of lipid (Fatty Acids Table 3) are calculated based on analytical values, estimated values and other reliable values of each fatty acid, and then Table 1 is formulated by multiplying the data in Fatty Acids Table 3 by the amount of lipid shown in the current Composition Tables. Then, Fatty Acids Table 2 is compiled by calculating the amount of fatty acids per 100 g of total fatty acids. The name of each table is as shown below.

Fatty Acids Table 1: Fatty acids per 100 g of edible portion
Fatty Acids Table 2: Fatty acids per 100 g of total fatty acids
Fatty Acids Table 3: Fatty acids per g of lipid (released online)

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 (Note), 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, 18 Prepared foods

(Note) Component values of fatty acids are not listed in "3 Sugars and sweeteners".

(2) Outlines

Foods are generally selected from the foods listed in the Food Composition Tables 2015. The selection criteria are, in principle, foods with high lipid content, foods of high daily intake, foods used as ingredients and representative prepared foods. Foods used as ingredients are chosen from those in the form taken.

On compiling the Fatty Acids Composition Tables 2015, in addition to the data of newly analyzed foods, the data in the 4th Follow-up Composition Tables and the 5th Enlarged Fatty Acids Composition Tables are used. Additionally, from the viewpoints of increasing the number of foods as much as possible and ensuring the users' convenience, contents are estimated by the methods mentioned below for some foods.

[1] For foods with analytical values for “Raw”, the data of “Boiled”, “Baked”, and other cooked foods are imputed based on raw food’s data.
[2] For foods unable to be estimated by [1] and there are similar foods in overseas’ food composition tables, the component data are borrowed.
[3] For processed foods with known blending ratio of raw materials and fatty acid component values, the component values were estimated using such values.

Because the estimated values by the method in [1], [2] or [3] do not consider possible changes of the composition by cooking nor differences between the foods available in Japan and overseas, they are shown in parenthesis. It is also mentioned in the Remarks that the value is an estimate.

For the methods in [1] and [2], the estimated values are calculated by multiplying the amount of each fatty acid per 1 g of lipid of the referencing food by the amount (g) of lipid in the subject food [1) 2)]. The referenced food is indicated in the Remarks for [1] and in **Chapter 3** for [2].

For the method in [3], the estimated values are calculated by (a): multiplying the ingredients’ blending portion by the amount of each fatty acid per 100 g of edible portion of ingredient that constitutes at least 1 % of total lipid for the subject food and adding them up, (b): multiplying the ingredients’ proportion by the amount of lipid per 100 g of edible portion of the relevant ingredient and adding them up, (c): dividing (a) by (b), and (d): multiplying the amount of lipid per 100 g of edible portion of the subject food by (c).[2)] The ingredients’ proportion used are those summarized in **Chapter 3** of the Food Composition Tables 2015.

The number of foods in the Fatty Acids Composition Tables 2015 is 1,782, as shown in **Table 1** by food group.

Table 1 Number of foods in food group

Food group		No. of foods (Table 1)
1	Cereals	151
2	Potatoes and starches	33
3	Sugars and sweeteners	0
4	Pulses	89
5	Nuts and seeds	42
6	Vegetables	244
7	Fruits	107
8	Mushrooms	42
9	Algae	36
10	Fish, mollusks and crustaceans	418
11	Meats	290
12	Eggs	20
13	Milk and milk products	56
14	Fats and oils	31
15	Confectionaries	126
16	Beverages	18
17	Seasonings and spices	75
18	Prepared foods	4
Total		1782

(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 Composition Tables 2015. Index numbers were newly assigned to each food. The index numbers are the same as those in the 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.

2) Components

(1) Components and their arrangement

[1] The arrangement of components is as shown below.

Fatty Acid Table 1: Fatty acids per 100 g of edible portion

Water, lipid, total fatty acids, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, *n*-3 polyunsaturated fatty acids, *n*-6 polyunsaturated fatty acids, and individual fatty acid

Fatty Acid Table 2: Fatty acids per 100 g of total fatty acids

(per 1 g of fatty acid)

Saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, *n*-3 polyunsaturated fatty acids, and *n*-6 polyunsaturated fatty acid

(per 100 g of total fatty acids)

Individual fatty acid

[2] The fatty acids are arranged in the order from smaller to larger number of carbons for each group of fatty acids, namely, saturated, monounsaturated, and polyunsaturated fatty acids.

(2) Fatty acids

[1] Fatty acids are shown by their symbols consisting of the numbers of carbons and double bonds as well as the names of fatty acids. The symbol expresses by "[number of carbons]:[number of double bonds]", such as 18:1. Note that "C" was added in front of the symbols to avoid confusion with component data for the Remarks of the main tables in **Chapter 2, such as C18:1**.

Fatty acid has a systematic name based on the nomenclature recommended by the International Union of Pure and Applied Chemistry (IUPAC) and some common names.[3)] The systematic name based on the numbers of carbons and double bonds allows unambiguous understanding on the structural features, but common names are widely accepted and used for many fatty acids. For that reason, either systematic names or common names are used in the main tables in **Chapter 2** of the Fatty Acid Composition Tables 2015, consistent with the 5th Enlarged Fatty Acids Composition Tables. The symbol, systematic names (English), and main common names (Japanese and English) are shown in **Table 2**.

Table 2 Name, symbol and molecular weight of fatty acids in the Fatty Acids Composition Tables

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Symbol		Fatty Acid		Molecular weight
No. of carbons: No. of double bonds		Systematic name (Note 1)	Common name	
4:0		butanoic acid	butyric acid	88.11
6:0		hexanoic acid	caproic acid	116.16
7:0		heptanoic acid	enanthic acid	130.18
8:0		octanoic acid	caprylic acid	144.21
10:0		decanoic acid	capric acid	172.26
12:0		dodecanoic acid	lauric acid	200.32
13:0		tridecanoic acid		214.34
14:0		tetradecanoic acid	myristic acid	228.37
15:0	(Note 3)	pentadecanoic acid		242.40
16:0	(Note 3)	hexadecanoic acid	palmitic acid	256.42
17:0	(Note 3)	heptadecanoic acid	margaric acid	270.45
18:0		octadecanoic acid	stearic acid	284.48
20:0		icosanoic acid	arachidic acid	312.53
22:0		docosanoic acid	behenic acid	340.58
24:0		tetraicosanoic acid	lignoceric acid	368.64
10:1		decenoic acid		170.25
14:1		tetradecenoic acid	myristoleic acid	226.36
15:1		pentadecenoic acid		240.38
16:1		hexadecenoic acid	palmitoleic acid	254.41
17:1		heptadecenoic acid		268.43
18:1		octadecenoic acid (*n*-9) (Note 5)	oleic acid (Note 4)	282.46
18:1		octadecenoic acid (*n*-7) (Note 5)	*cis* –vaccenic acid (Note 4)	282.46
20:1		icosenoic acid	eicosenoic acid (Note 6) (Note 7)	310.51
22:1		docosenoic acid	(Note 7)	338.57
24:1		tetracosenoic acid	(Note 7)	366.62
16:2		hexadecadienoic acid		252.39
16:3		hexadecatrienoic acid		250.38
16:4		hexadecatetraenoic acid		248.36
17:2		heptadecadienoic acid		266.43
18:2		octadecadienoic acid		280.45
18:2	*n*-6 (Note 5)	octadecadienoic acid (*n*-6)	linoleic acid	280.45
18:3		octadecatrienoic acid		278.43
18:3	*n*-3 (Note 5)	octadecatrienoic acid (*n*-3)	α-linolenic acid	278.43
18:3	*n*-6	octadecatrienoic acid (*n*-6)	γ-linolenic acid	278.43
18:4	*n*-3	octadecatetraenoic acid	parinaric acid	276.41
20:2	*n*-6	icosadienoic acid	eicosadienoic acid (Note 6)	308.50
20:3	*n*-6	icosatrienoic acid	eicosatrienoic acid (Note 6)	306.48
20:4	*n*-3	icosatetraenoic acid (*n*-3)	eicosatetraenoic acid (Note 6)	304.47
20:4	*n*-6	icosatetraenoic acid (*n*-6)	arachidonic acid	304.47
20:5	*n*-3	icosapentaenoic acid	eicosapentaenoic acid (Note 6)	302.45
21:5	*n*-3	henicosapentaenoic acid		316.48
22:2		docosadienoic acid		336.55
22:4	*n*-6	docosatetraenoic acid		332.52
22:5	*n*-3	docosapentaenoic acid (*n*-3)		330.50
22:5	*n*-6	docosapentaenoic acid (*n*-6)		330.50
22:6	*n*-3	docosahexaenoic acid		328.49

(Note) 1 In the systematic names of IUPAC nomenclature, the location of double bond counted from the carboxyl carbon is added in front of the name with a numeric number, which is omitted in this table.

2 IUPAC, Chemical Society of Japan, and Japan Oil Chemists' Society discontinued use of conventional names such as caproic acid, caprylic acid, and capric acid.

3 Foods in Milk and milk products and the food groups contain branched fatty acids such as iso acids and anteiso acids (shown as "iso" and "ant" respectively in the current Composition Tables).

4 In the 5th Enlarged Fatty Acids Composition Tables, 18:1 fatty acids were collectively listed as "oleic acid" regardless of the location of double bond or geometrical isomers. In the Fatty Acids Composition Tables 2015, this was renamed as "Fatty acid 18:1 undifferentiated". For food for which "18:1 (*n*-9) oleic acid" and "18:1 (*n*-7) *cis*-vaccenic acid" are newly analyzed, their component values and the total value are included.

5 Referencing the location of carbon atom of the terminal methyl group, symbols ω3, ω6, ω9, etc. have been conventionally used as a method to describe the location of other carbon atoms. However, it is now official to use "*n*-" like *n*-3, *n*-6, and *n*-9 instead of ω.

6 It used to be called "eicosa-", but IUPAC, Japanese Scientific Terms (Chemistry), Chemical Society of Japan, and Japan Oil Chemists' Society have adopted "icosa-" instead.

7 20:1(*n*-11) is called gadoleic acid, 20:1(*n*-9) gondoic acid, 22:1(*n*-11) setoleic acid, 22:1(*n*-9) erucic acid, and 24:1(*n*-9) selacholeic acid.

[2] Fatty acid is usually a general term for aliphatic non-branched carboxylic acids with one carboxylic group per molecule. It often exists in a bond form with glycerol moiety through an ester bond, and they are the main constituent of lipids. Fatty acid that has no, one or multiple double bonds in the molecule, except carboxyl group, is called saturated fatty acid, monounsaturated fatty acid, or polyunsaturated fatty acid, respectively [4]. Monounsaturated fatty acid is also called monoenoic acid. Polyunsaturated fatty acid is also called polyenoic acid [5) 6)]. Fatty acids having 4 or more double bonds are called highly unsaturated fatty acids to distinguish them from other fatty acids. Intake of lipids, the balanced intake of saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids is important.

Some fatty acids in Milk and milk products include branched fatty acids, such as iso acids (methyl group is located at the 2nd carbon atom from the terminal methyl group) and anteiso acids (methyl group is located at the 3rd carbon atom from the terminal methyl group). Additionally, some foods have *trans*-fatty acids with a different configuration of two hydrogen atoms bound to two carbon atoms concerning a carbon-carbon double bond, i.e. the hydrogen atoms are on opposite sides relative to a reference plane, the double bond.

Among polyunsaturated fatty acids, those with a double bond showing for the first time on the 3rd or 6th carbon atom from the carbon atom of terminal methyl group are called *n*-3 polyunsaturated fatty acids (Omega-3) or *n*-6 polyunsaturated fatty acids (Omega-6), respectively. Recent studies report the importance of the intake balance of *n*-3 polyunsaturated fatty acids and *n*-6 polyunsaturated fatty acids.

Among these polyunsaturated fatty acids, linoleic acid and α-linolenic acid are fatty acids that cannot be synthesized in animal bodies and must be taken in from food. These fatty acids are called essential fatty acids, and serve as raw materials of many physiologically active substances. A lack of essential fatty acids can lead to hypotrophy, cornification of skin, etc. It is known that α-linoleic acid is deeply involved with the function of the brain or nervous system, and converted to icosapentaenoic acid (IPA) or docosahexaenoic acid (DHA) in the body by action of chain elongation or desaturation ((note) IPA is also called eicosapentaenoic acid, and the abbreviation as EPA may be used instead). IPA or DHA is naturally found in lipids of aquatic products, and it is known that people living in areas that consume Fish, mollusks and crustaceans containing a large amount of IPA and DHA tend to have relatively less risk of thrombosis such as cerebral infarction and myocardial infarction. Linoleic acid is known to have a serum cholesterol reducing action etc., yet it also is reported that excessive intake can lead to health issues.

For any fatty acid, the main source of supply is food with high lipid content, and excessive intake of such food can lead to excessive intake of energy, so attention needs to be paid.

[3] Fatty acids subject to measurement were those with the number of carbon atoms from 4 to 24 in principle, and each amino acid was quantified per 1g of lipid. The measurement method for fatty acids is outlined in **Table 3**.

[4] For those for which the component values in the 4th Follow-up Composition Tables were used, there are unidentified fatty acids and the total amount may vary from the sum of the component values of fatty acids listed in the Composition Tables (i.e. lacking component values for these unidentified fatty acids).

Table 3 Measurement methods for fatty acids

Component	Sample preparation method	Measurement method
Fatty acid	Extract lipid and esterify	Hydrogen flame ionization detection – gas chromatography

(3) Water and lipid

From the viewpoint of ensuring convenience for users, the component values of water and lipid listed in the Composition Tables 2015 were included in Table 1 in **Chapter 2**. The measurement methods for water and lipid are outlined in **Table 4**.

Table 4 Measurement methods for water and lipid

Component	Measurement method
Water	Air drying or vacuum drying method with or without addition of a drying aid. Note that the weight of alcohol or acetic acid was subtracted from the dry weight of alcohol beverages or vinegars, respectively.
Lipid	Soxhlet extraction method by diethylether, modified chloroform-methanol extraction method, Roese-Gottlieb method, or acid decomposition method.

(4) Remarks

Regarding important matters closely related to the content of food, component values, etc., the contents below are listed in the Remarks.

[1] State of food, or ingredient name, blending ratio of main raw materials, additives, etc. of prepared foods.

[2] Component values of fatty acids other than those listed at the top of the Table.

3) Procedure of presenting values

The method of presenting values conforms to the rules below (see **Table 5**).

Water and lipid are shown to the first decimal place, in g.

Total fatty acids, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, *n*-3 polyunsaturated fatty acids and *n*-6 polyunsaturated fatty acids per 100 g of edible portion are shown to the second decimal place, in g.

Each fatty acid per 100 g of edible portion is shown to the ones place, in mg. Values no less than 100 are rounded off at the third digit from the left to have two significant digits, and values less than 100 are rounded off at the first decimal place.

Total fatty acids, saturated fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids per 1 g of lipid are shown to the ones place, in mg.

Each fatty acid per 100 g of total fatty acids is shown to the first decimal place, in g.

For each component, “0” indicates the value being less than 1/10 of the minimum listing value or not detected, and “Tr (trace)” indicates the value contained is 1/10 or greater of the minimum value listed yet less than 5/10.

For fatty acids where the values in the 4th Follow-up Composition Tables or the 5th Enlarged Fatty Acids Composition Tables were used, those not analyzed in these Composition Tables are indicated by “–”.

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

Table 5 Procedure of presenting values in Fatty Acids Composition Tables

Component	Breakdown	Unit	Decimal place in presentation	Rounding method
Fatty acid	per 100 g of edible portion Total fatty acids Saturated fatty acids Monounsaturated fatty acids Polyunsaturated fatty acids *n*-3 polyunsaturated fatty acids *n*-6 polyunsaturated fatty acids	g	2	Round off the third decimal place.
	Each fatty acid	mg	0	Round off at the third digit to have two significant digits. Values less than 100 are rounded off at the first decimal place.
	per 1 g of lipid Saturated fatty acids Monounsaturated fatty acids Polyunsaturated fatty acids	mg	0	Round off the first decimal place.
	per 100 g of total fatty acids Each fatty acid	g	1	Round off the second decimal place.
Water		g	1	Round off the second decimal place.
Lipid		g	1	Round off the second decimal place.

(Note) Component values derived by calculation (e.g., total amount) may vary from the values calculated using the component values listed in the Composition Tables since the calculation results are rounded off.

4) Cooking and preparation conditions

The cooking conditions used in the 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, and deep-fried, and the following foods are newly added in this revision: breaded and fried, ("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. Boiling is done as a preparation of cooking, and the resultant broth is discarded. It includes post-boiling handling such as draining in a colander or hand-squeezing after cooling.

Unheated preparation methods include bleached in water, soaked in water, salted pickles, and "Nukamiso-zuke" (pickled in salty rice bran paste). 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, glazed carrot, salted pickles, and "Nukamiso-zuke" (pickled in salty rice bran paste), because it is difficult to generalize the kind and amount of condiments to be used. See the Composition Tables 2015 for the outline of cooking conditions for each food.

References

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