Identity Preserved Soybean Nutrition and Application

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Soy Ingredients

- Soy Flour (50% Protein)
- Lecithin

- Soy Protein, textured/hydrolyzed
- Soy Grits

- Soy Protein Isolate/ Concentrate
- Soy Fiber (Okara, Soy Bran, Soy Fiber Isolate)

- Soybean oil and Products

Soy foods

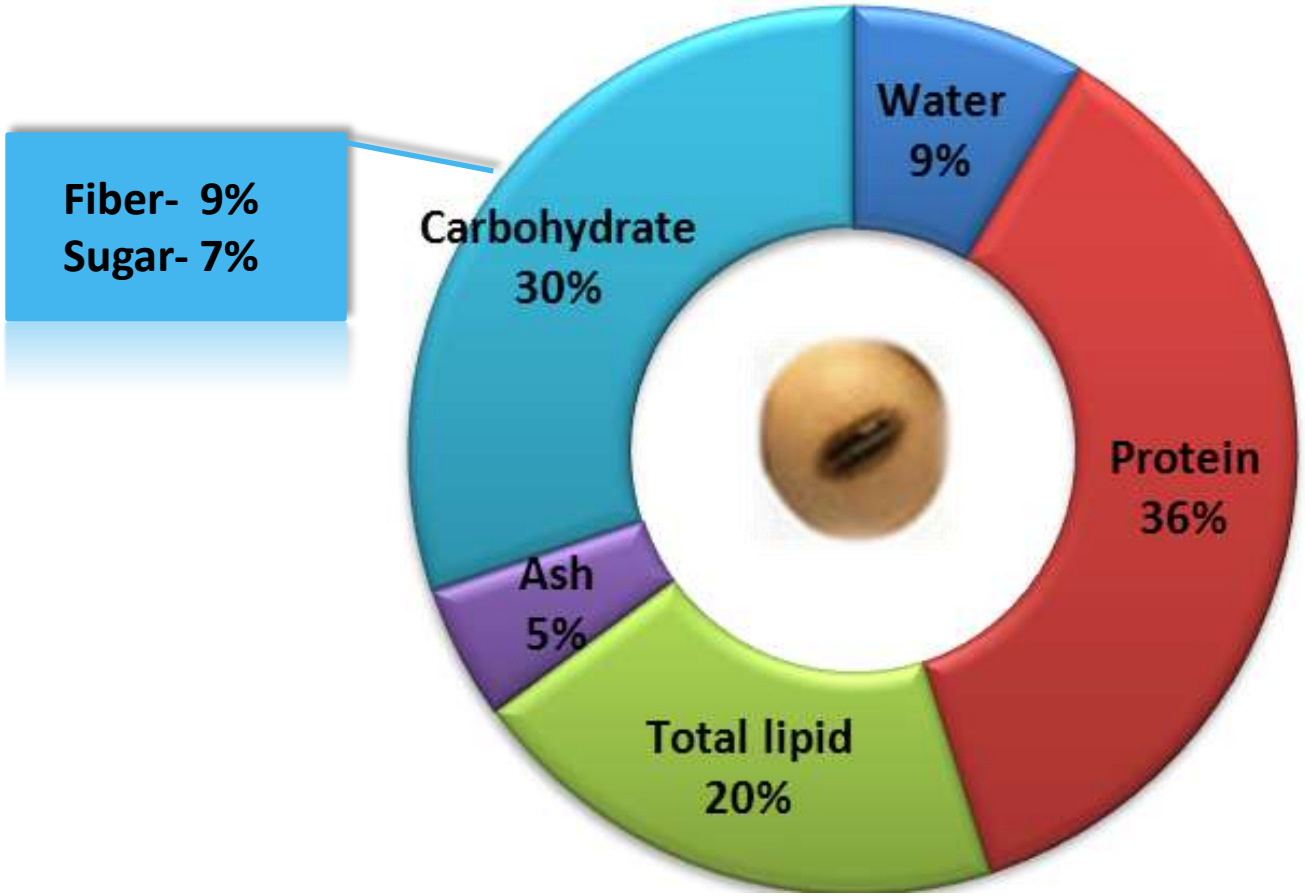
Traditional Soy foods	Soy-based foods
 Green Vegetable Soybeans	Meat Analogs
Tofu	Soy beverages 
Fermented soybean whole/paste	Soy Cheese
Soynuts	Whipped toppings, Soy based
 Soymilk	Infant Formulas, Soy based
Soy Sauce	Soynut butter
Soy Sprouts	Soy Yogurt 
Tempeh	Nondairy soy frozen desserts
Tofu skin	

Identity Preserved Soybean

- According to the United Soybean Board (2008), food grade soybeans are used in soybean-based products like tofu, natto, and miso.
- They are identity preserved and non-biotech.

- These soybeans are grown and harvested in a fully separate farm, require separate storage and shipping containers, and require a certain amount of traceability.

Soybean Composition



Soybean Micronutrients

Micronutrients	Value per 100g	% DV
Vitamin A - IU (IU)	22	0
Vitamin B1 - Thiamin (mg)	0.9	58
Vitamin B2 - Riboflavin (mg)	0.9	51
Vitamin B3 - Niacin (mg)	1.6	8
Vitamin B6 (mg)	0.4	19
Vitamin C (mg)	6	10
Vitamin E - IU (IU)	1.3	4
Folate (mcg)	375	94
Vitamin K (mcg)	47	59
Pantothenic Acid (mg)	0.8	8

Micronutrients	Value per 100g	% DV
Calcium (mg)	277	28
Copper (mg)	1.7	83
Copper (mg)	1.7	83
Magnesium (mg)	280	70
Manganese (mg)	2.5	126
Molybdenum (mcg)	75	100
Phosphorus (mg)	704	70
Potassium (mg)	1797	51
Selenium (mcg)	17.8	25
Zinc (mg)	4.9	33

Soy and cancer prevention

- Epidemiological studies have indicated that soy is associated with a reduced risk of prostate cancer in men (1) and breast cancer in women (2,3)
- To derive protection against breast cancer, soy foods need to be consumed during childhood and/or adolescence.
- Evidence suggests that consuming just one serving per day can reduce risk later in life by as much as 50%.

(1) American Journal of Clinical Nutrition, 2009, 89:1, 155-1,163.

(2) Journal of the National Cancer Institute, 2006, 98:459-471.

(3) British Journal of Cancer, 2008; 98:9-14.

Soy and Heart Health

- Clinical trials indicate that soy protein lowers low-density lipoprotein (LDL) cholesterol by 4-5% (1).
- The effects of soy protein is significant, since each 1% decrease in LDL lowers heart disease risk by 1-2%.
- The U.S. Food and Drug Administration (FDA) approved a health claim for soy due to the ability of soy protein to directly lower blood cholesterol (LDL) level.
- *"25g of soy protein per day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease".*

Journal of Nutrition, 2009; 139:796S-802S.

Soy and Heart Health

In addition, soy has been shown to:

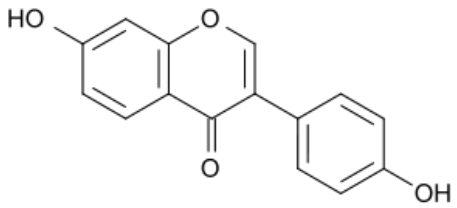
- Moderately raise HDL cholesterol.
- Modestly lower fasting and postprandial blood levels of triglycerides.
- Make LDL cholesterol less atherogenic.

Soy for women

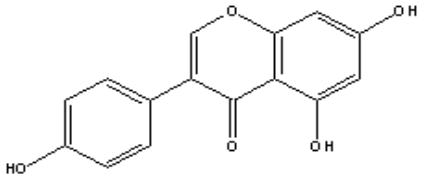
- A recent epidemiologic study found that consumption of soymilk and cow's milk equally reduce the risk of osteoporosis among postmenopausal women.
- Isoflavone supplements consistently reduced both the frequency and severity of hot flashes in postmenopausal women.

Isoflavones

- Isoflavones are plant-derived compounds with structural similarity to estrogen.
- Genistein, daidzein are the major isoflavones in soybeans.
- The predominant (95%) isoflavones in unprocessed soybeans are the malonylglucosides.



DAIDZIN



GENISTEIN

Isoflavones

- Isoflavones have shown inhibiting properties on tumor growth and development in several in vitro and in vivo models.
  - ***Barnes (1995); Chen and Anderson (2001)***

- Limited data is available regarding the biological activity of isoflavones delivered in a food matrix or the effect of processing on these bioactive compounds.

- Processing, such as heat treatment, may alter isoflavone content and composition in processed soy foods.
  - *Mahungu et al.(1999) and Grun et al. (2001)*

Isoflavones

OSU Department of Food Science: Dr. Vodovotz Group

Bread supplemented with 30% defatted soy flour was developed.

A serving size of 50gram provides:

- Soy protein: ~7.3 gram
- Isoflavones: 35 mg
- *Low in saturated fat and low in cholesterol*
- *Highly acceptable*

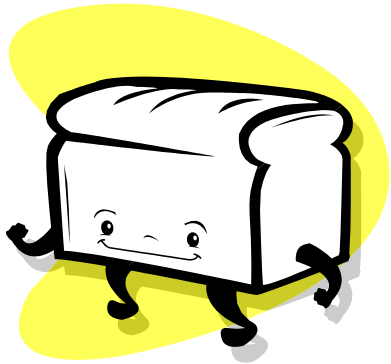
Isoflavones

Zheng et al. J. Agric. Food Chem. Vol. 51, No. 26, 2003

1. Compared wheat and soy fortified breads
2. Prepared bread extracts
3. In vitro cancer cells
4. Monitored prostate cancer growth

BAKING

- Proofing at 50°C for 1 h.
- Baking 165°C for 50 min.



Isoflavones

Wheat Bread vs. Soy Bread

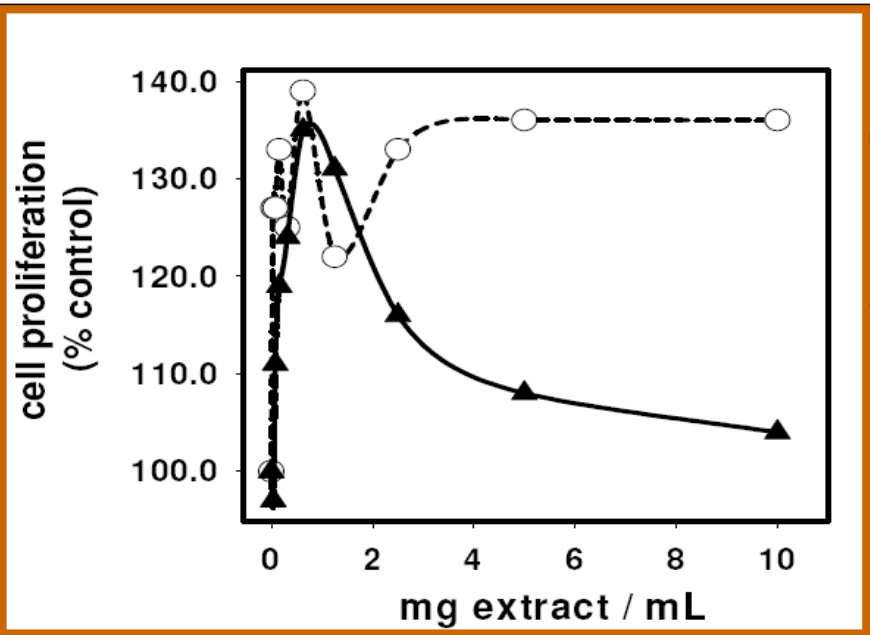


Figure. The effects of the control (wheat) bread extract and soy bread extract on the proliferation of PC-3 prostate cancer cells.

Zheng et al. J. Agric. Food Chem., Vol. 51, No. 26, 2003

Isoflavones

Soy Bread Crust vs. Soy Bread Crumb

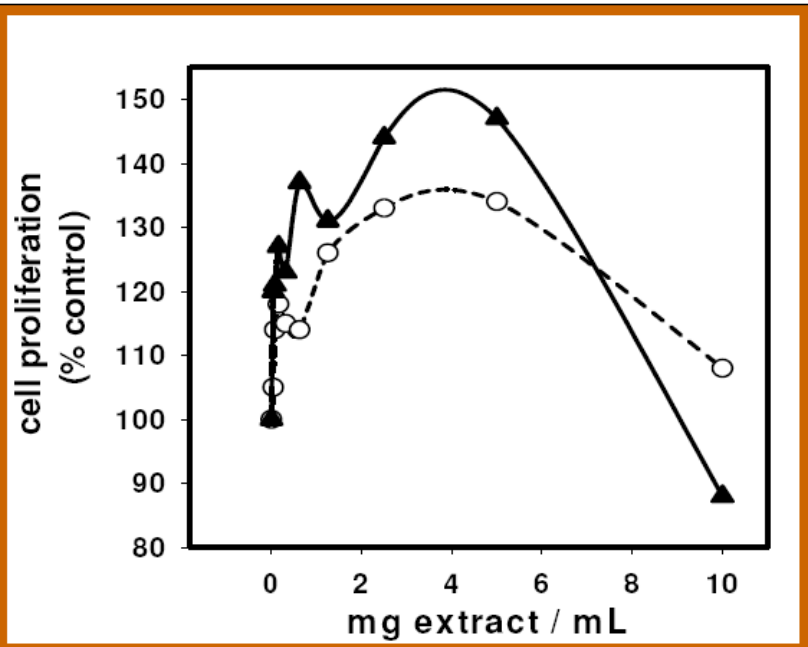


Figure. The effects of soy bread extract (crust and crumb) on the proliferation of PC-3 prostate cancer cells.

Zheng et al. J. Agric. Food Chem., Vol. 51, No. 26, 2003

Isoflavones

Zheng et al. J. Agric. Food Chem. Vol. 51, No. 26, 2003

1. Soy crust was found to be the most effective compound

2. Maillard reactions

3. Formation of anti-oxidant and anti-cancer compounds.

Conclusions

- Soy flour improves the nutritional attributes of bread not only by increasing protein but also isoflavone content.

- Soy isoflavones are stable and also enhanced during baking process.

- Supplementing soy flour in bread is a good method of increasing isoflavone intake from bread products.

Isoflavones

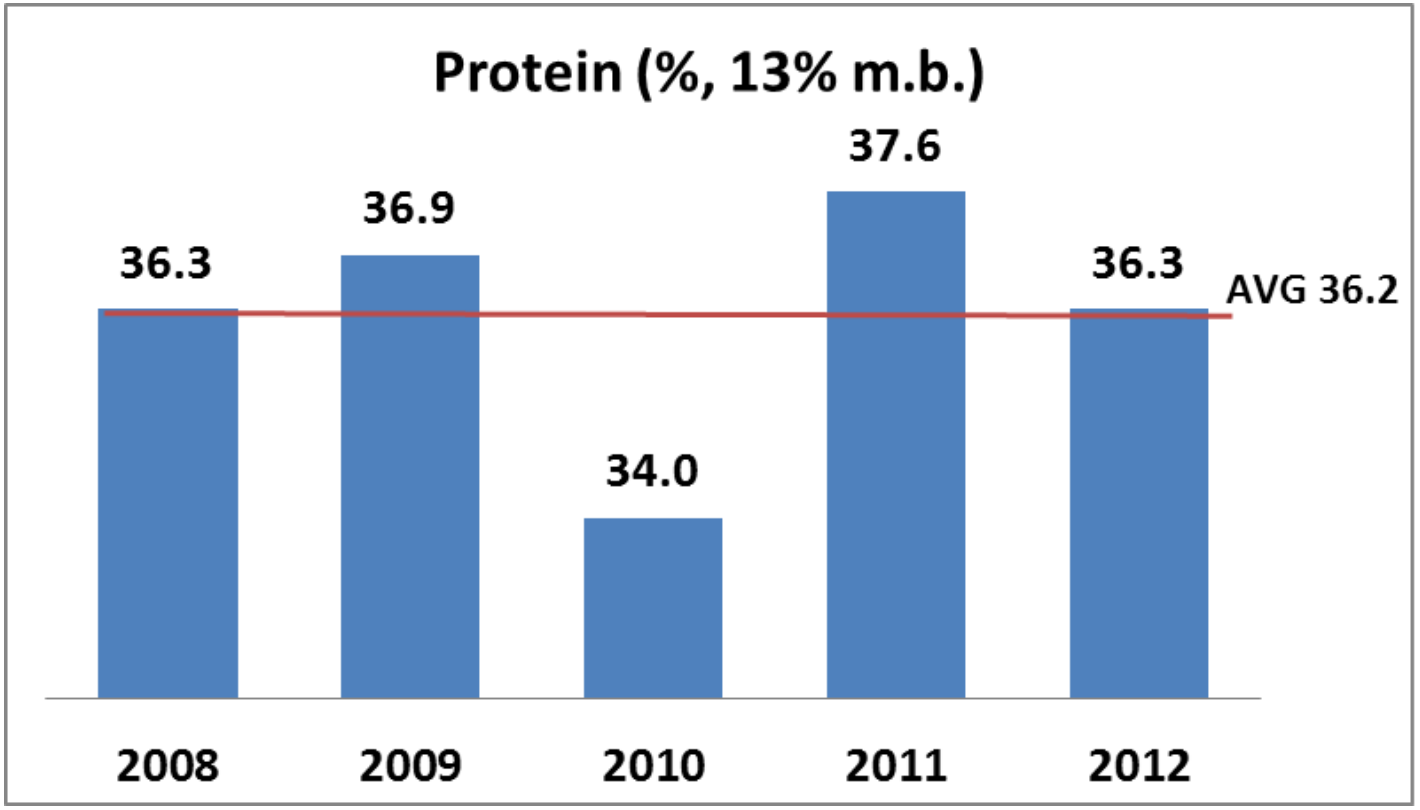
	Serving Size	Total g soy protein/serving	Total mg isoflavone/serving
Miso	1 Tbsp	2	7
Soybeans, Green, Cooked	1/2 cup	11	50
Soybeans, Black, Cooked	1/2 cup	9	40
Soybeans, Yellow, Cooked	1/2 cup	14	78
Soybeans, Roasted, Plain	1/4 cup	15	78
Soymilk, Plain, Unfortified	1 cup	7	10
Soy Flour, Defatted	1/4 cup	12	42
Soy Flour, Full-Fat	1/4 cup	8	33
Soy Flour, Low-Fat	1/4 cup	11	50
Soy Crumbles, Meat Alternative	1/2 cup	11	9
Soy Protein Isolate Powder, Plain	1/3 cup	23	53
Textured Soy Protein, Dry	1/4 cup	11	33
Tempeh	1/2 cup	16	53
Tofu	1/2 cup	10	25

Soybean Quality

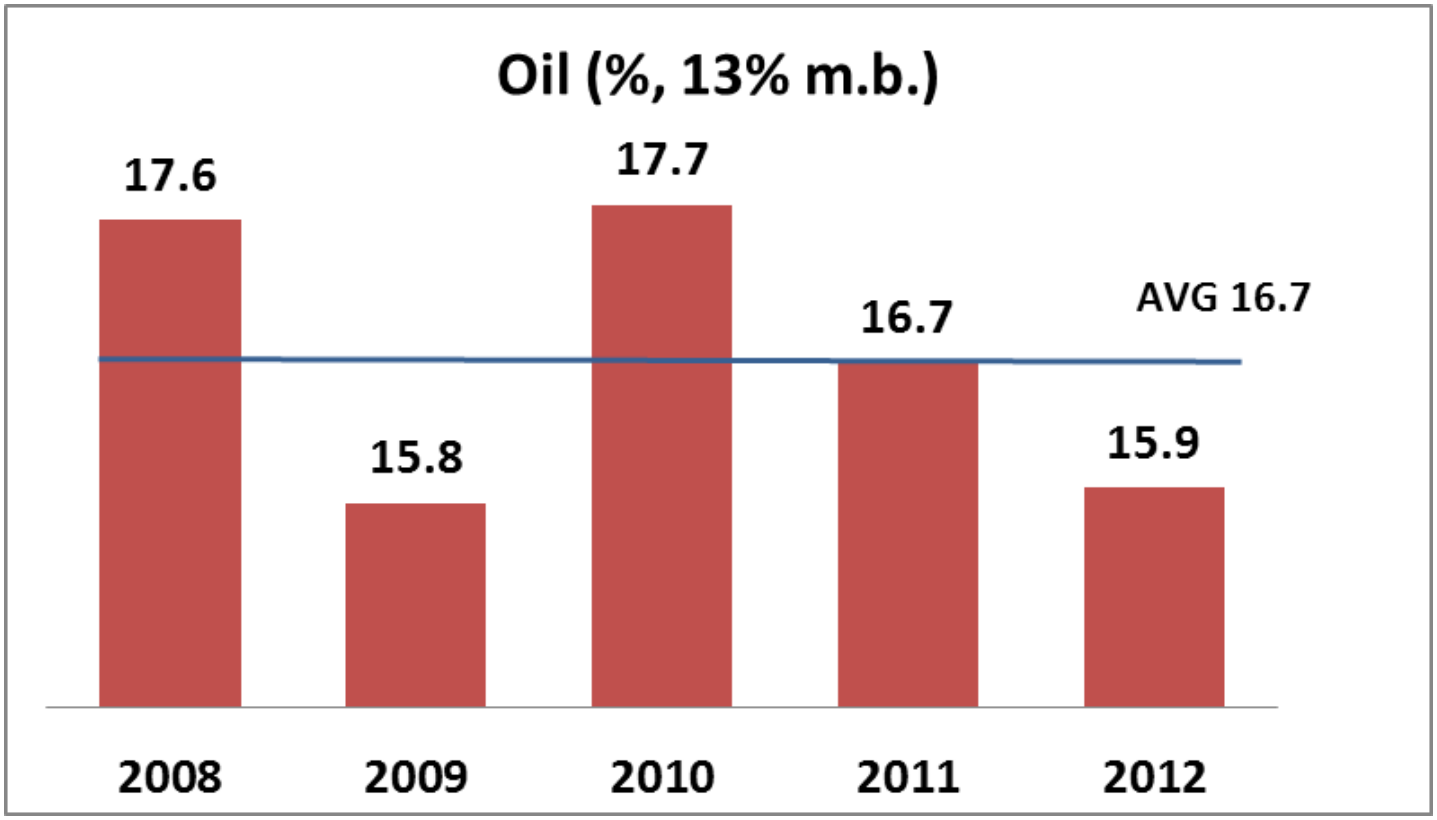
Environmental impact on soybean protein and oil quality

Environmental variable	Protein impact	Oil Impact
Early season drought	Negative	Positive
Late season drought	Positive	Negative
Early frost/cold temperatures	Negative	Negative
Additional soil nitrogen	Positive	Negative
Increase soil fertility (P or S)	Positive	Positive
Late planting	Positive	Negative
Insect defoliation	Negative	Negative

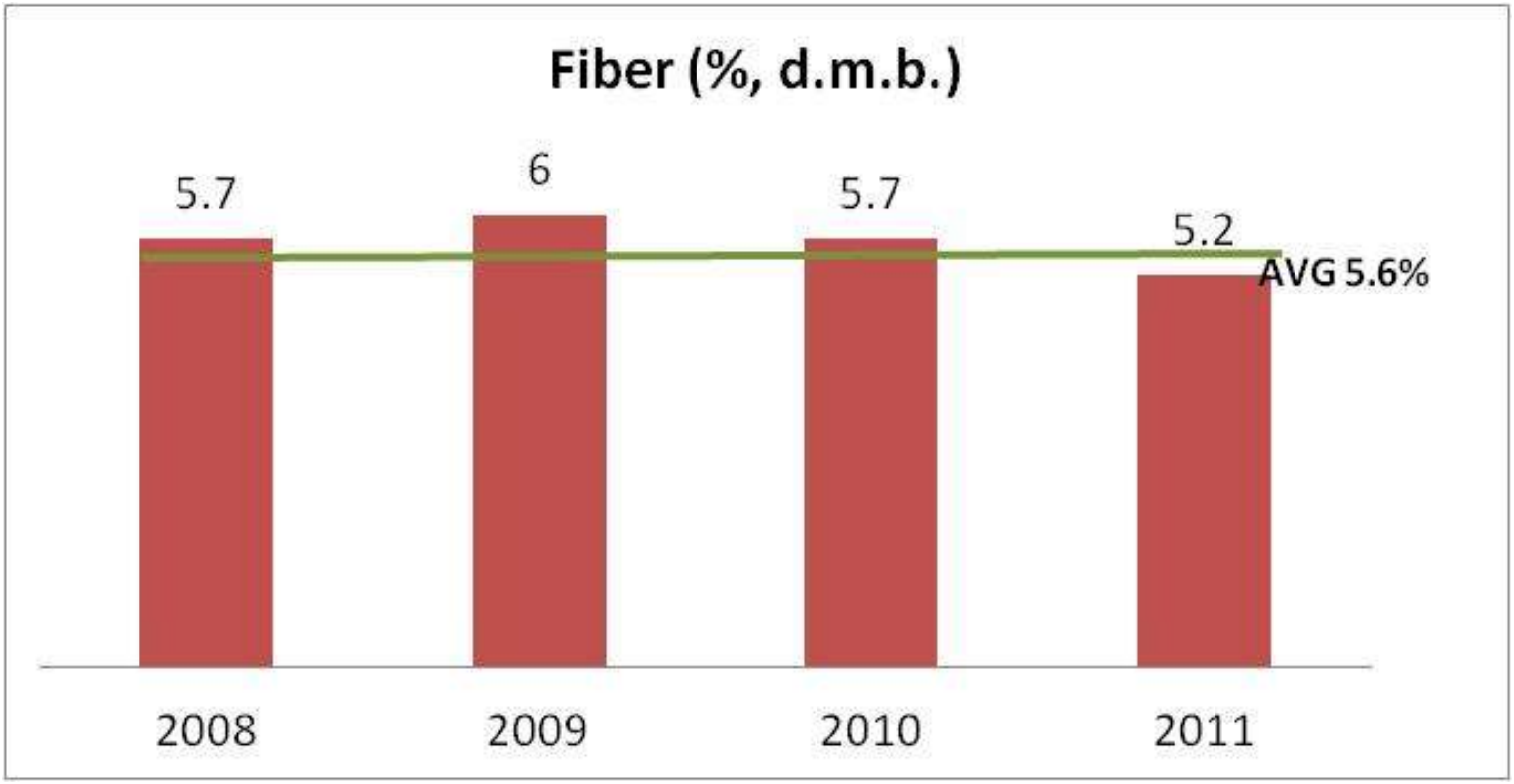
Protein content



Oil content



Fiber content



Sugar content

Region	Seed size	Sucrose	Raffinose	Stachyose
Northern	Small	5.48	0.56	3.64
	Average	5.09	0.53	3.64
	Large	4.89	0.52	3.76
Central	Small	5.20	0.54	3.98
	Average	4.58	0.53	3.77
	Large	4.46	0.50	3.67

§ Small seed: ≤13.0 g/100 seeds; Average: 13.1-21.0 g/100 seeds; Large: >21 g/100 seeds (unofficial categories)
‡ Northern region = Michigan, Minnesota, North Dakota, and Wisconsin; Central region = Illinois, Indiana, Iowa, Missouri, Nebraska, and Ohio

Adapted from Seth et. al (2011) Quality of the United States Food Soybean Crop: 2011

Soybean requirements for soy foods

Soymilk	High protein and protein solubility, low acidity, white soymilk color, good taste
Tofu	High protein, high 11S/7S ratio, high protein solubility, low acidity, good taste
Tempeh	High protein, high 11S/7S ratio, high protein solubility, low acidity, good taste

Information courtesy of Dr. Sam K.C. Chang (2010)

Effect of soybeans component on soymilk and tofu quality

Major Factors	Soybean cultivar, processing, and storage practice
Other factors	Location (environment of growth) and handling practice

- Prolonged postharvest storage of soybeans will decrease the quality of edible soybean .
- Low humidity may effectively preserve the original bean qualities even at high temperature (Saio and others 1980).

Soybean storage

Changes in soybeans during storage include:

- Surface discoloration
- Mailard reaction
- Loss in protein extractability
- Increase in acidity and decrease in pH
- Decrease phospholipid content
- Changes in isoflavone forms
- Degraded of total free sugar

Chang SE. 2007. Handbook of Food Products Manufacturings: Soymilk and tofu manufacturing. John Wiley and Sons, Inc. New York, NY.

Soybean storage

- When soybeans are stored in adverse conditions, the decrease in quality and yield of soymilk and tofu are the results.
  - Example: Soymilk darkened, low protein and solid recovery, rancid flavor, tofu yield reduced, tofu texture hardened.
- Hou and Chang (2005) reported that soybeans in conditions of 57% RH 20°C, cool 4°C or in an uncontrolled ambient temperature condition in North Dakota could remain their soymilk and tofu qualities for up to 18 months.

Northern Identity Preserved Soybean

IP soybean from northern U.S. are recognized as the world's finest quality food-grade soybean- high demand throughout Asia.

Advantage:

- High quality due to fertile soils, ample rainfall, and temperature suitable for soybean production.
- Minimum disease and insect pressure- due to experienced farm management and the cool storage conditions.
- Leading breeding technology- aggressive breeding programs continually respond to changing customer demands.
  - ✓ Different soybean varieties were developed for specific food usage.
- 4-6 generations family owned companies with the state of the art processing facility.

Summary

- Soybeans are versatile and can be used in many food product applications.
- Soybean are nutritious foods for human consumption.
- Soybean benefits include cancer prevention, improve heart health, and alleviate postmenopausal symptoms.
- Many factors impact soybean qualities
  - Locations, storage practice, handling practices.

Thank you for your time

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