

Soybean

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Soybean



Scientific classification

Kingdom: Plantae
Phylum: Magnoliophyta
Class: Magnoliopsida
Order: Fabales
Family: Fabaceae
Subfamily: Faboideae
Genus: Glycine
Species: ***G. max***

Binomial name

Glycine max

The **soybean** (U.S. and UK) or **soya bean** (UK) (*Glycine max*) is a species of legume native to eastern Asia. It is an annual plant that may vary in growth habit and height. It may grow prostrate, not growing higher than 20 cm (7.8 inches), or even stiffly erect up to 2 meters (6.5 feet) in height. The pods, stems, and leaves are covered with fine brown or gray pubescence. The leaves are trifoliolate (sometimes with 5 leaflets), and the leaflets are 6-15 cm (2-6 inches) long and 2-7 cm (1-3 inches) broad; they fall before the seeds are mature. The small, inconspicuous, self-fertile flowers are borne in the axil of the leaf and are either white or purple. The fruit is a hairy pod that grows in clusters of 3-5, with each pod 3-8 cm (1-3 inches) long and usually containing 2-4 (rarely more) seeds 5-11 mm in diameter.

Like corn and some other crops of long domestication, the relationship of the modern soybean to wild-growing species can no longer be traced with any degree of certainty. It is a cultural variety (a cultigen) with a very large number of cultivars. However, it is known that the progenitor of the modern soybean was a vine-like plant, that grew prone on the ground.

Beans are classed as pulses whereas soybeans are classed as oilseeds. The word soy is derived from the Japanese word shoyu (soy sauce/soya sauce).

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Physical characteristics

Soybeans occur in various sizes, and in several hull or seed coat colors, including black, brown, blue, yellow, and mottled. The hull of the mature bean is hard, water resistant, and protects the cotyledon and hypocotyl (or "germ") from damage. If the seed coat is cracked the seed will not germinate. The scar, visible on the seed coat, is called the hilum (colors include black, brown, buff, gray and yellow) and at one end of the hilum is the micropyle, or small opening in the seed coat which can allow the absorption of water.

It is a remarkable fact that seeds such as soybeans, containing very high levels of soy protein, can undergo desiccation yet survive and revive after water absorption. A. Carl Leopold, son of Aldo Leopold, set out twenty years ago to answer this very question at the Boyce Thompson Institute for Plant Research at Cornell University. Studying the survival of soybeans and corn he found each to have a range of soluble sugars carbohydrate protecting the seed's cell viability. Patents were awarded to him in the early 1990s on techniques for protecting "biological membranes" and proteins in the dry state.

Chemical composition of the seed

The oil and protein content together account for about 60% of dry soybeans by weight; protein at 40% and oil at 20%. The remainder consists of 35% carbohydrate and about 5% ash. Soybean cultivars comprise approximately 8% seed coat or hull, 90% cotyledons and 2% hypocotyl axis or germ.

The majority of soy protein is a relatively heat-stable storage protein. It is this heat-stability of the soy protein that enables soy food products requiring high temperature cooking, such as tofu, soymilk and textured vegetable protein (soy flour) to be made.

The principal soluble carbohydrates, saccharides, of mature soybeans are the disaccharide sucrose(range 2.5-8.2%), the trisaccharide raffinose(0.1-1.0%) composed of one sucrose molecule connected to one molecule of galactose, and the tetrasaccharide stachyose(1.4 to 4.1%) composed of one sucrose connected to two molecules of galactose. While the oligosaccharides raffinose and stachyose protect the viability of the soybean seed from desiccation {see above section on physical characteristics} they are not digestible sugars and therefore contribute to flatulence and abdominal discomfort in humans and other

monogastric animals. Undigested oligosaccharides are broken down in the intestine by native microbes producing gases such as carbon dioxide, hydrogen, nitrogen, methane, etc.

Since soluble soy carbohydrates are found mainly in the whey and are broken down during fermentation, soy concentrate, soy protein isolates, tofu, soy sauce, and sprouted soybeans are without flatus activity. On the other hand, there may be some beneficial effects to ingesting oligosaccharides such as raffinose and stachyose, namely, encouraging indigenous bifidobacteria in the colon against putrefactive bacteria.

The insoluble carbohydrates in soybeans consist of the complex polysaccharides cellulose, hemicellulose, and pectin. The majority of soybean carbohydrates can be classed as belonging to dietary fiber.

Cultivation



Varieties of soybeans are used for many purposes.

Soybeans are an important global crop. It is grown for its oil and protein. The bulk of the crop is solvent extracted for vegetable oil and then defatted soy meal is used for animal feed. A very small proportion of the crop is consumed directly for food by humans. Soybean products, however, appear in a large variety of processed foods.

Soybeans have been a crucial crop in eastern Asia since long before written records, and they are still a major crop in China, Korea, and Japan today. Soy was not actually used as a food item until they discovered fermentation techniques around 2000 years ago. Prior to fermented products such as soy sauce, tempeh, natto, and miso, soy was considered sacred for its use in crop rotation as a method of fixing nitrogen. The plants would be plowed under to clear the field for food crops.^[*citation needed*] Soy was first introduced to Europe in the early 1700s and the United States in 1765, where it was first grown for hay. Benjamin Franklin wrote a letter in 1770 mentioning sending soybeans home from England. Soybeans did not become an important crop outside of Asia until about 1910. In America, soy was considered an industrial product only and not utilized as a food prior to the 1920's.

Cultivation is successful in climates with hot summers, with optimum growing conditions in mean temperatures of 20 °C to 30 °C (68°F to 86°F); temperatures of below 20 °C and over 40 °C (68 °F, 104 °F) retard growth significantly. They can grow in a wide range of

soils, with optimum growth in moist alluvial soils with a good organic content. Soybeans, like most legumes perform nitrogen fixation by establishing a symbiotic relationship with the bacterium *Bradyrhizobium japonicum* (syn. *Rhizobium japonicum*; Jordan 1982). However, for best results an inoculum of the correct strain of bacteria should be mixed with the soybean (or any legume) seed before planting. Modern crop cultivars generally reach a height of around 1 m (3 ft), and take between 80-120 days from sowing to harvesting.

Top Soybean Producers <i>in 2005</i>	
(million metric tons)	
 <u>United States</u>	83.9
 <u>Brazil</u>	52.7
 <u>Argentina</u>	38.3
 <u>China</u>	17.4
 <u>India</u>	6.6
 <u>Paraguay</u>	3.5
 <u>Canada</u>	3.0
 <u>Bolivia</u>	1.7
 <u>Italy</u>	0.5
World Total	214.3
<i>Source:</i> <u>UN Food & Agriculture Organisation</u> (FAO)	

Soybeans are native to southeast Asia, but 45 percent of the world's soybean area, and 55 percent of production, is in the United States. The U.S. produced 75 million metric tons of soybeans in 2000, of which more than one-third was exported. Other leading producers are Brazil, Argentina, China, and India.

Environmental groups, such as Greenpeace and the WWF, have reported that soybean cultivation and the threat to increase soybean cultivation in Brazil is destroying huge

areas of Amazon rainforest and encouraging deforestation. Besides destruction of the rainforest, it destroys unique biodiversity and causes a billion dollar's loss on technology from bionics revenue. American soil scientist, Dr. Andrew McClung, who first showed that the infertile Cerrado region of Brazil could grow soybeans will be awarded the 2006 World Food Prize on October 19,2006.

The first research on soybeans in the United States was conducted by George Washington Carver at Tuskegee, Alabama, but he decided it was too exotic a crop for the poor black farmers of the South so he turned his attention to peanuts. Peanuts, soybeans, or other legume plants that would replenish the soil with nitrogen and minerals were planted for two years and then cotton on the third year. A two-year rotation system alternating maize and soybeans is common in much of the U.S.

Uses

Soybeans can be broadly classified as "vegetable" (garden) or field (oil) types. Vegetable types cook more easily, have a mild nutty flavor, better texture, are larger in size, higher in protein, and lower in oil than field types. Tofu and soymilk producers prefer the higher protein cultivars bred from vegetable soybeans originally brought to the United States in the late 1930s. The "garden" cultivars are generally not suitable for mechanical combine harvesting because they have a tendency for the pods to shatter on reaching maturity.

Among the legumes, the soybean, also classed as an oilseed, is pre-eminent for its high (38-45%) protein content as well as its high (20%) oil content. Soybeans are the leading agricultural export in the United States. The bulk of the soybean crop is grown for oil production, with the high-protein defatted and "toasted" soy meal used as livestock feed. A smaller percentage of soybeans are used directly for human consumption.

Soybeans may be boiled whole in their green pod and served with salt, under the Japanese name edamame (IPA pronunciation: [eda-maa-me]). Soybeans prepared this way are a popular local snack in Hawai'i, where, as in China, Japan, and Korea the bean and products made from the bean are a popular part of the diet. In Korean cuisine, soybean sprouts are also used in a variety of dishes.

The beans can be processed in a variety of ways. Common forms of soy (or *soya*) include soy meal, soy flour, "soy milk", tofu, textured vegetable protein (TVP, which is made into a wide variety of vegetarian foods, some of them intended to imitate meat), tempeh, soy lecithin and soybean oil. Soybeans are also the primary ingredient involved in the production of soy sauce (or *shoyu*).



Soybeans grow throughout Asia and North and South America.

Genetic Modification

Soybeans are one of the "Biotech Food" crops that are being genetically modified, and GMO soybeans are being used in an increasing number of products. Monsanto is the world's leader in genetically modified soy for the commercial market. In 1995, Monsanto introduced "Roundup Ready" (RR) soybeans that have had a complete copy of a gene plasmid from the bacteria, *Agrobacterium* sp. strain CP4, inserted, by means of a gene gun, into its genome that allows the transgenic plant to survive being sprayed by this non-selective, glyphosate-based herbicide. Roundup kills conventional soybeans. RR soybeans allow a farmer to reduce tillage or even to sow the seed directly into an unplowed field, known as 'No Plow' tillage, greatly reducing soil erosion.

Currently, 81% of all soybeans cultivated for the commercial market are genetically modified. As with other "Roundup Ready" crops, concern is expressed over damage to biodiversity.

Liu, KeShun (1997). *Soybeans: Chemistry, Technology, and Utilization* Chapman & Hall.]

Archer Daniels Midland (ADM) is among the largest processors of soybeans and soy products. ADM along with DOW, DuPont and Monsanto support the industry trade

associations United Soybean Board (USB) and Soyfoods Association of North America (SANA). These trade associations have increased the consumption of soy products dramatically in recent years. - - The dramatic increase is largely credited to the Food and Drug Administration's (FDA) approval of health claims for soy which very likely is unfounded (see 6.3 Reduce Cholesterol?). Since the bulk of the soy grown in the US is GMO variety the chief beneficiaries of the increase are the biotech seed companies. Dr. Jane E. Henney who was the FDA commissioner at the time, now sits on the board of biotech giant Astra Zeneca. Many top agency officials from the Bush Administration, have been under criticism for close ties to industry and possible financial conflicts of interest. The former USDA Secretary of Agriculture, Daniel Robert Glickman, also left to accept seats on the boards of soy related companies including Hain Foods. - - From 2001 to 2004, food manufacturers in the US introduced over 1600 new foods with soy as an ingredient, averaging 400 new products per year, according to the Mintel's Global New Products Database. - - From 1992 to 2003, soyfoods sales have experienced a 15% compound annual growth rate, increasing from \$300 million to \$3.9 billion over 11 years, as new soyfood categories have been introduced, soyfoods have been repositioned in the market place, and new customers have selected soy for health and philosophical reasons. Dramatic growth followed the FDA approval of a health claim linking soy with heart disease reduction.

Oil

In processing soybeans for oil extraction and subsequent soy flour production, selection of high quality, sound, clean, dehulled yellow soybeans is very important. Soybeans having a dark colored seed coat, or even beans with a dark hilum will inadvertently leave dark specks in the flour, an undesirable factor when used in food products. All commercial soybeans in the United States are yellow or yellow brown.

To produce soybean oil, the soybeans are cracked, adjusted for moisture content, rolled into flakes and solvent-extracted with commercial hexane. The oil is then refined, blended for different applications, and sometimes hydrogenated. Soybean oils, both liquid and partially hydrogenated, are exported abroad, sold as "vegetable oil," or end up in a wide variety of processed foods. The remaining soybean husks are used mainly as animal feed.

The major unsaturated fatty acids in soybean oil triglycerides are linolenic acid, C18:3; linoleic acid, C-18:2; and oleic acid, C-18:1. Soybean oil has a relatively high proportion, 7-10%, of oxidation prone linolenic acid, which is an undesirable property for continuous service, such as in a restaurant. Two companies, Monsanto and DuPont/Bunge in 2004 introduced low linolenic, (C18:3; cis-9, cis-12, cis-15 octadecatrienoic acid) Roundup Ready soybeans: the former introduced a new soybean seed variety called "Vistive" and the latter Pioneer seed variety 93M20. Dupont/Bunge is marketing its low linolenic soybean oil under the brand name Nutrium. The idea is that reducing or eliminating the triple unsaturated fatty acid, linolenic, also eliminates the tendency to be a paint-like drying oil producing noticeable rancidity. In the past hydrogenation reduced the unsaturation in linolenic acid but produced the unnatural trans fatty acid trans fat configuration whereas in nature the configuration is cis.

One unintended consequence of moving away from partially hydrogenated soybean oil (containing trans fatty acids) is the switch to partially saturated palm oil for frying, especially in China. This fact is resulting in a severe threat of deforestation to pristine forests in Indonesia followed by the planting of oil palm plantations. ^[1] Center for Science in the Public Interest

In the 2002-2003 growing season, 30.6 million metric tons of soybean oil were produced worldwide, constituting about half of worldwide edible vegetable oil production, and thirty percent of all fats and oils produced, including animal fats and oils derived from tropical plants.

Meal

Soybean meal, the material remaining after solvent extraction of soybean flakes, with a 50% soy protein content, toasted (a misnomer because the heat treatment is with moist steam), and ground, in a hammer mill, provided the energy for the American revolution, beginning in the 1930s, of growing farm animals such as poultry and swine on an industrial scale; and more recently the aquaculture of catfish.

Flour

Soy flour refers to defatted soybeans where special care was taken during desolventizing (not toasted) in order to minimize denaturation of the protein to retain a high Nitrogen Solubility Index (NSI), for uses such as extruder texturizing (TVP). It is the starting material for production of soy concentrate and soy protein isolate.

- Defatted soy flour, is obtained from solvent extracted flakes, and contains less than 1% oil.
- Full-fat soy flour, is made from unextracted, dehulled beans, and contains about 18% to 20% oil. Due to its high oil content a specialized Alpine Fine Impact Mill must be used for grinding rather than the more common hammermill.
- Low fat soy flour, is made by adding back some oil to defatted soy flour. The lipid content varies according to specifications, usually between 4.5% and 9%.
- High fat soy flour, is produced by adding back soybean oil to defatted flour, at the level of 15%.
- Lecithinated soy flour, is made by adding soybean lecithin to defatted, low fat or high fat soy flours to increase their dispersibility and impart emulsifying properties. The lecithin content varies up to 15%.

Infant formula

Infant formulas based on soy are used by lactose-intolerant babies; and for babies that are allergic to human milk proteins and cow milk proteins. The formulas are sold in powdered, ready to feed, or concentrated liquid forms.

It has been recommended internationally by pediatric associations that soy formulas not be used as the primary or sole source of nutrition for infants due to the high risk of several deficiencies including calcium and zinc.

Substitute for existing products

Many traditional dairy products have been imitated using processed soybeans, and imitation products such as "soy milk," "soy yogurt" and "soy cream cheese" are readily

available in most supermarkets. These imitation products are derived from extensive processing to produce a texture and appearance similar to the real dairy-based ones. Soy milk does not contain significant amounts of calcium, since the high calcium content of soybeans is bound to the insoluble constituents and remains in the pulp. Many manufacturers of soy milk now sell calcium-enriched products as well.

Other products

Soybeans are also used in industrial products including oils, soap, cosmetics, resins, plastics, inks, crayons, solvents, clothing, and biodiesel. Soybeans are also used as fermenting stock to make a brand of vodka.

Henry Ford promoted the soybean, helping to develop uses for it both in food and in industrial products, even demonstrating auto body panels made of soy-based plastics. Ford's interest led to 2 bushels of soybeans being used in each Ford car as well as products like the first commercial soy milk, ice cream and all-vegetable non-dairy whipped topping.

The Ford development of so called soy-based plastics was based on the addition of soybean flour and wood flour to phenolformaldehyde plastics.

In 1931 Ford, who said, "most people dig their graves with their teeth", hired the chemists Robert Boyer and Frank Calvert in a "Quest" for artificial silk. They succeeded in making a textile fiber of spun soy protein fibers, hardened or tanned in a formaldehyde bath which was given the name Azlon by the Federal Trade Commission. Pilot plant production of Azlon reached 5000 pounds per day in 1940, but never reached the commercial market. However, Henry Ford did have the "now famous" suit made for him of Azlon which he wore on special occasions. The winning textile fiber in the "Quest" for artificial silk was, of course, Nylon a synthetic polyamide or artificial protein discovered in 1935 by Wallace H. Carothers at DuPont. [Soybeans and Soybean Products, Vol.II, edited by K.H. Markley, 1951]

Today, very high quality textile fibers are made commercially from okara or soy pulp, a by-product of tofu production.

Nutrition

Protein

Soybeans are a source of complete protein. A complete protein is one that contains significant amounts of all the essential amino acids that must be provided to the human body because of the body's inability to synthesize them. For this reason, soy is important to many vegetarians and vegans. Soy protein is similar to that of other legume seeds, but has the highest yield per square meter of growing area, and is the least expensive source of dietary protein. The only non-legume to have an almost identical protein profile to soy is the cereal oat (*Avena sativa*), and perhaps quinoa. However, rapeseed/Canola may actually even have a better amino acid profile than soy protein.

The original Protein Efficiency Ratio PER method of measuring soy protein quality was found to be flawed for humans because the young rats used in the study have higher relative requirements for sulfur-containing amino acids. The FAO/WHO (1990) adapted a new method: Protein Digestibility Corrected Amino Acid Score. Based on the new method, soy protein is considered equivalent in quality to animal proteins.

Egg white has a score of 1.00, isolated soy protein 0.92, soy concentrate 0.99, beef 0.92. The digestibilities of some soyfoods are as follows: steamed soybeans 65.3%, tofu 92.7%, soy "milk" 92.6%, soy protein isolate 93–97% (Watanabe, et al., 1971 (in Japanese) cited on page 391 in *Liu, KeShun (1997). *Soybeans: Chemistry, Technology, and Utilization* Chapman & Hall.]

Vitamins and minerals



Toasted soybeans

Of any studied legume, whole soybeans have the highest levels of phytic acid, an organic acid and mineral chelator present in many plant tissues, especially bran and seeds, which

binds to certain ingested minerals: calcium, magnesium, iron, and especially zinc—in the intestinal tract, and reduces the amount the body assimilates. For people with a particularly low intake of essential minerals, especially young children and those in developing countries, this effect can be undesirable. However, dietary mineral chelators help prevent over-mineralization of joints, blood vessels, and other parts of the body, which is most common in older persons. The Journal of Environmental Nutrition (April 2004 volume 27 issue also indicates that it may reduce the risk of colon cancer.

The role of soyfoods in disease prevention

Omega-3 fatty acids

Omega-3 fatty acids, for example, linolenic acid C18-3, all cis, 9,12,15 octadecatrienoic acid (where the omega-3 refers to carbon number 3 counting from the hydrocarbon tail whereas C-15 refers to carbon number 15 counting from the carboxyl acid head) are special fat components that benefit many body functions. For instance, they inhibit blood clotting. Soybean oil is one of the only common vegetable oils that contains a significant amount of omega-3s; others include canola, walnut, and flax.

Isoflavones

Soybeans also contain isoflavones, a type of phytoestrogen, that are considered by some nutritionists and physicians to be useful in the prevention of cancer and by others to be carcinogenic and endocrine disruptive. Soy's high levels of phytoestrogens are the subject of heated debate and controversy. They are also blamed for some thyroid and reproductive health problems. Isoflavones are polyphenol compounds, produced primarily by beans and other legumes, including peanuts and chickpeas.

Isolated phytoestrogen like isoflavones are an active area of research. The Proceedings of the National Academy of Sciences May 28, 2002 contains the article "The phytoestrogen genistein induces thymic and immune changes: A human health concern?" It studies the effect of the isolated soy isoflavones genistein and daidzein, commonly found in dietary supplements and infant formulas, on adult mice with their ovaries removed. The study found the mice had thymic and immune system abnormalities and reduction in immune

system activity that suggest further research into human phytoestrogen response is warranted.

From a website that advertises [saliva pH alkalinity](#) as a form of [cancer](#) protection:

"Researchers [Daniel Doerge](#) and [Daniel Sheehan](#), two of the FDA's experts on soy, signed a letter of protest, which points to studies that show a link between soy and health problems in certain animals. The two say they tried in vain to stop the FDA approval of soy because it could be misinterpreted as a broader general endorsement beyond benefits for the heart."

The anti-soy website [Soy Online Service](#) has the original letter in [pdf](#).

The FDA has since publicly rejected these claims due to lack of evidence and cite numerous studies that uphold the health benefits of soy foods.

Reduce cholesterol?

In 1995, the New England Journal of Medicine (Vol. 333, No. 5) published a report from the [University of Kentucky](#) entitled, "Meta-Analysis of the Effects of Soy Protein Intake on Serum Lipids." It was financed by the PTI division of DuPont, "The Solae Co." [11] [St. Louis, Missouri](#), a soy producer and marketer. This meta-analysis concluded that soy protein is correlated with significant decreases in serum cholesterol, Low Density Lipoprotein [LDL](#) (bad cholesterol) and triglyceride concentrations. However, High Density Lipoprotein [HDL](#) (good cholesterol) did not increase by a significant amount. Soy [phytoestrogens](#) ([isoflavones](#): genistein and daidzein) [adsorbed](#) onto the soy protein were suggested as the agent reducing serum cholesterol levels. On the basis of this research PTI, in 1998, filed a petition with FDA for a health claim that soy protein may reduce cholesterol and the risk of heart disease. It should be noted that only subjects with serum cholesterol of 250mg/dl and higher showed any improvement in the study.

The FDA granted this health claim for soy: "25 grams of soy protein a day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease." One serving, (1 cup or 240 mL) of soy milk, for instance, contains 6 or 7 grams of soy protein. Solae resubmitted their original petition, asking for a more vague health claim, after their

original was challenged and highly criticised. Solae also submitted a petition for a health claim that soy can help prevent cancer. They quickly withdrew the petition for lack of evidence and after more than 1000 letters of protest were received.

In January, 2006 an American Heart Association review (in the journal *Circulation*) of a decade long study of soy protein benefits casts doubt on the FDA allowed "Heart Healthy" claim for soy protein. This review of the literature compared soy protein and its component isoflavones with casein (isolated milk protein), wheat protein, and mixed animal proteins. The review panel also found that soy isoflavones have not been shown to reduce post menopause "hot flashes" in women and the efficacy and safety of isoflavones to help prevent cancers of the breast, uterus or prostate is in question. Thus, soy isoflavone supplements in food or pills is not recommended. Among the conclusions the authors state, "In contrast, soy products such as tofu, soy butter, soy nuts, or some soy burgers should be beneficial to cardiovascular and overall health because of their high content of polyunsaturated fats, fiber, vitamins, and minerals and low content of saturated fat. Using these and other soy foods to replace foods high in animal protein that contain saturated fat and cholesterol may confer benefits to cardiovascular health."

The original paper is in the journal *Circulation*: January 17,2006

Potential problems with soy



The neutrality of this section is disputed.

Please see the discussion on the [talk page](#).

Phytoestrogen

Soybean isoflavones (isoflavonoids) are not the primary source of phytoestrogens in the human diet. Plant lignans associated with high fiber foods such as cereal brans and beans are the principal precursor to mammalian lignans which have an ability to bind to human estrogen sites, thus mimicking the hormone estrogen. The best source of lignans is flax seed but soybeans are a significant source of mammalian lignan precursor secoisolariciresinol containing 13-273 µg/100 g dry weight. A third phytoestrogen, in the human diet, with stronger estrogen activity than either isoflavones or lignan but much less well studied is coumestans which are found in beans, split-peas, with the best sources being alfalfa, clover, and soybean sprouts. Coumesterol, an isoflavone coumarin derivative is the only coumestan in foods. ^{[3][4]}

Phytoestrogen in men

Because of the phytoestrogen content, some studies suggest that there is a correlation between a soybean-rich diet and a decrease in the level of testosterone in men, although these findings are controversial.

A study carried out at the Royal Victoria Hospital in Belfast linked soy to male infertility, including damage of reproductive capability already caused during childhood. The study also points out that "soy is not just consumed by vegetarians, it is contained in a lot of everyday processed foods."

Phytoestrogen in infant formula

There are some studies that suggest that a phytoestrogen in soy can lead to alterations in the proliferation and migration of intestinal cells. The effects of these alterations are unknown. However, some studies conclude there are no adverse effects in human growth, development, or reproduction as a result of the consumption of soy-based infant formula.

Other studies conclude that more research is needed to answer the question of what effect phytoestrogens have on infants.

Allergens

With the increased use of soybean in western diet comes also a danger of food allergies. About 8% of children in the USA are allergic to soybean proteins. The major soy allergen has been identified by scientists at USDA. Both transgenic and conventional soybean varieties without the allergenic protein have been prepared, and hopefully will soon reach the market. This will be particularly important for preparation of baby formulas, since dual allergy to both milk and soy proteins is not uncommon. Soya allergy, typically, will manifest itself approximately a day after consumption of the beans. Common symptoms are urticaria, rash, itching, and redness of the skin. ^[citation needed]

Thyroid effects

Eating as little as 35 grams of soy protein per day (just 10 grams over the amount recommended by the U.S. Food and Drug Administration) has been said to cause thyroid function suppression in previously healthy adult women and men.

Cancer

A 1985 animal study showed that young rats fed large amounts of soy products as their primary food source showed an increased risk of pancreatic cancer. This is probably because rats are extremely sensitive to dietary protease inhibitors like those found in soybeans, which can disrupt the action of digestive enzymes needed to break down protein. This condition has not been found in many other animals, and is not known to occur in humans.