General information

The new Indian Food Composition Tables (IFCT) 2017 is the major source of food composition data in India, generated, developed, managed and maintained by the National institute of Nutrition (ICMR), Hyderabad. All data except for poultry and egg pertains to raw food. None of the food sampled for analysis is fortified and it represents only inherent values. The uniqueness of the IFCT is that all nutrient values presented here have been derived from comprehensive national food sampling followed by analysis and contains only analytical data. The data set were carefully scrutinized in detail for consistency and validity, using FAO/INFOODS 'Guidelines for Checking Food Composition Data prior to Publication of a User Tables/Database – version 1.0 (2012)'.

1. Food identification

The Food entity is described by its most common english name, scientific name and photographs of the food sampled for analysis in order to provide as much description as possible. Scientific names consisting of the genus and the species are provided for clarity and to avoid confusion. Foods have been arranged alphabetically by english name for easy identification. The names of foods are also listed in regional official Indian languages namely Assamese, Bengali, Gujarati, Hindi, Kannada, Kashmiri, Konkani, Malayalam, Manipuri, Marathi, Nepali, Oriya, Punjabi, Sanskrit, Telegu and Urdu to make them acquiescent with the local or regional needs. For animal source foods, the specific body part sampled for analysis is also given. Each food tabulated has a unique four character alpha-numeric identification code. The alphabetic food character indicates the food group and the numeric character(s) represent a record position within a category. This allows convenient tracking of the data for each food throughout the food composition database.

2. Food groups

Foods with common characteristics have been placed together and arranged in groups (**Table1**). Each food group is preceded by text covering points of specific relevance to the foods in that group. All foods have been categorized into 20 food groups and the number in parenthesis indicates the total number of foods present in each group. A total of 528 foods have been analyzed for more than 150 parameters and presented under different nutrient component parameter.

3. Information on nutrients

3.1 Proximate components include moisture, protein, total fat, ash and carbohydrates. The Difference between 100 and the sum of proximate components including total dietary fibre represents carbohydrate 'by difference'.

3.2 Available carbohydrate is the sum of total free sugars and total starch. Free sugars are individual monosaccharides (galactose, glucose and fructose) and disaccharides (sucrose, lactose and maltose). The values for available carbohydrate have generally been obtained from the sum of individually analyzed values for these components and will differ with figures for carbohydrate 'by difference'. Available carbohydrates are those which is digested and absorbed, and are glucogenic in human corresponding to the term 'glycaemic carbohydrates'. For conversion between carbohydrate weights and monosaccharide equivalents, the factors shown in **Table 2** was used.

3.3 Total dietary fibre (TDF) is made of complex and heterogeneous polymeric materials such as soluble and insoluble polysaccharides and non-digestible oligosaccharides, as well as a range of non-swellable, more or less hydrophobic compounds such as cutins, suberins and lignins. Currently three different AOAC approved methods for measuring TDF values are available. TDF was analyzed using enzymatic gravimetric method (AOAC 991.43).

3.4 Protein values were calculated from the estimated total nitrogen in the food using the Jones (1941) conversion factors (**Table 3**). Protein values for soybean and mushrooms contain considerable non-protein nitrogen (NPN) in several form including urea, purines & pyrimidine. Therefore, NPN was estimated and subtracted from total nitrogen of mushrooms before multiplying with the Jones factor.

Table 1. Food groups in the IFCT.

Code	Food groups	No. of food entries
A	Cereals and Millets	24
B	Grain Legumes	25
C	Green Leafy Vegetables	34
D	Other Vegetables	78
E	Fruits	68
F	Roots and Tubers	19
G	Condiments and Spices	33
H	Nuts and Oil Seeds	21
I	Sugars	2
J	Mushrooms	4
K	Miscellaneous Foods	2
L	Milk and Milk Products	4
M	Egg and Egg Products	15
N	Poultry	19
O	Animal Meat	63
P	Marine Fish	92
Q	Marine Shellfish	8
R	Marine Mollusks	7
S	Fresh Water Fish and Shellfish	10
T	Edible Oils and Fats	9

Table 2. Conversion of carbohydrate weights to monosaccharide equivalents.

S. No.	Carbohydrate	Equivalent after Hydrolysis (g/100g)	Conversion to monosaccharide equivalent
1	Monosaccharides e.g. glucose	100	No conversion necessary
2	Disaccharides e.g. sucrose, lactose, maltose	105	x 1.05 or ÷ 0.95
3	Oligosaccharides		
	a. Raffinose (trisaccharide)	107	x 1.07 or ÷ 0.93
	b. Stachyose (tetrasaccharide)	108	x 1.08 or ÷ 0.93
	c. Verbascose (pentasaccharide)	109	x 1.09 or ÷ 0.92
4	Polysaccharides e.g. starch	110	x 1.10 or ÷ 0.90

Table 3. Jones factors for conversion of nitrogen to protein.

Food	Conversion Factor
Barley and its Flour; Rye and its flour; Oats	5.83
Rice and its flour	5.95
Wheat whole	5.83
Wheat bran	6.31
Refined wheat flour (Maida)	5.70
Almonds	5.18
Peanuts	5.46
Soybean	5.71
Cashew nuts, pistachio nut, Chest nut	5.30
Egg whole	6.25
Meat and Fish	6.25
Milk and milk products	6.38
Sunflower seeds	5.30
Food where specific factor is not listed	6.25

3.5 Total fat content of foods is determined by gravimetric methods, including acid hydrolysis and extraction methods using a mixed solvent system of chloroform and methanol. Total fat includes the triglyceride and other lipid components such as glycerol, sterols and phospholipids.

3.6 Food energy is expressed in kilojoules (kJ) calculated based on the Atwater system for determining energy values (**Table 4**). The data represent physiologically available energy, which is the energy value remaining after digestive and urinary losses are deducted from gross energy. Food energy in kilojoules (kJ) can be converted using the formula 1 kcal = 4.18 kJ

3.7 Minerals and trace elements included in the table are Aluminium, Arsenic, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Phospohorus, Potassium, Selenium, Sodium and Zinc. Except phosphorus, levels of all minerals and trace elements are determined by atomic absorption spectroscopy (AAS) or inductively coupled plasma mass spectrophotometry (ICP-MS). Phosphorus was determined by spectrophotometric method.

3.8 Thiamin, Riboflavin and Niacin: Thiamin was determined chemically by the thiochrome procedure and riboflavin by microbiological method. Niacin is determined by microbiological method. The values represent only preformed niacin and do not include the niacin contributed by tryptophan, a niacin precursor. Niacin equivalent applies to the sum of the preformed niacin and the amount that could be derived from tryptophan can be calculated as

Niacin equivalents (mg) = Niacin (mg)+ (Tryptophan, mg / 60).

3.9 Vitamin C data include both ascorbic and L-dehydroascorbic acids, as both forms are biologically active, the sum of which is expressed as total ascorbic acid content.

3.10 Vitamin B6 occurs in foods as pyridoxine, pyridoxal, pyridoxamine and their phosphates which were estimated by HPLC. The sum of all forms represents vitamin B6.

3.11 Pantothenic acid in foods was determined by liquid chromatographic methods.

Table 4. Metabolizeable energy conversion factors.

Component	kJ/g	kcal/g
Protein	17	4
Fat	37	9
Available carbohydrate	17	4
Fibre	8	2
Alcohol	29	7

3.12 Food folate values are analyzed using the trienzyme procedure and liquid chromatography. Food folate was expressed as the sum of one or more individual folate vitamers namely 5-methyl tetrahydrofolate, 10-formyl folic acid, 5-formyl tetrahydrofolic acid and tetrahydrofolic acid.

3.13 Vitamin A content is expressed as retinol and provitamin A carotenoid. The groups of plant pigments that are precursors of vitamin A are called carotenoids. Individual carotenoids available in the IFCT includes Lutein, zeaxanthin, lycopene, β-cryptoxanthin, α-carotene, β-carotene, γ-carotene and total carotenoids. The body can utilize these inactive forms once they are converted to the active form, retinol. Vitamin A activity values in Retinol Activity Equivalents (RAE) are calculated from the content of individual carotenoids using appropriate factors. Incidentally, there are many conversion factors for carotenoids and no universal factor exists.

3.14 Vitamin D have been reported in the IFCT which is lacking in many food composition databases. Ergocalciferol or vitamin D2 content in plant foods measured by LC-MS has been reported for the first time in the world. Cholecalciferol or vitamin D3 in animal source foods including 25 hydroxy-D3 measured by LC-MS/MS has also been reported. The availability of new analytical vitamin D data in foods will permit dietary intake assessment. Vitamin D2 (ergocalciferol) made commercially has been reported to have the similar potency in human. Total vitamin D activity has been taken as the sum of vitamin D3 (cholecalciferol) and five times 25-hydroxy vitamin D3 (25-hydroxy cholecalciferol), where data are available.

3.15 Vitamin E in food is presented as tocopherols and tocotrienols and its isomers. The new Dietary Reference Intake (DRI) for vitamin E (Krinsky, 2000) has stated that with the exception of α-tocopherol all other individual isomers of tocopherols and tocotrienols do not contribute to vitamin E activity, nevertheless, they are included in the database.

3.16 Vitamin K data as phylloquinone in plant foods and menaquinone in animal foods estimated using liquid chromatography are presented in the IFCT.

3.17 Fatty acid profile is obtained as the percentage of fatty acid methyl esters determined by gas liquid chromatographic (GLC) analysis. Fatty acids are expressed as the actual quantity of fatty acid in mg per 100g of edible potion of food calculated using Sheppard conversion factor as detailed in Weihrauch et al. (1977). Detailed information on individual fatty acids of each food including values for total saturated, monounsaturated and polyunsaturated fatty acids are reported.

3.18 Amino acid profile of each food is determined by three different analyses. Tryptophan is determined by alkaline hydrolysis, methionine and cystine by performic oxidation and the rest of the amino acids by acid hydrolysis. The amino acid profile of each food is expressed as g/100 g protein.

3.19 Organic acids is naturally present in a wide variety of foods especially fruits, berries and vegetables. Organic acids *cis*-aconitic acid, citric acid, fumaric acid, mallic acid, quinic acid, succinic acid and tartaric acid were determined in single liquid chromatographic run. Soluble, insoluble and total oxalates were determined separately by HPLC method. The organic acids are energy contributing components, although it varies between the different organic acids. According to the Codex Alimentarius Commission's Guidelines for Nutrition Labeling, the energy conversion factor for organic acids is 13 kJ/g. However, organic acids have not been included in the total energy of foods given in the IFCT.

3.20 Polyphenols exhibit highly diverse structures characterized by the presence in their structure of one or several phenolic groups. The recognition of the antioxidant properties of polyphenols, and their probable role in the prevention of various diseases associated with oxidative stress has generated great interest. Polyphenols are found abundantly in our diet and over 500 different molecules are known to be present in foods. The IFCT presents data on 37 individual and total polyphenols present in key Indian foods.

3.21 Cholesterol values are generated primarily by gas liquid chromatographic method in foods of animal origin assuming that cholesterol is present only in animal origin foods. Cholesterol values are expressed as mg/100g food. To convert to mmol cholesterol, divide the values by 386.6.

3.22 Plant sterols data on campesterol, stigmasterol, and β-sitosterol are obtained by gas-chromatographic procedures and summed to calculate total phytosterols.

3.23 Oligosaccharides are indigestible but the beneficial colonic bacteria break them down in the large intestine. In the recent times there is great interest in the health properties of non-digestible oligosaccharides (NDO) as prebiotic compounds. Data on the oligosaccharide content in foods are very meager, making it difficult to assess oligosaccharide consumption of any population in the world. Therefore, content of raffinose, stachyose, verbascose and ajugoes in key Indian foods is presented.

3.24 Saponins consist of a polycyclic aglycones attached to one or more sugar side chains and are found in most vegetables, beans and herbs. Saponins were not destroyed by processing or cooking and have many health benefits.

3.25 Phytate is commonly known as phytic acid, inositol hexaphosphate and IP-6. It has received considerable attention as anti-nutrient because it binds minerals in the digestive tract, making them less available metabolically to our bodies. However, in the recent years, some novel metabolic effects of phytate or some of its degradation products have been recognized as antioxidant and may help fight some cancers and other diseases.

4. The expression of nutrient values

All foods are expressed per 100g edible portion. Generally the values have been expressed to a constant number of decimal places for each nutrient. The values of the more variable vitamins or minerals and trace elements have been expressed to less than their usual number of places where greater values render the extra places non-significant.

5. Nutrient identification-Tagnames

A unique abbreviation for a food component developed by International Network of Food Data Systems (INFOODS), have been used to aid in data interchange. Tagnames unambiguously indicate how the nutrient data are obtained indicating the methods of analysis used for the data. In case data was derived by calculation, tagname even indicates the formula used for calculation. INFOODS Tagnames, utilized worldwide, facilitate international data interchange and harmonization.

6. Data documentation

The alpha-numeric code provides a unique food identifier within the IFCTs. The foods are sorted alphabetically in the tables. All analytical data scrutinized against quality control data, unit of expression, conversion factors and calculations applied to each nutrient data and accepted after all criteria were met. The metadata was compiled in the archival database which has all the information on the sampling plan, numbers of samples analyzed, analytical methods used and quality assurance procedures in place.

The data presented in this book is the nutrient mean of all six regions representing the country wide value where the standard deviation represents the variation of the particular nutrient. The second type of sample is the individual sample of rice and wheat collected from the 107 sampling sites and analysed individually which increased variability by increasing the effective sample size. Such samples were drawn only for the main staples in the country and not for other foods due to the high cost associated with such analysis. The third type of samples are those of food within the species which were also analysed according to varieties/cultivars for some foods.

The values of six separate regions namely East, Northeast, North, West, South and Central India obtained from compositing adequate number of similar foods collected from within the region was tabulated. The mean value of six regional data was then used to calculate the national value with standard deviation to represent the variation within each nutrient. The mean±SD of all nutrients and bioactive components in foods are tabulated to represent the user database or the Indian Food Composition tables (**Figure 1**). All blank spaces in the nutrient tables represents below detectable limit of the particular method used for analysis.
Electronic format allow capturing higher volume of data, easier to update and can reach wider distribution if they are made publicly available. The region specific database is available in the electronic version at the National Institute of Nutrition (NIN). Regional foods may have a different nutrient profile that may differ from national average and hence individuals seeking local specific nutrient data are encouraged to obtain region specific data from NIN.

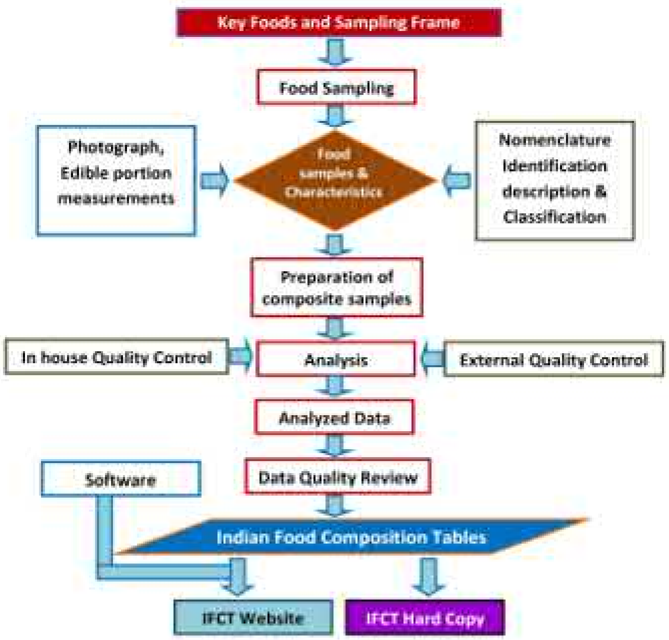

Figure 1. Indian food composition tables-data flow.