Documentation for the
USDA-IOWA STATE UNIVERSITY ISOFLAVONES DATABASE

The development of the database for Isoflavones, one of the families of phytoestrogens, in foods was a collaborative effort between the Food Composition Laboratory (FCL), and the Nutrient Data Laboratory (NDL) of ARS/USDA and the Department of Food Science and Human Nutrition of the Iowa State University (ISU). Many scientists are interested in isoflavones because of their weak estrogenic and other biological properties. The main dietary sources of isoflavones are soybeans and soyfoods. Some other food legumes contain very small amounts of isoflavones.

Data for isoflavone contents of foods were collected from scientific articles published in refereed journals. In addition, isoflavones data were generated by extensive sampling of soy-containing foods and subsequent analysis at the Iowa State University. Data for only the most prominent isoflavones, Daidzein, Genistein, Glycitein and their glucosides were evaluated using the expert system described by Mangels, et al (J. Am. Diet. Assoc. 93:284-296, 1993) for five general categories: analytical method, analytical quality control, number of samples, sample handling and sampling plan. The analytical method described by Murphy, et al (J. Agric. Food Chem. 45:4635-4638, 1997) was used as the reference method for evaluating analytical methodologies in the published articles. Although acid addition to extraction solvent and use of internal standard to adjust analytical errors due to work-up procedures are highly recommended, only few studies have used these procedures. Since this is the first database on isoflavones, the methodology criteria for inclusion in the database were relaxed so as to include as many foods as possible.

The glucoside forms of the isoflavones are converted to free forms (aglycone) to be absorbed by the gut and exert their potentially protective effects (Murphy, et al, J. Agric. Food Chem. 45:4635-4638, 1997). Therefore, we have converted the values for glucoside forms into aglycone (free) forms by using appropriate ratios of molecular weights and have added them to their respective free form values to generate mean values for each aglycone form: Daidzein, Genistein and Glycitein. Simple addition of free and glucoside forms of isoflavone concentrations without this correction will overestimate true isoflavone aglycone concentration by almost a factor of two (Wang and Murphy, J. Agric. Food Chem. 42:1666-1673, 1994; 44:2377-2383, 1996).

Values expressed on a dry weight basis were converted to wet weight basis either by using given moisture content or by assuming commonly expected moisture content for that particular food. The table contains mean values, standard errors of the means (SEM), minimum (Min) and maximum (Max) values for individual aglycone forms: Daidzein, Genistein and Glycitein and the total isoflavone content. The totals are given if values were available for at least Daidzein and Genistein. The values for total isoflavones may not agree with the simple addition of the mean individual values. Several articles did not report Glycitein values. Glycitein contributes about 5%-10% to the total content. For example: soy flour full fat (NDB No. 16115), daidzein mean was calculated from 20 values (#S), genistein mean from 21 values, glycitein mean from 7 values, and total isoflavones mean from 20 values. Reinli and Block (Nutr. Cancer 26:123-148, 1996) summarized values for daidzein and genistein available prior to 1996. However, values for glycitein were not included because of the lack of data on the estrogenic activity of glycitein.

Preliminary evidence suggests that glycitein has as potent an estrogen activity as daidzein and genistein (Song et al, J. Agric. Food Chem, 1999 In press). Each mean is assigned a Confidence Code (CC) of a, b, or c. The Confidence code is an indicator of relative quality of the data and the reliability of a given mean value. A confidence Code of "a" indicates considerable reliability, due either to a few exemplary studies or to a large number of studies of varying quality.

The user is reminded that the variety, the crop year and the location affect the isoflavone contents of the soybeans (Wang and Murphy, J. Agric. Food Chem.,42:1674-1677,1994) and contribute to the large variability in the isoflavone contents of soybeans, as well as, soyfoods. The soybean varieties, therefore, were divided into 'food quality' (NDB no.16108) and 'commodity grade' (NDB no. 99091) for U.S. varieties. Japanese (NDB no. 99092) and Korean (NDB no. 99093) varieties were also separated from the U.S. varieties. The method of extracting proteins (alcohol vs aqueous) in the processing of various soy products also affects the isoflavone contents; alcohol extraction reducing the contents significantly.

The isoflavone database is typical of small data sets which can be developed for food components of recent scientific interest. A review of the numbers of studies which contributed acceptable data reveals that for most foods, one study contributes the values for each isoflavone. For example, daidzein values for 73 foods were derived from single studies. It should be noted that one study may have reported values for one or more foods. Furthermore, a single study may have analyzed multiple samples for a single food.

Coumestrol (the most common coumestan), though not an isoflavone, has a similar structure and competes with estradiol for cytoplasmic receptors in mammary tumor cells. Biochanin A and formononetin, 4-methyl ether derivatives of genistein and daidzein respectively, are reduced to genistein and daidzein by the gut bacteria.. These three compounds share the estrogenic/antiestrogenic, antioxidant and antiproliferative activities of the prominent isoflavones (Mazur *et al.* Anal. Biochem. 233(2):169-180, 1996). Very few articles contained values for these three compounds. Therefore a separate table for their contents in foods was prepared.

The completed database contains three files;

1. Isfl_tble (isoflavone_table) is the table of analytical isoflavone values.
2. Isfl_ref (isoflavone_references) is a list of references/studies from which isoflavone values were obtained.
3. CBF_tble is the table of analytical Coumestrol, BiochaninA and Formonetin values.

Isfl_tbl - Analytical Isoflavone Values for Foods

Isfl_tble contains isoflavone values for 128 foods.
The fields in the table are as follows:

NDB	USDA Nutrient Data Bank Number[1]
Desc	Food description
NutrDesc	Name of the isoflavone
Dein	Daidzein
Gein	Genistein

Glein	Glycitein
Total Isofl.	Isoflavone total [2]
Mean	Mean value (mg/100g edible portion)
SEM	Standard error of the mean
#S	Number of means/individual values [3]
Min	Minimum value (mg/100g edible portion)
Max	Maximum value (mg/100g edible portion)
CC	Confidence Code [4]
Reference. No.	Reference(s) from which isoflavone values were obtained [5]

Footnotes:

[1]The NDB number is a five-digit numerical code used in the USDA Nutrient Database for Standard Reference, the electronic version of Agriculture Handbook No. 8, which can be downloaded from this site. Foods in the Isoflavone Database which do not have corresponding entries in the USDA Nutrient Database for Standard Reference, are given tentative NDB numbers starting with '99---". For more information on these files contact the Nutrient Data Laboratory, 4700 River Road, Unit 89, Riverdale, MD 20737. Tel. 301-734-8491.

[2] Values in the Total isoflavones column may not agree with the simple additions of the mean individual isoflavone values. Several articles did not report Glycitein values. Glycitein contributes only about 5% to 10% of the total content. Therefore if an article reported values for at least Daidzein and Genistein, then the total value for that food was calculated.

[3]#S is the total number of means/individual values used to compute the data in the Isoflavones Database. In the scientific literature each value can be a mean of many values (depending on the number of samples used in the study) or an individual value. Furthermore there may be more than one value for a single food in one reference. As a result, the total number of references may not equal #S. Since the data have been compiled from various sources, #S does not necessarily equal "n" in statistical terms.

[4]The Confidence Code designated as a, b, or c is a general indicator of the quality of the data (a=best). The procedure for determining confidence codes is described in Mangels, et al. (J. Am. Diet. Assoc. 93:284-296, 1993).

[5]Documentation for each reference can be found in the Isfl_ref file.

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CBF_tbl - Analytical Coumestrol, Biochanin A, Formononetin values for Foods

CBF_tble contains individual values for Coumestrol, Biochanin A and Formononetin for 41 foods. The fields in this table: NDB, and Ref. No. are the same as in the file, Isfl_tbl.

Isfl_ref - Isoflavones References

Isfl_ref provides a list of 38 references from which values for the Isoflavones Database were obtained. The reference numbers from the reference file correspond with the Ref. No. Column. All references list authors, title, journal citation and the foods and isoflavones analyzed.