Food and Agriculture Organization of the United Nations

FAO/INFOODS Databases

FAO/INFOODS global food composition database for pulses Version 1.0 - uPulses1.0

User guide

2016 INTERNATIONAL YEAR OF PULSES

FAO/INFOODS global food composition database for pulses. Version 1.0 - uPulses1.0

User guide

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Foreword

Pulses have recently gained more attention. In 2013, the United Nations General Assembly declared 2016 as the International Year of Pulses (IYP) recognizing the importance of pulses for nutrition, health and agriculture. The Food and Agriculture Organization of the United Nations (FAO) was nominated to facilitate the implementation of the IYP in collaboration with Governments, relevant organizations and stakeholders. The IYP aims to increase the awareness on the multiple benefits of pulses for humans and agriculture and thus increase pulse consumption and production.

Most countries face some form of malnutrition, ranging from undernutrition and micronutrient deficiencies to obesity and diet-related diseases (e.g. type II diabetes and certain types of cancer). Diet is an important contributor to both health and disease. Pulses are important food crops and should be part of a healthy diet because they are high in protein, fibre, vitamins, minerals and bioactive compounds while being low in fat.

Even though pulses were part of many traditional diets, pulse consumption has decreased globally often being replaced by animal products. While this might be a positive trend in countries with a low consumption of animal-based foods it can intensify some malnutrition and health problems in developed countries where animal-based foods are already highly consumed. Pulses however remain an important part of the diets of vegetarians in all countries. In some developed countries, the increased awareness of the environmental and health impact of diets has led to a revival of the interest for pulses. Therefore, raising awareness of the contribution of pulses to food security and nutrition can help countries to improve human health.

Food composition data for pulses are needed not only to estimate their contribution to nutrient intakes and diet formulations, but also provide background information on the content of pulses that can be taken into consideration to develop, food-based dietary guidelines or food labelling information. Furthermore, accurate information on the nutrient content of locally available foods are needed for the formulation of complementary foods, development of school meals and for nutrition information.

In many national or regional food composition tables or databases (FCT/FCDB) pulses are poorly covered and in the international scientific literature reliable compositional data on vitamins and minerals contents of pulses are lacking. A comprehensive database on the composition of pulses was therefore considered important by the International Steering Committee of the IYP. FAO was given the tasks to develop the FAO/INFOODS Global Food Composition Database for Pulses.

This first edition of the FAO/INFOODS User Database for Pulses (uPulses) is one of the legacies of the IYP. The database provides high quality data on the nutrient composition of pulses from a wide variety of species (16 pulse varieties). This database can be used to disseminate nutritional information about pulses to promote its production and consumption and hopefully boost policies and programmes on research and breeding of pulses. Their effectiveness would be enhanced if new analytical data on micronutrient content would be generated and included in uPulses.

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Preface

The International Year of Pulses (IYP) was implemented throughout 2016 and was indeed a very successful year with many activities and media attention worldwide. The main objective of the IYP is to raise awareness of the contribution of pulses to food security, nutrition and health, while contributing to the sustainable management of soils. Pulses have been staple foods for many civilizations for centuries and still are an integral part of the culinary culture. In some parts of the world pulses have a stigma of being a 'poor person's food' and are replaced by meat once people can afford it. Despite all the traditions and actual scientific knowledge, consumers often are unaware of their nutritional and health benefits, therefore greatly undervalue them and do not integrate them into their meal plans. It is well established that pulses are important food crops and offer significant nutritional and health advantages due to their high protein and essential amino acid content as well as being a source of complex carbohydrates, fibre, vitamins and minerals. Additionally, they are environmental-friendly foods as they have a low carbon and water footprint.

Most of the key messages of the IYP are founded on the knowledge of their nutritional composition:

- Pulses are highly nutritious
- Pulses are economically accessible and contribute to food security at all levels
- Pulses have important health benefits
- Pulses foster sustainable agriculture and contribute to climate change mitigation and adaptation
- Pulses promote biodiversity

In order to promote pulses, accurate data on their composition are of the essence. Therefore, the International Steering Committee decided in 2015, before the Year was officially launched, to develop a food composition database on pulses. The FAO/INFOODS User Database for Pulses (uPulses), in which data are expressed per 100 g edible portion on fresh weight basis, as well as the FAO/INFOODS Database for Pulses on Dry Matter Basis (PulsesDM) will remain as important legacies of the IYP and will be the basis to continue promoting pulses for nutrition, food security and agriculture.

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Abbreviations

Abbreviation	Description
AA	amino acid
av.	average
a	analytical
Ar	analytical and from reference data set
aRF	apparent nutrient retention factor
c.	calculated
DP	decimal place
DW	dry weight basis
EP	edible portion on fresh weight basis
EPD	edible portion on dry matter basis
e	estimated
FA	fatty acid
FAO	Food and Agriculture Organization of the United Nations
FCDB	food composition database
FCT	food composition table
FW	fresh weight basis
g	gram
INFOODS	International Network of Food Data Systems
IP	inositol phosphate
IP6	inositol hexaphosphate
mg	milligram
N	nitrogen
r	from reference data set
PA	phytic acid
RF	nutrient retention factor
sig.	significant
tr	trace
uPulses	FAO/INFOODS Global Food Composition Database for Pulses
µg	microgram
YF	weight yield factor
XFA	fatty acid conversion factor
z	estimated zero

1. INTRODUCTION

Background

Pulses are part of the legume family, and are defined as annual leguminous crops yielding between 1 and 12 grains or seeds of variable size, shape and color within a pod, used for both food and feed. The term “pulses” is limited to crops harvested solely for dry grain, thereby excluding crops harvested green for food, which are classified as vegetable crops, as well as those crops used mainly for oil extraction and leguminous crops that are used exclusively for sowing purposes.

Data regarding the nutrient composition of pulses are scarce in food composition tables and databases (FCT/FCDB). Even though many national FCT/FCDB in different countries cover pulses to a certain extend (FAO, 2016) analytical data on the nutrient composition of pulses are lacking in the published international literature for vitamins, minerals and amino acids. In addition, often the food description is very generic, and the coverage of foods emphasizes on major consumed species, while neglecting the minor species. All these factors contribute to limitations of data use as well as imprecisions of nutrient intake estimations through pulses consumption.

The FAO/INFOODS Global Food Composition Database for Pulses Version 1.0 (uPulses1.0) was developed with the aim to provide a complete nutrient profile for different species as a tool to promote pulses consumption and advice member states on breeding programmes on pulses for higher nutrient contents of these crops as well as on agriculture projects, programmes and policies. This database will thus contribute in the promotion of pulses and in identifying solutions to nutrition, health, trade and environmental sustainability issues as well as strengthened national, regional and local capacities to formulate and implement programmes and policies on pulses.

Objectives and principles

The objectives of the FAO/INFOODS Global Food Composition Database for Pulses are:

- To provide, at a global level, nutrient data (energy, macronutrients, main minerals and vitamins, amino acids, fatty acids classes and phytate) for various pulse species, covering different varieties and/or origins of production;
- To report compositional data with a comprehensive documentation following international standards and guidelines;
- To allow compilers to include relevant nutritional values for pulses into their national or regional FCT/FCDB;
- To increase the quality and precision of nutrient intake estimations taking variations in the composition of pulses into account;
- To raise awareness of the contribution of pulses to food security and nutrition due to their health and nutritional benefits; and
- To identify knowledge gaps in terms of missing compositional data.

In order to achieve these objectives, the following principles were applied:

- Compile complete nutrient data sets of pulses by reporting as few missing data as possible;
- Represent the mean composition of pulses based on available analytical data; only if no or very few analytical data are found, non-analytical data from published FCT/FCDB are to be used;
- As much as available data allow, portray intra-species variation of nutrient values due to:
  - variety;
  - origin (country of production); or
  - edible part (e.g. whole seed or split, as split indicates the pulse has had its seed coat removed).
- Describe foods as precisely as the original data permit using the scientific name as the reference point to correctly identify the different species;
- Be as close as possible to the exact species when estimating values or borrowing data;
- Evaluate, standardize, compile and document data according to international standards. For uPulses, the following FAO/INFOODS tools were used:
  - Guidelines for Checking Food Composition Data prior to Publication of a User Table/Database - Version 1.0 (FAO/INFOODS, 2012a)
  - Guidelines for Converting Units, Denominators and Expressions - Version 1.0 (FAO/INFOODS, 2012b)
  - Guidelines for Food Matching - Version 1.2 (FAO/INFOODS, 2012c)
  - INFOODS food component identifiers, called tagnames (FAO/INFOODS, 2014)
  - INFOODS Compilation Tool - Version 1.2.1 (FAO/INFOODS, 2011)

In 2015, FAO/INFOODS started an extensive literature research on the nutrient composition of pulses. The data search was performed in the Scopus database using common and scientific names for each pulse species associated with some key words.

Data from this literature search were evaluated, compiled and standardized. All compiled data were included in two FAO/INFOODS databases: the FAO/INFOODS Food Composition Database for Biodiversity (FAO, forthcoming) and the FAO/INFOODS Analytical Food Composition Database (FAO, forthcoming). Both databases represent a repository of solely analytical data found in the published and unpublished literature. These data were the basis for uPulses, being complemented with further analytical datasets obtained through the INFOODS listserv as well as compiled national food composition tables and databases. This step was necessary as most data from the scientific literature reported limited data on vitamins.

The objectives of uPulses suggest the development of a database with representative compositional data on a global, regional, or national level. It needs, however, to be recognized that uPulses can only represent available data of a certain quality, rather than “truly representative” compositional states of the foods presented – especially when considering that data availability per species varied significantly for the different factors affecting the nutrient composition (see *8.* QUALITY CONSIDERATIONS). Due to the lack of data, uPulses cannot represent the existing biodiversity of pulses. Out of the 23 pulse species investigated, only 16 species could be included in uPulses due to the lack of analytical and/or secondary data. Further generation and compilation of analytical data on pulses is therefore necessary to provide a complete picture on the composition of pulses, not only at the species but also at the variety level.

Outputs

This User Guide provides an explanation of the foods and component definitions included in uPulses as well as the data compilation methodology. The output of uPulses include one dataset per 100 g edible portion on fresh weight basis (EP) with or without additional statistics. An additional database per 100 g edible portion on dry matter basis (EPD) called the FAO/INFOODS Database for Pulses on Dry Matter Basis (PulsesDM) will be published in 2017 based on the average values presented in uPulses.

The Excel file holding the actual compositional data is available at the INFOODS website http://www.fao.org/infoods/infoods/tables-and-databases/faoinfoods-databases/en/.

In order to provide an overview of data published in reference datasets, nutrient data from selected national FCT/FCDB (Australia, Denmark, Thailand, United Kingdom, and USA) were added to uPulses (see also 9. REFERENCE DATASETS).

2. SELECTION OF SPECIES

Pulses were selected for the data collection according to the FAO classification (1994), however only those with sufficient data of sound quality were included in uPulses. The list of vernacular and scientific names for the 16 species of pulses included in uPulses1.0 is presented both in the Table A1.1. (ANNEX 1) of this guide and in the worksheet '02 List of species' in the Excel file.

3. FOOD ENTRIES INCLUDED

The uPulses database contains a total of 16 species of pulses, for which at least one food entry is presented. In total, uPulses holds 177 food entries: 61 food entries for raw pulses and 116 food entries for cooked pulses.

Food Item ID This code consists of three letters and three digits and is unique for each food.
For example, PHV001:

- The three letters refer to the code used to identify the pulse species (e.g. PHV stands for *Phaseolus vulgaris*).
- The latter three digits give a serial number within the pulse species.

Food names The most recognizable and descriptive food name was chosen for the referenced food, with the English name, a detailed description of its edible portion (whole/split), and its state (raw/cooked). Wherever possible, the name further includes information on origin and varieties.

4. COMPONENTS

Definition and expression of nutrients

In the main datasheets in the Excel file, all component values are given per 100 g edible portion on fresh weight basis (EP). One additional datasheet includes data in table format for amino acids expressed per g nitrogen.

The values reported are mean values derived from several food records with the same/similar food description that have been entered in the archival datasheet (unpublished). Nutrient values are presented in the following datasheets (see also 10. STRUCTURE OF uPulses):

Main datasheets	
04 NV_sum per 100 g EP	Compositional data for proximates, minerals, vitamins, amino acids, fatty acids classes and phytate expressed per 100 g EP on fresh weight basis, **without** statistics or value documentation per component.
05 NV_stat per 100 g EP	Compositional data for proximates, minerals, vitamins, amino acids, fatty acids classes and phytate expressed per 100 g EP on fresh weight basis, **with** statistics and value documentation per component.
Additional datasheet	
06 tbl_AA (per g N)	Compositional data for amino acids expressed per g nitrogen, with statistics and value documentation per component.

Note that values per component are presented with significant digits and decimal places as outlined by Greenfield & Southgate (2003).

Table A2.1. and Table A2.2. (ANNEX 2) list the components with their INFOODS component identifiers, units, denominators and number of significant digits.

Proximates and related compounds/ factors

Energy The metabolizable energy values of all foods are presented in both kilojoules (kJ) and kilocalories (kcal). These are calculated based on protein, fat, available carbohydrates, fibre and alcohol by applying the energy conversion factors as given in Table 1. For pulses alcohol was assumed zero for all entries since fermented foods are not presented in the first version of uPulses

Table 1. Metabolizable energy conversion factors. General Atwater factors (FAO, 2003)

Component	kJ/g	Kcal/g
Protein	17	4
Fat	37	9
Available carbohydrates	17	4
Dietary fibre	8	2
Alcohol[1]	29	7

[1] The alcohol content for all foods in the datasheets is assumed zero.

Equation 1. *Energy (kJ/100 g EP) = total protein (g/100 g EP) x 17 + total fat (g/100 g EP) x 37 + available carbohydrates (g/100 g EP) x 17 + dietary fibre (g/100 g EP) x 8 + alcohol (g/100 g EP) x 29*

Equation 2. *Energy (kcal/100 g EP) = total protein (g/100 g EP) x 4 + total fat (g/100 g EP) x 9 + available carbohydrates (g/100 g EP) x 4 + dietary fibre (g/100 g EP) x 2 + alcohol (g/100 g EP) x 7*

Water Water is measured as the loss of weight after drying the food sample to constant weight. Values may derive from different drying methods used.

Nitrogen, total and protein, total The main analytical method used to determine total nitrogen is the Kjeldahl method. The protein content is then estimated from the total amount of nitrogen in the food sample. For most foods including pulses the nitrogen content of protein by weight is 16 %, thus the following equation is applied:

Equation 3. *Total protein (g/100 g EP) = total nitrogen (g/100 g EP) x 6.25*

In uPulses, total protein values originally published were reconverted applying 6.25 to nitrogen values[1]. Thus, statistical information is given on the nitrogen values, while total protein is calculated within the datasheet.

Pulses also contain non-protein nitrogen. However, no further investigations on the proportion of non-protein nitrogen in the various species presented was carried out and could therefore not be taken into account. This may lead to an overestimation of the total protein value.

Fat, crude The fat value refers to total lipid including triglycerides, phospholipids, sterols and related compounds. Almost all available data for fat in pulses was analyzed using the classic method based on continuous extraction (e.g. Soxhlet method). Therefore, values presented in the datasheets where mainly determined by continuous extractions even though it may result in incomplete lipid extractions underestimating the fat content. Data referring to preferred analytical methods using mixed solvent extraction or Capillary Gas Cromatography were included in the mean values whenever available and an asterisk (*) is added in the value documentation. Values referring to unknown method were also marked with an asterisk when included in the calculations.

Carbohydrates, available In uPulses, the content of available carbohydrates is estimated by:

Equation 4: *Available carbohydrates by difference (g/100 g EP) = 100 - water (g/100 g EP) - total fat (g/100 g EP) - total protein (g/100 g EP) - total dietary fibre (g/100 g EP) - ash (g/100 g EP).*

Fibre, total dietary The content of dietary fibre was analyzed by the AOAC Prosky method. This is a mixture of non- starch polysaccharides, lignin, resistant starch and resistant oligosaccharides. No data using the most recent official method (AOAC 2011.25) was found in the literature therefore could not be compiled.

Ash The ash content of foods is determined by gravimetric methods.

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[1] Values assigned the tagname <PROT-, total protein with method of determination unknown or variable> are included to calculate values for total nitrogen, assuming that Kjeldahl or similar methods were originally applied to determine total nitrogen.

Minerals

The following minerals are included in the datasheets: calcium, copper, iron, magnesium, phosphorus, potassium, sodium and zinc. Several determination methods were reported by the sources, including atomic absorption spectrometry (AAS), inductively coupled plasma (ICP), ICP-mass spectrometry, and colorimetric methods.

Fat-soluble vitamins

Vitamin A Vitamin A is comprised of multiple active compounds, each of them with different biological activity. Retinol is the most bioactive form and is normally only present in animal source foods therefore it is assumed as zero for all the food entries in uPulses. In the datasheets, vitamin A is presented both as Retinol Equivalent (RE) and Retinol Activity Equivalent (RAE), calculated according to the following equations:

> ***Equation 5.*** *Total vitamin A activity expressed as Retinol Equivalent (RE) (mcg/100 g EP) = mcg retinol + 1/6 mcg β- carotene + 1/12 mcg α-carotene + 1/12 mcg β-cryptoxanthin*

> ***Equation 6.*** *Total vitamin A activity expressed as Retinol Activity Equivalent (RAE) (mcg/100 g EP) = mcg retinol + 1/12 mcg β- carotene + 1/24 mcg α-carotene + 1/24 mcg β-cryptoxanthin*

Vitamin E Vitamin E occurs in several active forms such α-tocopherol, β-tocopherol, γ-tocopherol, and δ-tocopherol, and tocotrienols. Only α-Tocopherol values are given in the datasheets. The less active forms were not taken into consideration because few data for pulses were reported. Values referring to unknown method or expression are indicated by an asterisk (*) in the value documentation.

Water-soluble vitamins

Thiamin Values are expressed as thiamin only.

Riboflavin Sources reported microbiological, fluorimetry and HPLC methods for the determination of riboflavin.

Niacin The values for niacin are for preformed niacin only (NIA).

Niacin equivalents Niacin equivalents include the niacin contributed by tryptophan (a niacin precursor) and refer to the potential niacin value; that is the sum of preformed niacin and the amount which could be derived from tryptophan. The mean value of 60 mg tryptophan is considered equivalent to 1 mg niacin (U.S. Department of Agriculture, 2015), i.e.:

> ***Equation 7.*** *Niacin equivalents (mg/100 g EP) = niacin (mg/100 g EP) + tryptophan (mg/100 g EP) / 60*

Vitamin B_6 Vitamin B_6 consists of pyridoxine, pyridoxal and pyridoxamine and their phosphates. Values given in the datasheets were determined by HPLC, while values derived by other methods such as the microbiological assay or unknown method are indicated by an asterisk (*) in the value documentation.

Folate, total The values refer to total folate determined by microbiological assay in which bound folate is released by enzymatic treatment. Values referring to unknown method, other analytical methods (e.g. HPLC) or expressions are indicated by an asterisk (*) in the value documentation.

Vitamin B_{12} Vitamin B_{12} is found intrinsically in foods of animal origin therefore it is assumed as zero for all the food entries.

Vitamin C Values for vitamin C include both L-ascorbic acid and L-dehydroascorbic acid. Where both values were available, they are presented in the datasheets. Where only ascorbic acid data was available, the values are marked by an asterisk (*) in the value documentation.

Fat-related compounds

Cholesterol The content of cholesterol is assumed as zero for all the food entries since it is not present in plant foods.

Total fatty acids Total fat consists of triglycerides, phospholipids and unsaponifiable matter. In order to estimate the amount of total fatty acids in the lipid, a fatty acid conversion factor (XFA) is applied:

Equation 8. *Total fatty acids (g/100 g EP) = total fat (g/100 g EP) x XFA (g/g)*

The XFA used in uPulses is equal to 0.775 (U.S. Department of Agriculture, 1988)

Fatty acids classes Fatty acids (FA) classes for saturated, monounsaturated and polyunsaturated fatty acids are given per food, presented per 100 g EP. Table A2.1. (ANNEX 2) lists the fatty acids classes reported with their INFOODS component identifier, units and denominators.

For uPulses, all collected fatty acid data reported differently than as *g/100 g total fatty acids* (in this document also referred to as fatty acid profile) were converted to this expression. All fatty acid profiles were evaluated and aggregated, resulting in a mean value for each fatty acid fraction per food entry. Generally, values of individual fatty acids were available from fewer sources than total lipid values.

The mean value for each fatty acid class per 100g edible portion was calculated with data expressed as g/100 g total FA. This method allowed a better evaluation of data on a common basis and explains why value documentation per class are indicated as *calculated (c)* in the documentation.

Amino acids

The amino acid (AA) content is given for 18 amino acids for each food, presented both per 100 g EP and per g nitrogen. Table A2.2. (ANNEX 2) lists the amino acids with their INFOODS component identifier, units and denominators.

Usually amino acids are extracted in three groups—tryptophan, sulfur-containing amino acids (methionine and cystine) and all others. Tryptophan is determined by alkaline hydrolysis/HPLC, methionine and cystine by performic oxidation/HPLC and all others by acid hydrolysis/HPLC.

For uPulses, all collected amino acid data were converted to mg/g nitrogen (also referred to as amino acid profile in this document) as a common expression; these data were evaluated and aggregated, resulting in mean amino acid profiles for each food. The amino acid profiles and the total nitrogen content were then used to express the levels of individual amino acids per 100 g EP, applying the following formula:

> ***Equation 9.*** Amino acid (mg/100 g EP) = amino acid (mg/g total nitrogen) x total nitrogen (g/100 g EP)

This method of compilation allowed a better comparison of the amino acid data on a common basis and explains the reason that value documentation per component and summary statistics are provided for the amino acids profiles per g nitrogen, while those expressed per 100 g EP are indicated as *calculated (c)* in the documentation.

In the case of missing amino acid data for a specific food entry, a more generic AA profile per mg/g nitrogen was used to complete these data gaps. The AA data was always borrowed from within the same species.

Phytate

Phytate or inositol phosphates (IP), are saturated cyclic acids found in many plant tissues being most abundant in pulses and cereals. They are considered the main storage form of phosphorus in plants (Mullaney et al, 2007; Frank, 2013). Phytate presents an antinutritional effect in the human diet since the phosphate groups in phytates can bind mineral cations especially iron, zinc or calcium, but also potassium, magnesium and manganese thus lowering their bioavailability (Thavarajah, 2014). The capacity to bind cations was found to be a function of the number of phosphate groups on the myo-inositol ring. Inositol hexaphosphate (IP6), also considered as phytic acid (PA), is the most abundant inositol phosphate. The complex formed by IP6 with minerals is stronger than the ones with IP5 and IP4 (Michaelsen et al, 2009), thus IP6 is has the highest binding capacity.
Different procedures to analyse phytate are available and as each analytical method results in a significantly different value, new tagnames were required in order to classify the different values in function of the detection method. The previous tagname PHYTAC was considered obsolete and new tagnames (Table 2) were created according to the analytical method used.

Table 2. New tagnames, description and units used for phytate in uPulses

Tagname	Description	Unit
PHYTCPPI	Phytate, determined by indirect preciptation	mg
PHYTCPPD	Phytate, determined by direct preciptation	mg
PHYTCPP	Phytate, calculated from phytate phosphorus by anion exchange method	mg
PHYTC-	Phytate, calculated from phytate phosphorus by an unknown method	mg
IP3	Inositol triphosphate	mg
IP4	Inositol tetraphosphate	mg
IP5	Inositol pentaphosphate	mg
IP6	Inositol hexaphosphate	mg

The content for each IP fraction analysed by HPLC was presented in uPulses when data was available. For some foods entries where it was not possible to give the IP fractions, phytate data determined by other methods were considered and are indicated by an asterisk (*) in the value documentation with the corresponding tagname given under comments. In these cases, preferred tagnames were PHYTCPP or PHYTCPPD. Values for PHYTCPPI were used only when no other data was available.

5. FOOD AGGREGATION AND PRINCIPLES OF IMPUTATION

Generally, foods records with the same description were aggregated, following a 'top-down' approach. This means that in the first instance a generic food is compiled, while further distinct foods were created if data availability was sufficient, considering the following characteristics:

- Variety
- Origin (country of production)
- Edible portion (whole or split)

Example of 'top-down' aggregation, *Phaseolus vulgaris* (common beans):

Level 1 Common bean (all types), seeds, mature, whole, dried, raw
Level 2 Black turtle bean, seeds, mature, whole, dried, raw
Level 2 Kidney bean (all types), seeds, mature, whole, dried, raw
Level 3 Black turtle bean, seeds, mature, whole, dried, raw (Canada)
Level 3 Kidney bean, Red, seeds, mature, whole, dried, raw

Considerations:
- Where appropriate, missing values in the nutrient set of a specific food were estimated from a higher level of aggregation.
- Aggregation of distinct food records is principally based on all compositional data; however, data for vitamins and amino acids were often estimated from the generic food due to limited data availability. Furthermore, distinct food records may have a very similar/the same content of nutrient values due to underlying data used for the aggregation.
- Analytical data from scientific articles and reports was always used in preference to compiled data from food composition tables.
- No weighting factors considering global production or market share data were applied when compiling nutrient values for a food.
- No weighting factors were applied considering the inclusion of reference datasets compared to articles from scientific literature or analytical reports. This was mainly done because information on number of samples was often lacking.

6. COOKED FOODS

Nutrient values of cooked pulses were calculated using yield factors and nutrient retention factors as published by FAO/INFOODS (2013). Two different cooking procedures were applied wherever possible: (1) boiled without salt, drained (seeds); (2) pulse, boiled without salt (total dish). Except for pea and lentil that do not require soaking prior to cooking, all the pulses were considered as water-soaked drained and soaking water discarded and then boiled in fresh water.

Weight yields factors (YF) These factors describe the weight change in foods or mixed dishes due to losses and gains of water and/or fat during cooking. Wherever possible, species-specific yield factors were used in uPulses, while in some cases factors referring to less specific foods needed to be applied. The YF and respective references used in the uPulses are given on Table A3.1. (ANNEX 3).

Nutrient retention factors (RF) These factors express the nutrient content retained in the food during preparation or processing. They are defined as the coefficient expressing the preservation of nutrients in a food or dish after storage, preparation, processing, warm holding or reheating. For boiled pulses the RF were applied to minerals, vitamins and inositol hexaphosphate (IP6). There are no RF available for phytate, therefore two apparent retention factors (aRF) where calculated based on data compiled from literature that analyzed the same samples of pulses raw and cooked. Even though the true RF is the most recommended one it was not feasible to obtain data on the fresh weights of foods before and after cooking. The aRF were calculated according to the following equation:

Equation 10. Apparent retention factor (aRF) = [IP6 content per 100 g of cooked food (dry basis)]/ [IP6 content per 100 g of raw food (dry basis)]

Table 3 gives the RF applied for boiled pulses, based on Bognár (2002), according to the cooking procedure used.

Table 3. Nutrient retention factors applied in uPulses

Component	Boiled without soaking		Water-soaked and boiled	
	seeds	total dish	seeds	total dish
Calcium	0.85	1.00	0.85	1.00
Iron	0.85	1.00	0.85	1.00
Magnesium	0.85	1.00	0.85	1.00
Phosphorus	0.90	1.00	0.90	1.00
Potassium	0.75	1.00	0.75	0.90
Sodium	0.75	1.00	0.75	0.90
Zinc	0.90	1.00	0.90	1.00
Copper	0.70	1.00	0.70	1.00
Carotenoids	1.00	1.00	1.00	1.00
α-tocopherol	0.90	1.00	0.90	1.00
Thiamin	0.65	0.80	0.65	0.75
Riboflavin	0.75	1.00	0.75	1.00
Niacin	0.65	0.80	0.65	0.75
Vitamin B6	0.70	0.80	0.70	0.70
Folate	0.50	0.60	0.50	0.55
Vitamin C	0.60	0.60	0.60	0.60
Inositol hexaphosphate (IP6)*	0.67	0.74	0.67	0.74

*Apparent retention factors calculated based on compiled data

Note that the water used to boil the pulses was not included as an ingredient in the calculation. Therefore, for locations where the water presents a high content of some minerals, the recalculation of the mineral content for boiled pulses may be necessary.

7. VALUE DOCUMENTATION

Statistics The foods represent average values of the collected compositional data. When the number of data points was 3 or above the median and the standard deviation (SD) were calculated. If two data points were available, only the minimum (min) and maximum (max) values were listed. For each value, the number of data points is indicated (n).
Note that the value for *n* should not be misinterpreted as the number of analysis or composite samples; further, a higher number of data points compared to another food does not automatically suggest a higher validity of the content value.

Documentation at food level For all information given per food, the data sources are indicated with the respective reference ID in the source column, while the bibliographic information on each is given in the sheet "*10 List Bibliography*".

Documentation at component level For each value the type of acquisition is given to indicate quickly whether a value is 'truly' analytical or refers to a compiled, calculated or estimated value. The abbreviations used for component level documentation are listed in Table 4.

Table 4. Abbreviations and symbols used in uPulses

Acquisition type of source	Abbreviation used	Comment
Article from scientific literature Analytical report	*a*	Analytical value
Reference dataset	*r*	Value taken from data compilation, i.e. food composition datasets/databases
Mix of data sources	*ar*	Value represents a mix of data from the scientific literature or reports (i.e. analytical data) or from reference data sets
Calculated	*c*	Value derived by calculation in present dataset (e.g. PROTCNT, ENERGY, see ANNEX 2)
Estimated	*e*	Value borrowed from similar/same food (values may be adjusted/unadjusted), or estimated from calculations.
	z	Value is assumed zero.
	tr	Value is estimated trace.
	*	Tag for values for which INFOODS tagnames referring to a less preferred/inappropriate analytical method were also included in the aggregation, or were the only option available. In the latter case the respective tagname is added in the documentation field.
	Blank	Missing value, i.e. no validated value can be reported. Wherever possible, the content has been estimated from a similar food or calculated based on various analytical data. A zero value cannot automatically be assigned.
	[ ]	Data are considered of lower quality.

Considerations:

- Values labelled with r or ar include data from reference datasets. Users may want to verify the origin of a value by referring to the original material in detail.
- Data from non-preferred tagnames or inappropriate methods were included where preferred tagname data was limited or not available. In these cases, data from non-preferred tagnames or less appropriate methods were included only if they were consistent with values of available, preferred tagnames. Thus, values labelled with an asterisk (*) do not indicate lower quality of values, but allow a precise documentation.

8. QUALITY CONSIDERATIONS

The values in uPulses are the result of a comprehensive literature search, additional analytical data and other reference datasets. Because the underlying analytical data used to compile uPulses are mainly results of specific research questions but have not been sampled to represent a global, regional or national average, the presented data have to be taken with caution. To the author's knowledge, however, the data represent the bulk of publicly available data on these pulse species with the set standard for data quality.

Even though great efforts were undertaken to collect and compile data accounting for different origins, data coverage was nevertheless limited. It is therefore recognized that the limited number of data points per species do not permit to present nutrient compositional data that are globally representative.

In some cases the data availability was poor, which resulted in a significant amount of imputed or borrowed data, especially for vitamins. Data were mainly borrowed from national FCT/FCDB and marked accordingly in the documentation.

The final selection of values published is dependent on the judgment of the compilers and their interpretation of available data.

Component variability Component values have been scrutinized and selected carefully for inclusion in uPulses; however, it is important that users appreciate that the composition of different samples of the same or similar foods may vary considerably. Values can differ as much within a species as between species. Variability in minerals for example can be due to several natural variations in the soil where the pulse was cultivated. Even for macronutrients, such as dietary fibre, a wide range may be found within a species.

The uPulses database has been designed to reflect various factors influencing the composition of pulses by having as many food entries as possible. However, data availability did not always allow a more specific food description.

Data remarks Calculated mean values should not be considered as 'absolute and exhaustive' they derive from various sources and are subject to differences caused by sampling procedures and analytical performance, they also reflect data availability, data quality and estimations made.

Even though uPulses does not mention the number of individual analyses per source, it is an important and simple quality parameter, i.e. a high number of individual analytical samples increases the validity of the content value. However, for most of the data included for compilation no number of samples was provided in the original source. Thus it was also not possible to apply weighting factors according to their data quality or representativeness when aggregating food records.

Moisture content A wide range of moisture values for raw pulses was observed in the data collected from scientific articles. To avoid the misinterpretation of the average values calculated for uPulses, only the data with a moisture content between 6.70 - 15% were included. This range was defined based on all the reference datasets presented in the uPulses. Values below 6.70% of moisture may refer to the residual moisture present on the dried samples as analyzed and not the real moisture content of the pulses available for consumption. In some cases, where the only values available for certain compounds were from pulses with moisture outside the acceptable range, the data was converted to dry basis for the calculations and then adjusted to average moisture. For references that presented the results for different samples using a standardized moisture value, only one data point was taken into account to calculate the average moisture content.

Data checks Data were checked prior to publication as per the criteria outlined in FAO/INFOODS (2012a).

9. REFERENCE DATASETS

Selected reference datasets, i.e. national or regional compiled FCT/FCDB, were included in uPulses to provide nutrient values for a wider range of pulses in a standardized way (Table 5). The component names were assigned to INFOODS tagnames and appropriate unit conversions were carried out. Components originally presented solely per g nitrogen or per 100 g FA were additionally expressed per 100 g EP for easier data use.

Table 5. List of reference datasets included in uPulses

RefID	Bibliography
THAI/2016	Kunchit Judprasong, Prapasri Puwastien, Anadi Nitithamyong, Piyanut Sridonpai, Amnat Somjai. Institute of Nutrition, Mahidol University (2015). Thai Food Composition Database, Online version 1, January 2016, Thailand. http://www.inmu.mahidol.ac.th/thaifcd
AUSNUT/2011-2013	Australian Food, Supplement and Nutrient Database (AUSNUT) 2011-2013. Retrieved from: http://www.foodstandards.gov.au/science/monitoringnutrients/ausnut/pages/default.aspx
DTU/2015	Fødevaredatabanken, 2015. Retrieved from http://frida.fooddata.dk.
SR28	U.S. Department of Agriculture, (2015). USDA National Nutrient Database for Standard Reference, Release 28. U.S. Department for Agriculture, Agricultural Research Service, Nutrient Data Laboratory. Retrieved from http://ndb.nal.usda.gov/.
McW/2015	Public Health England (2015) McCance and Widdowson's The Composition of Foods Integrated Dataset (CoFID) 2015. Prepared by Finglas P., Roe M., Pinchen H., Berry R., Church S., Dodhia S., Powell N., Farron-Wilson M., McCardle J., & Swan G, Institute of Food Research. Public Health England, London. Retrieved from https://www.gov.uk/government/publications/composition-of-foods-integrated-dataset-cofid. Open Government Licence https://www.nationalarchives.gov.uk/doc/open-government-licence/version/2/.

It is advised to check the documentation or user guide of the reference datasets for the exact component definition (i.e. analytical method, calculation, expression), as well as the FAO/INFOODS webpage for more information on the definition and description of INFOODS tagnames (FAO/INFOODS, 2016).

10. STRUCTURE OF uPulses

The actual compositional data of uPulses1.0 and additional information on foods and components can be accessed at www.fao.org/fileadmin/templates/food_composition/documents/uPulses1.0.xlsx. The structure of uPulses is outlined in Table 6; it consists of 12 separate datasheets, where sheets 04 to 06 hold the actual nutrient values.

Table 6. Datasheets in uPulses1.0 per 100 g edible portion on fresh weight basis (EP)

Datasheet title	Description
01 Introduction	Gives an introduction to the tables, incl. information on copyright and disclaimer.
02 List of Species	Presents an overview of the pulse species for which compiled nutrient values are given in uPulses and their respective food item IDs used in the actual datasheets (sheets 04-06).
03 Components uPulses	Gives an overview of all components that are covered by the uPulses datasheets (sheets 04-06), listing INFOODS tagnames, descriptions, recommended units, max. decimal places and significant digits used.
04 NV_sum (per 100 g EP on FW)	Presents compiled nutrient values per 100 g EP on FW for raw, processed and cooked foods - without information on statistics and documentation per component.
05 NV_stat (per 100 g EP on FW)	Presents compiled nutrient values per 100 g EP on FW basis with information on statistics for raw, processed and cooked foods – includes information on statistics and documentation per component.
06 AA (per g N)	Presents compiled amino acid values per g nitrogen for raw, processed and cooked foods - includes information on statistics and documentation per AA.
07 Yield Factors	Lists yield factors and the corresponding source(s) for each food.
08 Retention Factors	Lists retention factors applied according to the preparation method.
09 RefDatasets	Contains nutrient values of selected reference datasets per 100 g EP, as well as amino acids per g nitrogen.
10 Components RefDatasets	Gives an overview of all components that are covered by the reference datasets (sheet 09). It lists INFOODS tagnames, units and descriptions and indicates which components are available per reference dataset.
11 Bibliography	Presents the entire reference list with the corresponding ID.

11. CONCLUSION AND RECOMMENDATIONS FOR FUTURE WORK

This is the first edition of the uPulses database and it represents a first review of the available data on the species included in uPulses. This work is the result of a comprehensive data collection, of thorough and demanding investigations on methodological issues concerning phytate analysis and data aggregation.

Even though huge amounts of data were collected, data availability was a major constraint in the development of uPulses, especially considering the objectives and principles described earlier (see *1. Introduction*). For example, it was in not possible to separate food entries according to additional factors such as agricultural practices or season and few were presented according to variety and location. It can be concluded that for proximates (i.e. water, fat, protein, and ash) sufficient data but of various quality were available for most species; mineral data were available to a medium extent, although reliable data on phytate were missing; amino acid data do not seem to vary hugely within species which allowed data to be imputed among different food entries within each species; there were very few analytical vitamin data in the international literature and in many cases they needed to be estimated from reference datasets.

It was decided to report the pulses data from different national FCT/FCDB to show the variation in the composition of the species they included. This might be helpful for those looking for species and types of processing or cooking which are not covered by the uPulses database.

The quality of the uPulses database could be enhanced by replacing borrowed and estimated values with analytical data in the future. This will only be possible if additional funds will be identified in order to analyse more pulse species in raw and processed forms, and also of those considered minor species. Importantly, more analysis of the vitamin contents need to be carried out in order to fill this large data gap, except for those which are known to be in trace amounts in pulses. Vitamin D is traditionally assumed to be zero in pulses. In this version of uPulses vitamin D_2 was not included as very few analytical vitamin D_2 data were available, suggesting that more investigations are needed for this compound. FAO would appreciate receiving analytical data from different stakeholders, especially on vitamins, in order to include more pulse species, varieties and forms of pulse products as well as higher data quality in future editions of uPulses.

This first edition holds the nutrient content of pulses in raw and cooked forms, i.e. cooked without any additional ingredients. It is recommended that future editions include compositional data on different varieties and forms consumed (e.g. sprouts, roasted seeds), more on processed pulses (e.g. flour meal), as well as pulses dishes.

12. BIBLIOGRAPHY

The reference sources used for uPulses, with their codes (RefID) and complete bibliography are given in datasheet 11.

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ANNEX 1. List of species presented in uPulses1.0

Table A1.1. list the vernacular names used in uPulses1.0 with their corresponding scientific names. The scientific name in bold is the legitimate name and all the others were considered as synonyms according to the updated taxonomic database Tropicos (Tropicos, 2016).

Table A1.1. Vernacular and scientific names for the 16 species of pulses included in the uPulses1.0

Vernacular name[a]	Scientific name[b]
Common bean (main varieties: Black turtle bean, Kidney bean, Navy bean, Cranberry bean)	***Phaseolus vulgaris* L.** *Phaseolus aborigineus* Burkart *Phaseolus aborigineus* var. hondurensis Burkart *Phaseolus communis* Pritz. *Phaseolus esculentus* Salisb.
Lima bean	***Phaseolus lunatus* L.** *Phaseolus bipunctatus* Jacq. *Phaseolus falcatus* Benth. ex Hemsl. *Phaseolus inamoenus* L. *Phaseolus limensis* Macfad. *Phaseolus macrocarpus* Moench *Phaseolus portoricensis* Bertero ex Spreng. *Phaseolus puberulus* Kunth *Phaseolus rosei* Piper *Phaseolus saccharatus* Macfad. *Phaseolus viridis* Piper *Phaseolus xuaresii* Zuccagni *Phaseolus xuarezii* Zuccagni
Mungo bean	***Vigna mungo* (L.) Hepper** *Azukia mungo* (L.) Masam. *Phaseolus mungo* L. *Phaseolus roxburghii* Wight & Arn.
Adzuki bean	***Vigna angularis* (Willd.) Ohwi & H. Ohashi** *Azukia angularis* (Willd.) Ohwi *Dolichos angularis* Willd. *Phaseolus angularis* (Willd.) W. Wight *Phaseolus nipponensis* Ohwi *Vigna angularis* var. nipponensis (Ohwi) Ohwi & H. Ohashi
Mung bean	***Vigna radiata* (L.) R. Wilczek** *Azukia radiata* (L.) Ohwi *Phaseolus abyssinicus* Savi *Phaseolus aureus* Roxb. *Phaseolus aureus* Wall. *Phaseolus aureus* Zuccagni *Phaseolus hirtus* Retz. *Phaseolus hirtus* Wall. *Phaseolus radiatus* L. *Rudua aurea* (Roxb.) Maekawa

Vernacular name[a]	Scientific name[b]
Rice bean	***Vigna umbellata* (Thunb.) Ohwi & H. Ohashi** *Azukia umbellata (Thunb.) Ohwi* *Dolichos umbellatus Thunb.* *Dolichos unguiculatus Thunb.* *Phaseolus calcaratus Roxb.* *Phaseolus chrysanthos Savi* *Phaseolus pubescens Blume* *Vigna calcarata (Roxb.) Kurz*
Moth bean	***Vigna aconitifolia* (Jacq.) Maréchal** *Dolichos dissectus Lam.* *Phaseolus aconitifolius Jacq.* *Phaseolus palmatus Forssk.* *Vigna aconitifolia (Jacq.) Verdc.*
Cowpea	***Vigna unguiculata* (L.) Walp.** *Dolichos biflorus* L. *Dolichos catjang* L. *Dolichos monachalis* Brot. *Dolichos sesquipedalis* L. *Dolichos sinensis* Forssk. *Dolichos sinensis* L. *Dolichos sphaerospermus* (L.) DC. *Dolichos unguiculatus* L. *Dolichos unguiculatus* Thunb. *Vigna catjang* (L.) Walp. *Vigna cylindrica* (L.) Skeels *Vigna sesquipedalis* (L.) Fruwirth *Vigna sinensis* (L.) Endl. ex Hassk. *Vigna sinensis* (L.) Savi ex Hassk.
Bambara groundnut	***Vigna subterranea* (L.) Verdc.** *Glycine subterranea* L.
Hyacinth bean	***Lablab purpureus* (L.) Sweet** *Dolichos albus* Lour. *Dolichos bengalensis* Jacq. *Dolichos lablab* L. *Dolichos purpureus* L. *Lablab lablab* (L.) Lyons *Lablab niger* Medik. *Lablab vulgaris* Savi *Lablab vulgaris* var. albiflorus DC. *Vigna aristata* Piper
Pea	***Pisum sativum* L.** *Pisum vulgare Judz.*
Chickpea	***Cicer arietinum* L.** *Ononis crotalarioides Coss.* *Ononis crotalarioides M.E. Jones*

Vernacular name[a]	Scientific name[b]
Broad bean	***Vicia faba* L.**
	Faba bona Medik.
	Faba faba (L.) House
	Faba major Desf.
	Faba minor Roxb.
	Faba sativa Bernh.
	Faba vulgaris Moench
	Orobus faba Brot.
	Vicia equina Steud.
	Vicia esculenta Salisb.
	Vicia vulgaris Gray
	Vicia vulgaris Uspensky
Lentil	***Lens culinaris* Medik.**
	Ervum lens L.
	Ervum lens Wall.
	Lens esculenta Moench
	Lens lens (L.) Huth
	Vicia lens (L.) Coss. & Germ.
	Vicia pisicarpa H. Lév.
Lupines	***Lupinus* spp.**
	Several lupines species
Pigeon pea	***Cajanus cajan* (L.) Huth**
	Cajan cajan (L.) Huth
	Cajan inodorum Medik.
	Cajanum thora Raf.
	Cajanus bicolor DC.
	Cajanus cajan (L.) Merr.
	Cajanus cajan (L.) Millsp.
	Cajanus cajan fo. bicolor (DC.) Baker
	Cajanus cajan var. bicolor (DC.) Purseglove
	Cajanus cajan var. flavus (DC.) Purseglove
	Cajanus flavus DC.
	Cajanus indicus Spreng.
	Cajanus indicus var. bicolor (DC.) Kuntze
	Cajanus indicus var. flavus (DC.) Kuntze
	Cajanus indicus var. maculatus Kuntze
	Cajanus luteus Bello
	Cajanus obcordifolia Singh
	Cajanus pseudocajan (Jacq.) Schinz & Guillaumin
	Cajanus striatus Bojer
	Cytisus cajan L.
	Cytisus guineensis Schumach. & Thonn.
	Cytisus pseudocajan Jacq.

Source: Tropicos.org. Missouri Botanical Garden. 09 Sep 2016 <http://www.tropicos.org>
[a]All species listed are considered to be pulses, but some of them are regarded as vegetables when harvested unripe.
[b]Scientific name in bold is the legitimate name, all the others were considered as synonyms

ANNEX 2. List of components presented in uPulses1.0

The tables below list the components used in uPulses with their corresponding INFOODS component identifier (tagname), units and denominators. Table A2.1. gives all components other than fat fractions and amino acids; they are presented in Table A2.2.

Table A2.1. List of components with corresponding INFOODS tagnames, units, denominators and decimal places

Component	INFOODS tagname	Unit	Denominator	Sig. digits	Data-sheet	Comment
Energy	ENERC	kJ, kcal	/100 g EP	3	04/05	Calc. from energy-yielding components FAT, CHOAVLDF, PROTCNT, FIBTG (*Equations 1 & 2*)
Water	WATER	g	/100 g EP	3	04/05	
Nitrogen, total	NT	g	/100 g EP	3	04/05	
Protein, total	PROTCNT	g	/100 g EP	3	04/05	Calc. from NT using nitrogen-to-protein factor 6.25 (*Equation 3*)
Fat, total	FATCE	g	/100 g EP	3	04/05	Derived by analysis using continuous extraction
Fatty acids, total	FACID	g	/100 g EP	3	04/05	Calc. from FAT using the conversion factor for fatty acids (*Equation 8*)
Fatty acids, total saturated	FASAT	g	/100 g EP	3	04/05	Calc. from FASAT g/ 100 g FACID
Fatty acids, total monounsaturated	FAMS	g	/100 g EP	3	04/05	Calc. from FAMS g/ 100 g FACID
Fatty acids, total polyunsaturated	FAPU	g	/100 g EP	3	04/05	Calc. from FAPU g/ 100 g FACID
Cholesterol	CHOLE	mg	/100 g EP	3	04/05	
Carbohydrate available, by difference	CHOAVLDF	g	/100 g EP	3	04/05	Calc. from proximates WATER, FAT, PROTCNT, ASH, FIBTG (*Equation 4*)
Fibre, total dietary	FIBTG	g	/100 g EP	3	04/05	
Ash	ASH	g	/100 g EP	3	04/05	
Calcium	CA	mg	/100 g EP	3	04/05	
Copper	CU	mg	/100 g EP	3	04/05	
Iron	FE	mg	/100 g EP	3	04/05	
Potassium	K	mg	/100 g EP	3	04/05	
Magnesium	MG	mg	/100 g EP	3	04/05	
Manganese	MN	mg	/100 g EP	3	04/05	
Sodium	NA	mg	/100 g EP	3	04/05	
Phosphorus	P	mg	/100 g EP	3	04/05	
Zinc	ZN	mg	/100 g EP	3	04/05	

Component	INFOODS tagname	Unit	Denominator	Sig. digits	Data-sheet	Comment
Thiamin	THIA	mg	/100 g EP	2	04/05	
Riboflavin	RIBF	mg	/100 g EP	2	04/05	
Niacin	NIA	mg	/100 g EP	2	04/05	
Niacin equivalents	NIAQ	mg	/100 g EP	2	04/05	Calc. of NIA and NIATRP (*Equation 7*)
Vitamin C	VITC	mg	/100 g EP	3	04/05	
Vitamin B6	VITB6C	mg	/100 g EP	2	04/05	Not preferred/improper tagnames: VITB6A, microbiological assay; VITB6-, unknown expression or method.
Vitamin B12	VITB12	µg	/100 g EP	2	04/05	
Folate	FOL	µg	/100 g EP	2	04/05	Not preferred/improper tagnames: FOLSUM, sum of vitamers determined by HPLC; FOL-, method unknown or variable.
Vitamin A (RE)	VITA	µg	/100 g EP	3	04/05	(*Equation 5*)
Vitamin A (RAE)	VITA_RAE	µg	/100 g EP	3	04/05	(*Equation 6*)
Retinol	RETOL	µg	/100 g EP	3	04/05	
Beta-carotene equivalent	CARTBEQ	µg	/100 g EP	3	04/05	
Alpha-carotene	CARTA	µg	/100 g EP	3	04/05	
Beta-carotene	CARTB	µg	/100 g EP	3	04/05	
Beta-cryptoxanthin	CRYPXB	µg	/100 g EP	3	04/05	
Alpha-Tocopherol	TOCPHA	mg	/100 g EP	2	04/05	
Inositol triphosphate	IP3	mg	/100 g EP	3	04/05	
Inositol tetraphosphate	IP4	mg	/100 g EP	3	04/05	
Inositol pentaphosphate	IP5	mg	/100 g EP	3	04/05	
Inositol hexaphosphate	IP6	mg	/100 g EP	3	04/05	Not preferred tagnames: PHYTCPPD, phytic acid, determined by direct preciptation; PHYTCPP, phytic acid, calc. from phytate phosphorus, anion exchange method; PHYTPPI, Phytate, determined by indirect preciptation

Table A2.2. List of amino acids with corresponding INFOODS component identifier, units and denominators

Amino acid	INFOODS tagname	Unit	Denominator	Sig. digits	Data sheet	Comment[1]
Isoleucine	ILE	mg	/100 g EP	3	04/05	Calc. from ILE/g N
			/g N	3	06	
Leucine	LEU	mg	/100 g EP	3	04/05	Calc. from LEU/g N
			/g N	3	06	
Lysine	LYS	mg	/100 g EP	3	04/05	Calc. from LYS/g N
			/g N	3	06	
Methionine	MET	mg	/100 g EP	3	04/05	Calc. from MET/g N
			/g N	3	06	
Cystine	CYS	mg	/100 g EP	3	04/05	Calc. from CYS/g N
			/g N	3	06	
Phenylalanine	PHE	mg	/100 g EP	3	04/05	Calc. from PHE/g N
			/g N	3	06	
Tyrosine	TYR	mg	/100 g EP	3	04/05	Calc. from TYR/g N
			/g N	3	06	
Threonine	THR	mg	/100 g EP	3	04/05	Calc. from THR/g N
			/g N	3	06	
Tryptophan	TRP	mg	/100 g EP	3	04/05	Calc. from TRP/g N
			/g N	3	06	
Valine	VAL	mg	/100 g EP	3	04/05	Calc. from VAL/g N
			/g N	3	06	
Arginine	ARG	mg	/100 g EP	3	04/05	Calc. from ARG/g N
			/g N	3	06	
Histidine	HIS	mg	/100 g EP	3	04/05	Calc. from HIS/g N
			/g N	3	06	
Alanine	ALA	mg	/100 g EP	3	04/05	Calc. from ALA/g N
			/g N	3	06	
Aspartic acid	ASP	mg	/100 g EP	3	04/05	Calc. from ASP/g N
			/g N	3	06	
Glutamic acid	GLU	mg	/100 g EP	3	04/05	Calc. from GLU/g N
			/g N	3	06	
Glycine	GLY	mg	/100 g EP	3	04/05	Calc. from GLY/g N
			/g N	3	06	
Proline	PRO	mg	/100 g EP	3	04/05	Calc. from PRO/g N
			/g N	3	06	
Serine	SER	mg	/100 g EP	3	04/05	Calc. from SER/g N
			/g N	3	06	

ANNEX 3. List of yield factors

Table A3.1. presents weight yield factors (YF) for pulses prepared by two different cooking procedures: (I) pulse, water-soaked, drained, boiled without salt, drained; (II) pulse, water-soaked, drained, boiled without salt (cooking water not discarded).

In cases where the yield factor refers to estimated values these YF are labelled with ♦ in the table for easier reference.

Table A3.1. List of weight yield factors (YF) for pulses

Specie/Common name	Boiled, drained (only seeds)			Boiled (cooking water+seeds)		
	YF	**(source) / description**	**Food Item ID**	**YF**	**source/description**	**Food Item ID**
***Phaseolus vulgaris* L**						
Common bean (all types)	2.67	(1) common bean, soaked, drained, boiled, drained	PHV011; PHV023; PHV025; PHV029	4.33	(1) Common bean, soaked, drained, boiled (water+seeds)	PHV012; PHV024; PHV026; PHV030
Black turtle bean	2.35	(3) beans, black, soaked, boiled	PHV013; PHV027	4.33♦	(2) from common bean, soaked, drained, boiled (water+seeds)	PHV014; PHV028
Kidney bean	2.61	(4) kidney beans dried (soaked and boiled)	PHV015	4.33♦	(2) from common bean, soaked, drained, boiled (water+seeds)	PHV016
Kidney bean, Red	2.61	(4) kidney beans dried (soaked and boiled)	PHV017	4.33♦	(2) from common bean, soaked, drained, boiled (water+seeds)	PHV018
Navy bean	2.60	(4) haricot beans dried (soaked and boiled)	PHV019	4.33♦	(2) from common bean, soaked, drained, boiled (water+seeds)	PHV020
Pinto bean	2.38	(4) pinto beans dried (soaked and boiled)	PHV021	4.33♦	(2) from common bean, soaked, drained, boiled (water+seeds)	PHV022
***Phaseolus lunatus* L**						
Lima bean	2.50	(4) butter beans (soaked and boiled)	PHL002	4.33♦	(2) from common bean, soaked, drained, boiled (water+seeds)	PHL003
Vigna angularis						
Adzuki bean	2.80	(1) adzuki bean, soaked, drained, boiled, drained	VIA002	4.60	(1) adzuki bean, soaked, drained, boiled (water+seeds)	VIA003
***Vigna radiata* (L) R Wilczek**						
Mung bean	2.69	(1) mung beans, soaked, drained, boiled, drained	VIR004; VIR006; VIR008	4.25	(1) mung beans, soaked, drained, boiled (water+seeds)	VIR005; VIR007; VIR009
***Vigna mungo* (L) Hepper**						
Mungo bean	3.08	(4) black gram, whole (soaked and boiled)	VIM003; VIM005	4.60♦	(2) from adzuki bean, soaked, drained, boiled (water+seeds)	VIM004; VIM006
***Vigna umbellata* (Thunb.) Ohwi & H Ohashi**						
Rice bean	2.69♦	(2) average of original YF for Vigna genus	VIU003; VIU005	4.42♦	(2) average of original YF for Vigna genus	VIU004; VIU006

Specie/Common name	Boiled, drained (only seeds)			Boiled (cooking water+seeds)		
	YF	(source) / description	Food Item ID	YF	(source) / description	Food Item ID
***Vigna aconitifolia* (Jacq) Marechal**						
Moth bean	2.20	(5) Moth bean, boiled	VAC003; VAC005	3.50♦	(2) from chickpea, soaked, drained, boiled (water+seeds)	VAC004; VAC006
***Vigna unguiculata* (L) Walp.**						
Cowpea	2.67	(1) cowpea, soaked, drained, boiled, drained	VUN005; VUN007; VUN009; VUN011	4.42	(1) cowpea, soaked, drained, boiled (water+seeds)	VUN006; VUN008; VUN010; VUN012
***Vigna subterranea* (L) Verdc.**						
Bambara groundnut	2.69♦	(2) average of original YF for Vigna genus	VSU002	4.42♦	(2) average of original YF for Vigna genus	VSU003
***Vicia faba* L**						
Broad bean	2.80	(6) broadbean, cooked	VIF003; VIF005	4.60♦	(2) from adzuki bean, soaked, drained, boiled (water+seeds)	VIF004; VIF006
***Pisum sativum* L**						
Pea, whole	2.70	(4) peas, whole (soaked and boiled)	PIS011	4.25♦	(2) from lentil, whole, boiled (water+seeds)	PIS012
Pea, green, whole	2.70♦	(2) from peas, whole (soaked and boiled)	PIS013; PIS017; PIS021	4.25♦	(2) from lentil, whole, boiled (water+seeds)	PIS014; PIS018; PIS022
Pea, yellow, whole	2.70♦	(2) from peas, whole (soaked and boiled)	PIS015; PIS019; PIS23	4.25♦	(2) from lentil, whole, boiled (water+seeds)	PIS016; PIS020; PIS024
Pea, split	2.33♦	(2) from pea, green, split, boiled, drained	PIS025	3.73♦	(2) from pea, green, split, boiled (water+seeds)	PIS026
Pea, green, split	2.33	(1) pea, green, split, boiled, drained	PIS027	3.73	(1) pea, green, split, boiled (water+seeds)	PIS028
Pea, yellow, split	2.33♦	(2) from pea, green, split, boiled, drained	PIS029	3.73♦	(2) from pea, green, split, boiled (water+seeds)	PIS030
Cicer arietinum						
Chickpea	2.25	(1) chickpea, soaked, drained, boiled, drained	CIA007; CIA013; CIA015; CIA017	3.15	(1) chickpea, soaked, drained, boiled (water+seeds)	CIA008; CIA014; CIA016; CIA018
Chickpea, Kabuli	2.25♦	(2) from chickpea, soaked, drained, boiled, drained	CIA009	3.15♦	(2) from chickpea, soaked, drained, boiled (water+seeds)	CIA010
Chickpea, Desi	2.25♦	(2) from chickpea, soaked, drained, boiled, drained	CIA011	3.15♦	(2) from chickpea, soaked, drained, boiled (water+seeds)	CIA012
***Cajanus cajan* (L) Huth**						
Pigeon pea	2.30	(1) pigeon pea, soaked, drained, boiled, drained	CAC004; CAC006; CAC008	3.20	(1) pigeon pea, soaked, drained, boiled (water+seeds)	CAC005; CAC007; CAC009

Specie/Common name	Boiled, drained (only seeds)			Boiled (cooking water+seeds)		
	YF	(source) / description	Food Item ID	YF	(source) / description	Food Item ID
***Lens culinaris* Medik**						
Lentil, whole	2.65	(1) lentil, whole, boiled, drained	LEC009; LEC019	4.25	(1) lentil, whole, boiled (water+seeds)	LEC010; LEC020
Lentil, green, whole	2.65♦	(2) from lentil, whole, boiled, drained	LEC011; LEC015	4.25	(2) from lentil, whole, boiled (water+seeds)	LEC012; LEC016
Lentil, red, whole	2.65♦	(2) from lentil, whole, boiled, drained	LEC013; LEC017	4.25	(2) from lentil, whole, boiled (water+seeds)	LEC014; LEC018
Lentil, split	2.40	(1) lentil, red, split, boiled, drained	LEC021	3.90	(1) lentil, red, split, boiled (water+seeds)	LEC022
***Lupinus* spp.**						
Lupin, whole	2.33	(1) lupin, whole, soaked, drained, boiled, drained	LUS007; LUS008; LUS009; LUS010; LUS011; LUS012			
***Lablab purpureus* (L) Sweet**						
Hyacinth bean	2.61♦	(2) average of original YF for all pulses	LAP002	4.13♦	(2) average of original YF for all pulses	LAP003

(1) Own measurement; (2) Own estimation; (3) Bergström (1994); (4) Holland et al (1991) - McCance & Widdowson's, (5) Khalil et al (1986); (6) USDA (2015); (7) Meiners et al (1976).

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