Sources of Variability in the Flavonoid content of Foods

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Steps in Developing Special Interest Databases

- Identify need for database on a specific component or class of components
- Conduct literature search of published data
- Ascertain current and appropriate methods
- Identify major food sources
- If funding permits, conduct sampling and analysis of major food sources

Steps in Developing Special Interest Databases

- Evaluate and rate acceptable data
- Define structure of the database
- Conduct statistical analysis of the data
  - Determine how to combine data
  - Calculate mean, variance, and ranges
- Release database with confidence codes

USDA'S Databases for Bioactive Compounds

Database	Year	No. of Foods	Compounds
Flavonoids	2003 2007 2011	220 385 500	Flavonols, flavones, flavanones, flavan-3-ols & anthocyanidins
Isoflavones	1999 2008	128 549	Genistein, daidzein & glycitein
Proantho-cyanidins	2004	205	Mono- thru polymers of flavan-3-ols

Flavonoid Database 3.0

- Contains data for 500 food items
- Values converted to aglycone form and standard units
- Based on data from 300 sources
  - Analyses conducted by USDA on 59 fruits, nuts and vegetables
  - Evaluated literature
- Released in September 2011

Flavonoid Database 3.0

- Anthocyanidins
  - Cyanidin, delphinidin, malvidin, pelargonidin, peonidin, petunidin
- Flavonols
  - Quercetin, kaempferol, myricetin, isorhamnetin
- Flavones
  - Apigenin, luteolin
- Flavanones
  - Hesperetin, naringenin, eriodictyol
- Flavan-3-ols
  - Catechins, epicatechins, epicatechin3-gallate, epigallocatechin, epigallocatechin 3-gallate, gallocatechin, theaflavin, Theaflavin 3-3′-digallate, theaflavin 3′-gallate, theaflavin 3-gallate, thearubigins

Flavonoids

- Stress induced secondary metabolites
- Stress can be:
  - Drought
  - Insect/pest attack
  - Harvesting
    - Conditions
    - Time of day
- Flavonoid content can be influenced by stress and other factors
  - Cultivar/color
  - Growing location

Hesperitin in Orange Juice

- 13 data sources
- 112 data points
- 3 cultivars identified with sufficient data for analysis
- 27 data points without cultivar identified
- 26 data points with a single cultivar, so collapsed into “other”

Hesperitin in Orange Juice -Cultivar

Cultivar	Mean	n	SD	Range
Navel	27.6	20	44.9	2.5 - 438
Pera	12.1	20	3.7	6.3 – 18.9
Valencia	14.5	28	30.1	4.2 - 122
Other	100.7	26	117.7	4.9 – 362.8
NS	57.12	27	81.5	2.46 – 437.5

F=4.16, p=0.0038

Hesperitin in Orange Juice -Location

Location	Mean	n	SD	Range
Brazil	12.4	28	4.5	4.9 – 25.4
France	234	9	85	121 – 163
Italy	20.7	8	15.9	2.5 – 39.2
USA	26.5	34	15.4	5.2 – 60.8
Spain	18.6	23	47.5	4.24 – 216
Other	120	8	143.1	3.9 - 438

F=4.16, p=<0.0001

Quercetin in Onions

- 27 Data sources
- 202 data points
- 2 cultivars identified with sufficient data for analysis
- 48 data points without cultivar identified
- 136 data points with a single cultivar, so collapsed into "other"

Quercetin in Onions - Cultivar

Cultivar	Mean	n	SD	Range
Red Barron	137	9	27.1	92.9 - 191.7
Cross bow	93.4	8	12.1	81 - 119
Other	76.58	136	102.6	0 - 544.5
NS	54.1	48	56.3	0.03 – 292.9

2.45, p=0.0650

Quercetin in Onions - Location

Location	Mean	n	SD	Range
USA	51.9	106	51.5	0 – 292
US	87.1	34	44.2	5.1 – 162
Japan	27.6	22	16.9	0 – 75.6
Italy	288.6	13	288.6	0.9 - 544
Other	83.8	26	83.8	0 - 282

F=31.97, p=<0.0001

Quercetin in Onions - Color

Color	Mean	N	SD	Range
Red	110	45	94.6	0 - 418
Sweet	21.5	20	31.8	1 - 143
White	26.2	32	31.8	0 - 103
Yellow	84.4	104	98.1	0 - 544

F=12.54, p<0.0001

Pelargonidin in Strawberries

- 11 data sources
- 101 Data points
- 2 cultivars identified with sufficient data for analysis
- 13 data points without cultivar identified
- 62 data points with a single cultivar, so collapsed into “other”

Pelargonidin in Strawberries - Cultivar

Cultivar	Mean	n	SD	Range
Allstar	25.3	14	3.3	25 - 31
Honeoye	47.9	12	6.0	39 – 56
NS	13.0	13	4.2	6 - 19
Other	44.9	62	16.7	12 - 94

$F=29.68$, $p<0.0001$

Pelargonidin in Strawberries - Location

Location	Mean	N	SD	Range
USA	33.2	64	13.5	8 - 57
Spain	56.3	27	16.3	33 - 94
Other	23.7	10	11.3	12 - 43

F=35.55, p<0.0001

Flavonoid Database, Release 3.1

- Will include individual data points used to determine the mean values in the table
- Data on specific glycosides will also be available
- Release later this year
- Developing database for use with NHANES 2007-8 consumption data to ascertain flavonoid intake
  - Calculated missing values for ~3,000 foods for 26 flavonoids
  - See Poster by Bhagwat, Haytowitz and Holden

Nutrient Data Laboratory

Web Site:
http://www.ars.usda.gov/nutrientdata