


PRIORITY FOOD TREE AND CROP FOOD COMPOSITION DATABASE: A USER GUIDE

Barbara Stadlmayr, Stepha McMullin, Ramni Jamnadass
World Agroforestry, Nairobi, Kenya



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United Nations Avenue

P O Box 30677, GPO 00100

Nairobi, Kenya

Tel: +254(0)20 722 4000, via USA +1 650 833 6645

Email: worldagroforestry@cgiar.org

Website: www.worldagroforestry.org

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LIST OF ABBREVIATIONS

AAS	Atomic Absorption Spectrometry
AOAC	Association of Official Analytical Chemists
CGIAR	Consortium of International Agricultural Research Centres
EC	European Commission
ECA	East and Central Africa
EP	Edible portion (on fresh weight basis)
FAO	Food and Agriculture Organization of the United Nations
FTA	Forests, Trees and Agroforestry
g	gram
HPLC	High Performance Liquid Chromatography
ICP	Inductively Coupled Plasma
ICRAF	World Agroforestry
IFAD	International Fund for Agricultural Development
INFOODS	International Network of Food Data Systems
kcal	kilocalories
kJ	kilojoules
max	maximum value
mcg	microgram
mg	milligram
min	minimum value
n	number of data points
ND	No data
NGO	Non-governmental Organization
RAE	Retinol Activity Equivalents
RE	Retinol Equivalents
RNI	Recommended Nutrient Intake
SD	Standard Deviation
WHO	World Health Organization

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1.0 INTRODUCTION

The Priority Food Tree and Crop Food Composition database contains nutritional information of selected tree foods and crops, with geographical focus on sub-Saharan Africa. The current version (version 1) comprises 132 foods (out of 99 species) and 30 components. All component values are presented per 100 g edible portion on fresh weight basis (EP). In addition to actual food composition values, the database includes scores for all foods – "high source", "source", "present, but low source", or "not a source" – of the selected micronutrients iron, vitamin A, folate and vitamin C. Searches can be done by food name, scientific name and by food group.

Tree foods are nutritious edible foods from trees and shrubs including fruits, vegetables, seeds, nuts and edible oils. These tree products have the potential to complement and diversify staple-based diets, thereby improving diet quality and health.

1.1 Why was the Database Developed?

Food composition data play a key role in linking agriculture to nutrition. Knowing what people eat and which nutrients the consumed foods contain is key in assessing and improving diet quality and health. It is equally important for agriculture, including domestication and breeding programs to select not only high-yielding, but highly nutritious species (Welch and Graham, 1999; Toledo and Burlingame, 2006; Burlingame et al., 2009)

The database was created during the implementation of the "Food Tree and Crop" portfolios developed by World Agroforestry. The portfolios are combinations of indigenous/underutilized and exotic food tree and crop species that can potentially provide year-round nutritious foods to address harvest and nutrient gaps in local diets (McMullin et al., 2019). In order to address certain "nutrient gaps" in a site, food tree species and others were mapped with food composition data. For the portfolios, the micronutrients iron, vitamin A (expressed as retinol equivalent), folate and vitamin C were selected. These nutrients were picked because of their public health concerns (iron, vitamin A, folate), their supportive functions (vitamin C supports the uptake of iron from plant foods) and their natural high quantity in tree foods (iron, vitamin A, folate, vitamin C).

However, the tree foods and other foods included in the portfolios contain several additional key vitamins, minerals and macronutrients that are of importance to the human body. To sustain all body functions and hence a healthy life, a well-balanced diet containing a variety of safe and nutritious foods is important. Therefore, the collection of food composition data has been extended to proximates, vitamins and minerals.

The database presents the backbone of the portfolios, but can also be used for dietary assessments, development of education and training materials, selection of nutritious species for agricultural domestication and breeding programs, and many more activities. It is a work in progress and will be updated on a regular basis.

- In the online database www.worldagroforestry.org/products/nutrition/ data can be searched by food name, scientific name and by food group.
- The data can also be exported in an Excel file under "Downloads" at www.worldagroforestry.org/products/nutrition/

2.0 METHODOLOGY

2.1 How was the Database Developed?

As a first step, food composition data of species identified for inclusion in location-specific portfolios were searched in scientific articles, food composition databases and reports. Thereafter, the data were screened against a set of quality criteria and compiled, standardized and aggregated following international tools, standards and guidelines on food composition (see Figure 1).

These include:

- Food composition data management system: FAO/INFOODS Compilation Tool Version 1.2.1. developed by Charrondiere, UR., 2009.
- Guidelines:
    - FAO/INFOODS Guidelines for Checking Food Composition Data prior to Publication of a User Table/Database - Version 1.0 (2012) FAO, Rome
    - FAO/INFOODS Guidelines for Converting Units, Denominators and Expressions Version 1.0 (2012) FAO, Rome
    - Greenfield and Southgate (2003) Food composition data. Production, management and use. 2nd edition. FAO, Rome
- Standards: INFOODS Food Component Tagnames (Klensin et al., 1989)
- References available at the FAO/INFOODS website (www.fao.org/infoods/infoods/)

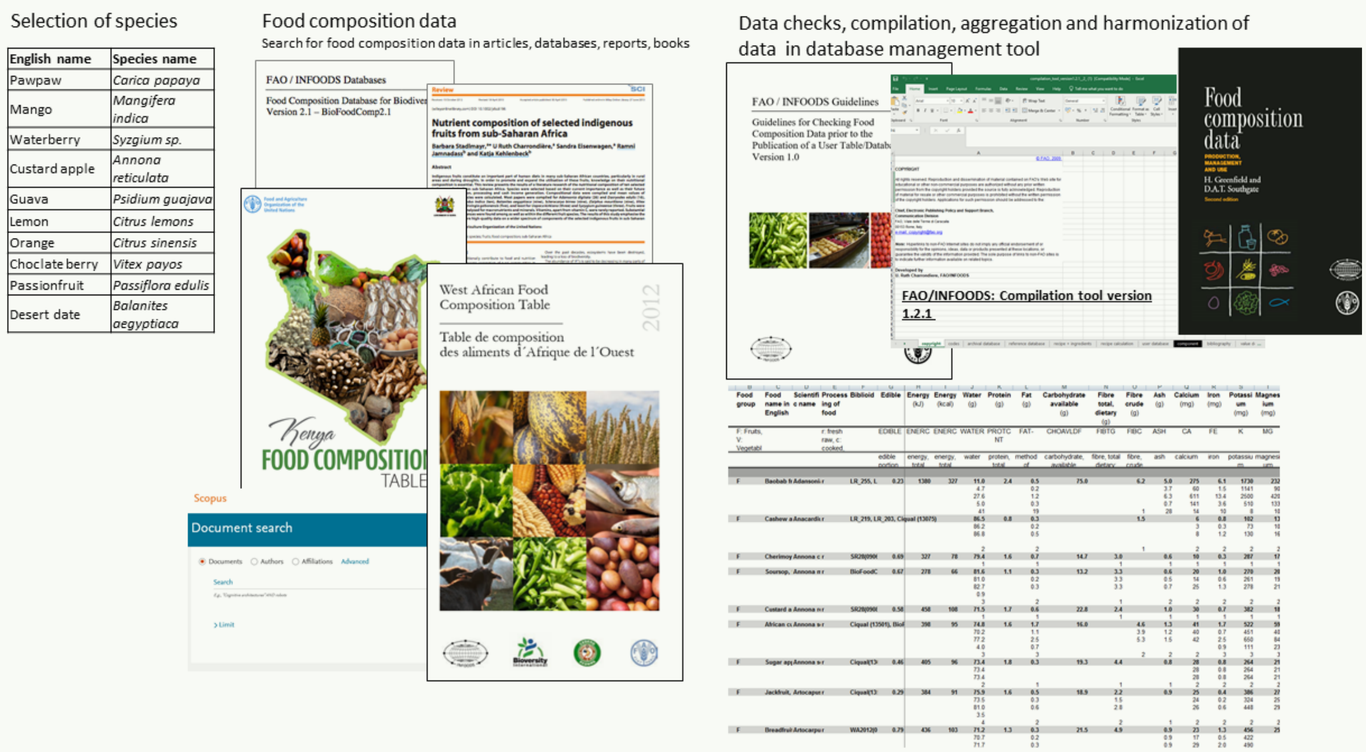


Figure 1: **Workflow from selection of species to data compilation and aggregation in database management tool**

2.2 Components

All component values in the database are presented per 100 g edible portion on fresh weight basis (EP)

Table 1: **Overview of components included in the database**

Component	Unit	INFOODS tag name	Explanation [1]
Proximates			
Edible portion coefficient		EDIBLE	Edible portion coefficient
Energy	kJ, kcal	ENERC	Energy, total metabolizable; calculated from the energy-producing components
Water	g	WATER	Water
Protein, total	g	PROTCNT	Protein, total; calculated from total nitrogen
Fat	g	FAT	Fat, method of determination unknown or mixed methods
Carbohydrate available, by difference	g	CHOAVLDF	Carbohydrates available were calculated by difference
Fibre, total dietary	g	FIBTG	Fibre, total dietary; determined gravimetrically by the AOAC total dietary fibre method
Fibre, crude	g	FIBC	Fibre, crude
Ash	g	ASH	Ash
Minerals			
Calcium	mg	CA	Calcium
Iron	mg	FE	Iron, total
Magnesium	mg	MG	Magnesium
Phosphorus	mg	P	Phosphorus
Potassium	mg	K	Potassium
Zinc	mg	ZN	Zinc
Copper	mg	CU	Copper
Vitamins			
Vitamin A (retinol equivalents)	mcg	VITA	Vitamin A; calculated by summation of the vitamin A activities of retinol and the active carotenoids. VITA (mcg) = Retinol (mcg/100 g EP) + beta-carotene (mcg/100 g EP)/6 + alpha-carotene (mcg/100 g EP)/12 + beta-cryptoxanthin (mcg/100 g EP)/12
Vitamin A (retinol activity equivalents)	mcg	VITA_RAE	Vitamin A; calculated by summation of the vitamin A activities of retinol and the active carotenoids VITA_RAE (mcg) = Retinol (mcg/100 g EP) + beta-carotene (mcg/100 g EP)/12 + alpha-carotene (mcg/100 g EP)/24 + beta-cryptoxanthin (mcg/100 g EP)/24
Retinol	mcg	RETOL	Retinol
Beta-carotene equivalents	mcg	CARTBEQ	Beta-carotene equivalents
Beta-carotene	mcg	CARTB	Beta-carotene
Alpha-carotene	mcg	CARTA	Alpha-carotene

[1] www.fao.org/fileadmin/templates/food_composition/documents/upload/PART4.TXT

Component	Unit	INFOODS tag name	Explanation [1]
Beta-cryptoxanthin	mcg	CRYPXB	Beta-cryptoxanthin
Vitamin E	mg	VITE	Vitamin E; calculated by summation of the vitamin E activities of the active tocopherols and tocotrienols
Alpha-tocopherol	mg	TOCPHA	Alpha-tocopherol
Thiamine	mg	THIA	Thiamin, vitamin B1
Riboflavin	mg	RIBF	Riboflavin, vitamin B2
Niacin	mg	NIA	Niacin, preformed
Vitamin B6	mg	VITB6-	Vitamin B6, method of determination unknown or mixed methods
Folate, total	mcg	FOL	Folate, total
Vitamin C	mg	VITC-	Vitamin C, method of determination unknown or mixed methods

2.2.1 Proximates and related compounds/factors

Energy (ENERC): The metabolizable energy values of all foods are presented in both kilojoules (kJ) and kilocalories (kcal). All energy values presented in the database are calculated based on protein, fat, available carbohydrates, fibre and alcohol by applying the energy conversion factors.

Table 2: **Energy conversion factors**

Component	kJ/g	kcal/g
Protein	17	4
Fat	37	9
Carbohydrates, available	17	4
Dietary fibre	8	2
Alcohol*	29	7

**It was assumed that the alcohol content in all foods was zero*

Water (WATER): Water is generally measured as the loss of weight after drying the sample to constant weight. Values presented in the database were mostly described to be derived by physical removal of water via air oven.

Protein, total (PROTCNT): Protein total is calculated by multiplying the nitrogen values with nitrogen to protein conversion factors (Jones factors). In the database, different nitrogen conversion factors were applied, depending on the food group and/or food. For the food groups: fruits, vegetables, starchy roots and tubers and pulses, the nitrogen to protein conversion factor of 6.25 was applied. In the food group cereals, the factor 5.83 was applied for millet and 5.95 for rice; 6.25 was used for all other food items within the cereal group. In the food group nuts and seeds, 5.30 was applied as nitrogen to protein conversion factor for all foods, apart from groundnuts (5.46). The nitrogen to protein conversion factors were retrieved from FAO/INFOODS Guidelines for Converting Units, Denominators and Expressions, Version 1.0.

Fat (FAT): The fat values for the foods included in the database was derived by mixed solvent extraction, or by continuous extraction (Soxhlet method). In some cases, the method of determination was unknown.

Carbohydrate, available (CHOAVLDF): Carbohydrates available were calculated by difference as follows: 100 - (water + protein + fat + ash + fibre + alcohol). Alcohol was estimated at zero for all foods in the database.

Fibre (FIBTG, FIBC): The database mostly contains values for total dietary fibre (FIBTG). However, in cases where no value of total dietary fibre was available, crude fibre values (FIBC) were taken. Generally, crude fibre values should not be used, as they underestimate the fibre value in a food.

Ash (ASH): The ash content of foods presented in the database is determined through gravimetric methods.

2.2.2 Minerals

The following minerals are included in the database: calcium, copper, iron, magnesium, phosphorus, potassium and zinc. Atomic absorption spectrometry (AAS), inductively coupled plasma (ICP), ICP-mass spectrometry and colorimetric methods were reported as methods of analysis by the different sources.

2.2.3 Vitamins

Water-soluble vitamins

Thiamin (THIA): Values have been analysed using microbiological methods and/or HPLC.

Riboflavin (RIBF): Microbiological methods and HPLC were reported as methods of analysis by the different sources.

Niacin (NIA): Niacin preformed values are included in the database.

Folate (FOL): Most of the foods included in the database were analysed by microbiological assay, as reported in the different sources. This method captures total folate in a food.

Vitamin B6 (VITB-): Microbiological methods and HPLC were reported in the sources as methods of analysis for vitamin B6.

Vitamin C (VITC-): Vitamin C values included in the database were analysed either via titrimetry or HPLC.

Fat-soluble vitamins

Vitamin A and Carotene (VITA, VITA_RAE, CARTB, CARTBEQ, CARTA, CRYPXB, RETOL): Carotene values presented in the database were mostly analysed via HPLC, as reported in the different sources. As the database contains only plant foods, the estimated value of retinol was zero for all foods. Vitamin A activity was calculated based on retinol and vitamin A-active carotenoids. It was expressed as retinol equivalents (RE) and as retinol activity equivalents (RAE).

Vitamin A in retinol equivalents, RE (VITA) are calculated as follows: Vitamin A in retinol equivalents (mcg/100 g EP) = Retinol (mcg/100 g EP) + beta-carotene (mcg/100 g EP)/6 + alpha-carotene (mcg/100 g EP)/12 + beta-cryptoxanthin (mcg/100 g EP)/12

Vitamin A in retinol activity equivalents, RAE (VITA_RAE): was calculated as follows: Vitamin A in retinol activity equivalents (mcg/100 g EP) = Retinol (mcg/100 g EP) + beta-carotene (mcg/100 g EP)/12 + alpha-carotene (mcg/100 g EP)/24 + beta-cryptoxanthin (mcg/100 g EP)/24

Beta-carotene equivalents (mcg) (CARTBEQ): was calculated as follows: beta-carotene equivalents (mcg/100 g EP) = beta-carotene (mcg/100 g EP) + alpha-carotene (mcg/100 g EP)/2 + beta-cryptoxanthin (mcg/100 g EP)/2

Vitamin E (VITE, TOCPHA): Values included in the database were analysed via HPLC. They include total vitamin E values and alpha-tocopherol.

2.3 Cooked Foods

While fruits are generally consumed raw, other parts from trees and shrubs, e.g., leafy vegetables and pulses, are consumed after preparation and/or processing. Hence, in addition to raw foods, the database also contains cooked foods, mostly boiled, for vegetables, cereals, pulses and starchy roots and tubers. For the following foods, the boiled form was calculated based and the raw form by applying retention and yield factors (see Table 3). Other boiled foods not listed in the table were borrowed directly from other sources.

2.3.1 Yield factors

Table 3: **Food items calculated in the database (from raw to boiled), including yield factors**

Food code	Food name in English	Scientific name	Yield factor	Source
Vegetables, green leafy vegetables				
V0019	Cat's whiskers, leaves, boiled	*Cleome gynandra*	0.98	Bognár, 2002 (Leafy vegetables, boiled)
V0021	Amaranth spinach, leaves, boiled	*Amaranthus hybridus*	0.98	
V0023	Wild spinach, leaves, boiled	*Amaranthus dubius*	0.98	
V0002	Drumstick leaves, boiled	*Moringa oleifera*	0.98	
V0026	Drumstick pods, boiled	*Moringa oleifera*	0.98	
Starchy roots and tubers				
S0016	Plantains, (yellow and green), boiled	*Musa paradisiaca*	1.00	Bognár, 2002 (Potato, without peel, boiled)
S0017	Plantains, yellow, boiled	*Musa paradisiaca*	1.00	
Cereals				
C0010	Finger millet, boiled	*Eleusine coracana*	2.40	Bognár, 2002 (Millet, shacked corn, boiled)

2.3.2 Retention factors

Table 4: **Retention factor, minerals and vitamins**

Retention factors	Food group/food		
	Vegetable or vegetable product, Leafy vegetables, cooked by moist heat	Starchy root or potato, cooked by moist heat	Rice or other grain, whole, cooked by moist heat
Minerals			
K	78	88	90
Ca	97	97	100
Mg	83	95	100
P	95	96	98
Fe	85	96	100
Cu	98	95	100
Zn	88	95	98
Vitamins			
VITA	90	93	93
CAROT	90	93	93
VITE	100	100	100
VITB1	78	84	63
VITB2	83	93	88
NIA	80	87	85
VITB6	80	83	65
FOL	60	65	75
VIT C	52	79	70

Source: Vásquez-Caicedo AL, Bell S, Hartmann BM. 2008. Report on collection of rules on use of recipe calculation procedures including the use of yield and retention factors for imputing nutrient values for composite foods, EuroFIR Network of Excellence.

3.0 DATA QUALITY

The figures presented in the database were derived from secondary literature, including food composition databases, scientific articles, books and reports. The literature source where the nutrient values were obtained is indicated at food level with the BiblioID code. The full reference is presented under the Bibliography. Much of the food composition data, particularly vitamins and minerals of underutilized or indigenous species, were either not available in the literature, obsolete or not of good quality. The objective was to include data primarily from sub-Saharan Africa. However, where good quality data was not available, the figures utilized were from outside Africa. The database is a work in progress, and it is hoped that in future, more analytical, good quality data will be included.

Quality checks were conducted at each database level, and the “FAO/INFOODS Guidelines for Checking Food Composition Data prior to Publication of a User Table/ Database – Version 1.0.” was applied.

3.1 Value Documentation and Statistics

The foods represent arithmetic mean values of the collected compositional data derived from different sources. In addition to the arithmetic mean, the minimum value (min), the maximum value (max), the standard deviation (SD) and the number of data points (n), are presented in cases where adequate data were available. The number of data points refers to the number of different data sources and/or the number of data points within one reference. No weighted mean was calculated due to lack of data.

3.2 Formats

The data are available in the online database: www.worldagroforestry.org/products/nutrition/ and can be downloaded as an Excel file on the same page.

The Excel database contains five datasheets:

1. **Information:** Includes a general introduction of the database
2. **UserDB:** Food composition data for proximates, minerals and vitamins, including statistics (mean, min, max and n) per component. All data are expressed per 100 g EP on fresh weight basis
3. **UserDB_abbr:** Food composition data for proximates, minerals and vitamins. No statistics included. All data are expressed per 100 g EP on fresh weight basis
4. **Scoring:** Instead of actual numbers, scores are presented, for whether the respective food is a high source, a source, present but low source or no source, or whether no information was available
5. **Bibliography:** All references, including their biblioID for cross-checking among the other datasheets are included

4.0 SCORES

To simplify the nutrient content information, scores have been calculated for all foods: “high source”, “source”, “present, but low source”, or “not a source” of the selected micronutrients iron, vitamin A, folate and vitamin C.

4.1 Explanation of Scores

The thresholds for “high source” and “source” are based on FAO/WHO (2007): Codex Alimentarius Commission, Food Labelling. Fifth edition. Rome. Recommended nutrient intakes (RNI) used in the calculation of the scores are based on FAO, WHO (2004): Vitamin and mineral requirements in human nutrition: report of a joint FAO/WHO expert consultation. Second edition. WHO, FAO.

Table 5: **Explanation of scores: minerals and vitamins (except vitamin C)**

+++	++	~		
high source	source	present, but low source	not a source	no data available
≥ 30 % of RNI	15-29% of RNI	5-14% of RNI	< 5 %	ND (no data available)
FAO/WHO (2007)	FAO/WHO (2007)	own adaptation	own adaptation	own adaptation

Table 6: **Explanation of scores: Vitamin C**

+++	++	~		
high source	source	present, but low source	not a source	no data available
≥ 100 % of RNI	40-99% of RNI	10-39% of RNI	< 10%	ND (no data available)
own adaptation	own adaptation	own adaptation	own adaptation	own wadaptation

4.2 Recommended Nutrient Intake

Values for recommended nutrient intakes (RNI) for iron, vitamin A (retinol equivalent), folate and vitamin C were adopted from FAO, WHO (2004): Vitamin and mineral requirements in human nutrition: report of a joint FAO/WHO expert consultation. Second edition. WHO, FAO. Average values for females and males were calculated and applied to the Scoring.

Table 7: **Overview of recommended nutrient intakes for selected groups and components**

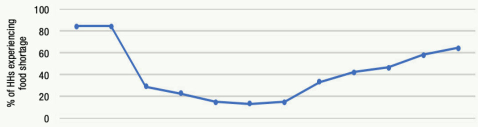
Component	RNI	Group
Iron[2]	9.1 mg/d	Males (18+ years)
	19.6 mg/d	Females (18+ years)
	14 mg/d	Average males, females (18+ years)

[2] Iron: RNI for dietary bioavailability of 15%

Component	RNI	Group
Vitamin A[3] (retinol equivalent = retinol + 1/6 beta-carotene + 1/12 alpha-carotene + 1/12 beta-cryptoxanthin	500 mcg/d	Females (19-65 years)
	600 mcg/d	Females, males (65+ years)
	600 mcg/d	Males (19-65 years)
	575 mcg/d	**Average males, females (19-65+ years)**
Folate [4](dietary folate equivalents = mcg of food folate + (1.7x mcg of synthetic folic acid)	**400 mcg/d**	**Adults (19-65 years)**
Vitamin C	**45 mg/d**	**Adults (19-65 years)**

4.3 Example of a Portfolio

The scores are primarily used for ICRAF's Food Tree and Crop Portfolios to highlight the micronutrient supply of various food tree and crop species (see Figure 2).



	Months of food insecurity																	
	Common Name	Food part used, preparation	Scientific Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Iron (mg)	Vitamin A* (mcg)	Folate (mcg)	Vitamin C (mg)
Fruits	Bananas	Bananas/Plantains, yellow, raw	*Musa x paradisiaca* **2, *3														++	~	++
	Bananas	Bananas/Plantains, green, raw	*Musa x paradisiaca* **2, *3													~		~	++
	Loquats	Loquat, pulp, raw	*Eriobotrya japonica*														+++		
	Avocado	Avocado pulp, raw	*Persea americana* **1													~		~	~
	ThornMelon	Thorn melon/Kiwano fruit, raw	*Cucumis metuliferus* *2													~			
	Oranges	Orange, raw	*Citrus sinensis* **1															~	+++
	Purple Passion	Passion fruit, purple, raw	*Passiflora edulis* *1													~	++		++
	Tree Tomatoes	Tamarillo, raw	*Solanum betaceum*														++		++
	Guava	Guava, pulp, raw	*Psidium guajava*													~	~		+++
	Lemon	Lemons, raw	*Citrus limon*																+++
	Bush plum	Karonda fruit, raw	*Carissa spinarum* **3													++			+++
	Mulberry	Mulberry, raw	*Morus alba*													~	++		~
	Wild berry		*Rhus natalensis/vulgaris*																
	Annona	Custard apple, raw	*Annona reticulata*													~			++
Vegetables	Stinging nettle		*Urtica mqassaica*																
	Pumpkin leaves	Pumpkin, leaves, boiled	*Cucurbita maxima*													++	++	~	
	Cabbages	Cabbage, boiled	*Brassica oleracea*															~	++
	Amaranths	Amaranth leaves, boiled	*Amaranthus caudatus*													+++	+++	~	++
	Black night shade	Black night shade, leaves, raw	*Solanum nigrum*													+++	+++		~
Pulses	Beans	Bean, mature, whole, water–soaked, boiled	*Phaseolus vulgaris* **2, *2													~		++	
	Cowpeas	Cowpea, mature, whole, water–soaked, boiled	*Vigna unguiculata*													~		++	
	Dolichos	Hyacinth bean, mature, whole, water–soaked, boiled	*Lablab purpureus*													~			
	Peas	Pea, mature, whole, boiled	*Pisum sativum* *1													~		~	
Staples	Cassava	Cassava, tuber, boiled	*Manihot esculeta*													~			++
	Maize	Maize, sweet, yellow, boiled	*Zea mays* **1													~	~		
	Potatoes	Potato, boiled	*Solanum tuberosum* **3, *3													~			~
	Pumpkins	Pumpkin, boiled	*Cucurbita maxima*													~	++		
	Millet	Pear millet, whole grain boiled	*Pennisetum glaucum*													++			

*1, *2, *3 = Most consumed ; **1, **2, **3 = Most sold for income generation

* Vitamin A (calculations based on Vitamin A retinol equivalent = retinol + 1/6 beta–carotene + 1/12 alpha–carotene + 1/12 beta–cryptoxanthin), Data are expressed per 100 g fresh weight of edible portion

	no data available
+++	high source
++	source
~	present, but low
	no source

Figure 2: **An example of a Food Tree and Crop Portfolio for Ngobit, Laikipia County, Kenya.** This portfolio provides a recommendation for a diversity of socio-ecologically suitable indigenous/underutilized and exotic food trees and crops (vegetables, pulses and staples) that can be cultivated for addressing year-round food harvest and providing key micronutrients (Iron, Folate, Vitamins A and C) in local diets. [Green shading indicates months of available harvest] World Agroforestry/ Food Trees Project.

[3] Vitamin A, retinol equivalent: Data presented are referring to recommended safe intake, because of insufficient evidence to set RNI.

[4] Folate: Synthetic folic acid - was estimated zero for all foods in the present database

Table 8: **Overview of selected nutrients, their functions and tree food sources**

Nutrient	Functions in the human body	Tree food source
Iron	• Consists of heam iron (source meat) and non-heam iron (source plant foods) • Serves as oxygen carrier in the red blood cells • Iron is an integral part of important enzyme systems in various tissues • Iron deficiency can have a negative impact on growth and cognitive development in children, with lifelong implications • Infants, children, adolescents, and women of childbearing age, especially pregnant women, are most at risk for iron deficiency	• Green leafy vegetables, nuts and pulses are rich sources of non-heam iron • The absorption of non-heam iron is lower than heam iron, but can be enhanced by vitamin C, while phytate, calcium and iron-binding phenolic compounds in tea and coffee act as iron inhibitors
Vitamin A	• Vitamin A activity consists of retinol and the vitamin A-active carotenoids, beta-carotene (highest activity), alpha-carotene and beta-cryptoxanthin, which are converted to vitamin A in the body • Is crucial for the visual circle • Plays an important role in the maintenance of body tissues • Deficiencies increase the risk of blindness and infectious diseases in children	• Plant foods are sources of carotenoids, while retinol occurs in animal source foods only • Yellow and orange fleshed fruits or dark green leafy vegetables are the best sources of vitamin A[5] in plants, due to their high content of vitamin A-active carotenoids • Vitamin A and its active carotenoids are substantially reduced by cooking processes like sun-drying
Folate	• Is a water-soluble vitamin belonging to the B vitamins • Important for the growth and maintenance of cells and tissues • Important for foetal development • Pregnant and lactating women have an increased folate requirement	• Dark green leafy vegetables, pulses and some fruits are high sources of folate • Stability of the water-soluble vitamin is greatly reduced when heated; prolonged cooking reduces the quantity in food
Vitamin C	• Vitamin C is an antioxidant, thus reduces the harmful actions of free radicals • It increases absorption of non-haem iron from plant foods in the body	• Fresh fruits and vegetables, particularly green leafy vegetables, are the best sources • Vitamin C is reduced during storage and destroyed by heat, e.g., by prolonged cooking

[5] Vitamin A expressed as retinol equivalent (= retinol + 1/6 beta-carotene + 1/12 alpha-carotene + 1/12 beta-cryptoxanthin)

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6.0 ANNEXES: OVERVIEW OF FOOD GROUPS, SPECIES AND FOOD ITEMS INCLUDED

6.1 Fruits

Fruits are, in addition to vegetables, pulses, nuts and whole grains, at the centre of a healthy diet. They have a high nutrient density (minerals and vitamins) and low energy content. Vitamin C is the main nutritive component in most fruit species. Some fruits like mangoes, guava and pawpaw are also excellent sources of beta-carotene, and hence vitamin A.

Scientific name	Food items included
Fruits	
Adansonia digitata	Baobab fruit, pulp, raw
Anacardium occidentale	Cashew apple, raw
Annona cherimola	Cherimoya, pulp, raw
Annona muricata	Soursop, fruit pulp, raw
Annona reticulata	Custard apple, raw
Annona senegalensis	African custard apple/wild soursop, pulp, raw
Annona squamosa	Sugar apple, pulp, raw
Artocarpus heterophyllus	Jackfruit, pulp, raw
Artocarpus atilis	Breadfruit pulp, raw
Azanza garckeana	Azanza, pulp, ripe,raw
Balanites aegyptiaca	Desert date, fresh, raw
Balanites aegyptiaca	Desert date, dried, raw
Berchemia discolor	Bird cherry, raw
Borassus aethiopum	Borassus, pulp, raw
Canarium schweinfurthii	Black olive, raw
Carica papaya	Papaya, pulp, raw
Carissa spp. (Carissa spinarum/Carissa carandas)	Karonda fruit, raw
Casimiroa edulis	White sapote, fruit, raw
Citrus aurantium	Orange, sour
Citrus latifolia	Limes, raw
Citrus lemon	Lemons, raw
Citrus paradisi	Grapefruit (pink, red), raw
Citrus reticulata	Tangerines, pulp, raw
Citrus sinensis	Orange, raw
Cordia sinensis	Grey-leaved saucer berry, pulp, raw
Cucumis metuliferus	Kiwano fruit, raw

Scientific name	Food items included
Fruits	
Dacryodes edulis	Bushbutter/African pear pulp, ripe, raw
Dialium sp.	Fruit, dried, raw
Diospyros kaki	Japanese persimmon, pulp, raw
Diospyros mespiliformis	African ebony, fruit, raw
Dovyalis caffra	Kei apple, pulp, raw
Eriobotrya japonica	Loquat, pulp, raw
Eugenia jambos/Syzygium jambos	Rose apple, raw
Ficus sycomorus	Sycamore fig, raw
Flacourtia indica	Indian plum, pulp, ripe, raw
Garcinia kola	Garcinia, fruit pulp, raw
Garcinia livingstonei	African mangosteen, raw
Grewia spp/Grewia villosa	Mallow raisin, raw
Hyphaene compressa	Doum palm, pulp, raw
Litchi chinensis	Litchi, pulp, raw
Mangifera indica	Mango, pulp, raw
Manilkara zapota	Sapodilla, pulp, raw
Morus alba	Mulberry, raw
Musa spp.	Banana, raw
Opuntia ficus-indica	Prickly pear, pulp, raw
Pappea capensis	Jacket plum, pulp, raw
Parinari curatellifolia	Mobola plum, raw
Passiflora edulis	Passion fruit, purple, pulp, raw
Persea americana	Avocado pulp, raw
Phoenix dactylifera	Dates, pulp and skin, dried, raw
Phoenix reclinata	African wild date plum, raw
Pithecellobium dulce	Manila-tamarind, fruit, raw

Scientific name	Food items included
Fruits	
Psidium guajava	Guava, pulp, raw
Punica granatum	Pomegranate, raw
Rubus pinnatus	Raspberry, raw
Sclerocarya birrea	Marula, fruit, pulp and skin, raw
Solanum betaceum/ Cyphomandra betacea	Tamarillo, flesh and seeds, raw
Soriendeia madagascariensis	Soriendeia, raw
Strychnos spinosa	Monkey-orange, pulp, raw
Syzygium cumini/Syzygium spp.	Eugenia/Jamun, Java-plum fruit, raw

Scientific name	Food items included
Fruits	
Syzygium guineense	Water berry, raw
Syzygium malaccense	Mountain apple
Tamarindus indica	Tamarind, pulp, ripe, raw
Vangueria infausta	Wild medlar, pulp, raw
Vitellaria paradoxa	Shea fruit pulp, raw
Vitex doniana	Black plum, pulp, raw
Ximenia americana	Wild plum, raw
Ziziphus mauritania	Jujube pulp, raw

6.2 Vegetables and Green Leafy Vegetables

Vegetables are plants cultivated both as field and garden crops, both in the open and under controlled environments. The food group "vegetables" includes fruits (e.g., pumpkins, tomatoes), leaves, roots (e.g., carrots), stalks (e.g., celery) and legumes, if harvested while still green (e.g., green peas, string beans).

Vegetables constitute an important part of the diet. While low in energy, they do provide many key nutrients like vitamins and minerals. A special sub-group within the vegetables is "green leafy vegetables". These are key sources of micronutrients including vitamins and vitamin-active components like beta-carotene (vitamin A-active component), folate, vitamin C and minerals such as iron. Dark green leaves contain far more of these nutrients than the pale green leaves or other vegetables. For example, both amaranth and pumpkin leaves are superior to cabbage.

Scientific name	Food items included (raw)	Food items included (boiled=
Vegetables		
Amaranthus dubius	Wild spinach, leaves, raw	Wild spinach, leaves, boiled
Amaranthus hybridus	Amaranth, spinach, leaves, raw	Amaranth spinach, leaves, boiled
Amaranthus spp.	Amaranth leaves, raw	Amaranth leaves, boiled
Brassica oleracea	Kale, raw	Kale, boiled
Brassica oleracea var. capitata	Cabbage, raw	Cabbage, boiled
Cleome gynandra	Cat´s whiskers, leaves, raw	Cat´s whiskers, leaves, boiled
Cucurbita spp.		Pumpkin, boiled
Cucurbita spp.		Pumpkin, leaves, boiled
Manihot esculenta		Cassava, leaves, boiled
Moringa oleifera	Drumstick leaves, raw	Drumstick leaves, boiled
Moringa oleifera	Drumstick, pods, raw	Drumstick, pods, boiled
Phaseolus coccineus		Beans, runner, boiled
Solanum nigrum	Black nightshade, leaves, raw	
Spinacia oleracea	Spinach, raw	Spinach, boiled
Urtica dioica		Stinging Nettles, blanched
Vigna unguiculata	Cowpea, leaves, raw	Cowpea, leaves, boiled

6.3 Nuts and seeds

Nuts and seeds are nutrient-dense and provide overall unsaturated fatty acids, fibre, minerals, vitamins (vitamin E) and antioxidants. Nuts like cashew nuts included in the database also contain high amounts of protein. Nuts and seeds are also energy-dense foods, but the consumption of nuts is associated with no weight gain and reduced risk of obesity.

Scientific name	Food items included
Nuts and seeds	
Anacardium occidentale	Cashew nut, raw
Arachis hypogea	Groundnuts/peanuts, raw
Cocos nucifera	Coconut, mature, meat/flesh, raw
Cocos nucifera	Coconut, immature kernel, fresh, raw
Macadamia integrifolia	Nuts, macadamia nuts, raw
Sesamum indicum	Seeds, sesame seeds, whole, dried

6.4 Pulses

Pulses are plant foods from the Leguminosae family. They are a sub-group of legumes and their edible seeds are consumed by both humans and animals. Pulses are protein-rich and high yielding crops in diverse climatic conditions, particularly in arid and semi-arid areas.

Moreover, they are important in agricultural cropping systems. Due to their ability to produce and fix nitrogen, they increase soil fertility thus enhancing productivity of other crops.

Pulses help to increase soil microbial biomass and activity, which improves soil biodiversity. A high soil biodiversity in turn provides the ecosystem with greater resistance and resilience against disturbances and stress.

Pulses are important from a nutritional point of view. They are rich in protein and contain good quantities of B vitamins and dietary fibre, in addition to carbohydrates. When pulses and cereals are consumed together in one meal, they provide an optimal amino acid mixture. In addition, when combined with foods rich in vitamin C, like green leafy vegetables or fruits, the iron of pulses can be better absorbed.

Scientific name	Food items included (raw)	Food items included (boiled)
Pulses		
Cajanus cajan	Pigeon pea, mature, whole, dried, raw	Pigeon pea, mature, whole, water-soaked, boiled
Lablab purpureus	Hyacinth bean, mature, whole, raw	Hyacinth bean, mature, whole, water-soaked, boiled
Phaseolus vulgaris	Common bean, mature, whole, dried, raw	Common bean, mature, whole, water-soaked, boiled
Pisum sativum		Pea, mature, whole, boiled
Vigna radiata	Mung bean, mature, whole, dried, raw	Mung bean, mature, whole, water-soaked, boiled
Vigna unguiculata	Cowpea, mature, whole, dried, raw	Cowpea, mature, whole, water-soaked, boiled

6.5 Starchy Roots and Tubers

Cassava, sweet potato and yams are examples of the food group starchy roots and tubers. Just like cereals, they provide large quantities of carbohydrates (primarily starch) and energy, but their protein and dietary fibre content is generally low. These foods contain on average lower quantities of minerals than whole cereal grains. However, some species like orange-flesh sweet potatoes are a good source of vitamin A-active beta-carotene.

Scientific name	Food items included (raw)	Food items included (boiled)
Starchy roots and tubers		
Dioscorea alata		Water yam, tuber, boiled
Ipomea batatas		Sweet potato, yellow, boiled
Ipomea batatas	Sweet potato, deep yellow, raw	Sweet potato, deep yellow, boiled
Manihot esculenta		Cassava, tuber, boiled
Musa paradisiaca	Plantains, yellow, raw	Plantains, yellow, boiled
Musa paradisiaca	Plantains, green, raw	Plantains, green, boiled
Musa paradisiaca	Plantains, (yellow and green), raw	Plantains, (yellow and green), boiled
Solanum tuberosum		Potato, boiled

6.6 Cereals

Cereal grains including maize, millet, sorghum, rice, barley and wheat are characterized as carbohydrates and suppliers of energy in the human diet. Depending on the type of cereal grain (species) and its processing, their micronutrient values vary greatly. While whole grains (as well as the fibrous layers) are sources of micronutrients, including iron, zinc, B vitamins and dietary fibre, refined and polished grains (removal of fibrous layers, e.g., refined maize flour) lack these important nutrients. When cereals and pulses are consumed together in one meal, they provide an optimal amino acid mixture.

Scientific name	Food items included (raw)	Food items included (boiled)
Cereals		
Eleusine coracana	Finger millet, dried, raw	Finger millet, boiled
Oryza sativa		Rice, brown, boiled
Oryza sativa		Rice, white, boiled
Oryza sativa		Rice, white, polished, boiled
Pennisetum glaucum		Pear millet, whole grain boiled
Sorghum bicolor		Sorghum, whole grain, boiled
Zea mays		Maize, sweet, yellow, boiled

GLOSSARY

BiblioID: Unique code indicating the literature source from where the nutrient values were taken. In the bibliography, the full reference of the code is provided

EDIBLE: The edible coefficient (EC) is the percentage weight loss when discarding the inedible weight from a food. 1.00 means the entire food is edible, while for an EC of 0.60 only 60% of the food is edible. (FAO/INFOODS, 2013: E-Learning course on food composition data. FAO, Rome)

Food code: Unique code, assigned to a food item

INFOODS Tagnames: INFOODS Component Identifier. These are unique codes or abbreviations that allow one to clearly define components using only a few characters based on a specific naming system. Its primary use is to determine whether the associated values can be compared or combined. (FAO/INFOODS, 2013: E-Learning course on food composition data. FAO, Rome)

Mean: arithmetic mean

Recommended nutrient intake (RNI): The daily intake which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age and sex-specific population group. Daily intake corresponds to the average over a period of time. (FAO/WHO, 2004).

Retention factor: The measure of the proportion of the nutrient remaining in the cooked food in relation to the nutrient originally present in the raw food (Murphy et al. 1975).

Retinol Activity Equivalent (RAE): The Retinol Activity Equivalent is a unit for expressing vitamin A activity. One mcg of RAE is equivalent to 1 mcg of all-trans-retinol, 12 mcg of all-trans-beta-carotene, or 24 mcg of other provitamin A carotenoids. These RAE conversion factors are based on studies that show that the conversion of provitamin A carotenoids to retinol is only half as great as previously thought.

The Priority Food Tree and Crop Food Composition database contains nutritional information on selected tree foods and crops with geographical focus on sub-Saharan Africa. Food composition data play a key role in linking agriculture to nutrition. Understanding what people eat and which nutrients the consumed foods contain is key to assessing and improving diet quality and health. It is equally important for agriculture, including domestication and breeding programs to select not only high-yielding, but highly nutritious species.

The database was created during the development of the "Food Tree and Crop" portfolios, part of the EC/IFAD-funded Food Tree and Agbiodiversity Projects. The portfolios are combinations of indigenous/underutilized, and exotic food tree and crop species that could potentially provide year-round nutritious diets to address food harvest and nutrient gaps in local diets.

The database not only presents the backbone of the portfolios, but can also be used for dietary assessments, development of training materials, and selection of nutritious species for agricultural domestication and breeding programs. It can be used by NGOs, research institutions or individuals involved in the selection of ecologically-suitable, and nutritionally-rich food trees. This is work in progress and will be updated on a regular basis.

World
Agroforestry

World Agroforestry, United Nations Avenue,
P O Box 30677, GPO 00100 Nairobi, Kenya
Tel: +254(0)20 722 4000, via USA +1 650 833 6645
Email: worldagroforestry@cgiar.org
Website: www.worldagroforestry.org

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