



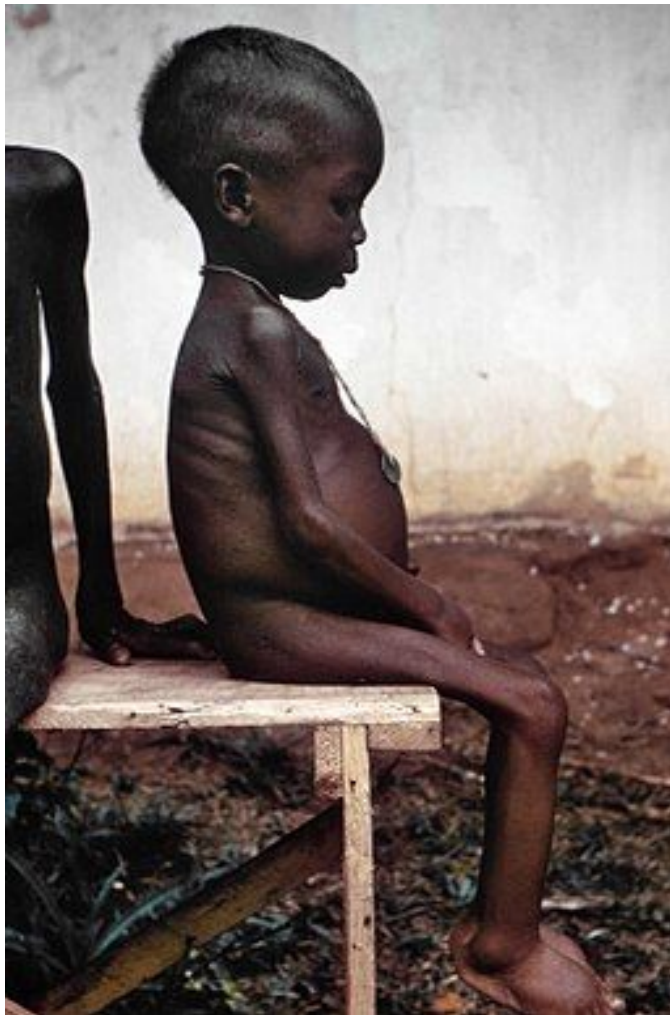
Sylvia R. Karasu M.D.
The Gravity of Weight

The 'Soy-ling' of Our Food: The Versatile U.S. Soybean

Soy intake may be beneficial for health, but some still want more evidence.

Like 34

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A 1960s victim of Nigerian famine. This child, with a hugely distended abdomen, is suffering from the protein deficiency kwashiorkor. Source: Centers for Disease Control and Prevention, Dr. Lyle Conrad.

Source: Wikimedia Commons/Public Domain

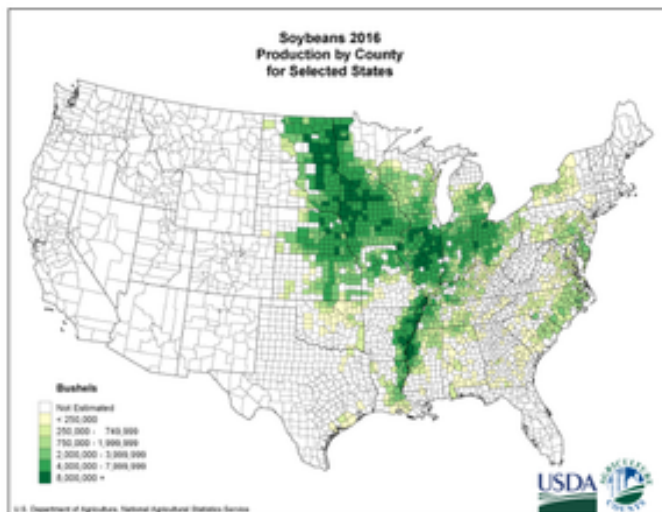
An unhappy little boy, obviously sick and swollen, stands with his mother, waiting in line for hours for their rationed water. Doctors have diagnosed him with “the kwash,” the mother tells Shirl, one of the main characters in Harry Harrison’s 1966 science fiction novel *Make Room! Make Room!* Shirl wonders if it is catching. No, explains Sol, because “‘kwash’ is short for ‘kwashiorkor,’ and it comes from not eating enough protein. They used to have it only in Africa but now they got it right across the whole U.S...there’s no meat around, and lentils and soybeans cost too much,” Sol adds. Some of the soybeans have even been poisoned by insecticide. The year is 1999, and there are massive shortages throughout the grossly overpopulated U.S. “I hope this proves to be a work of fiction,” Harrison wrote in his introduction. In the much darker thriller film version *Soylent Green* (1973), soy as a protein source was not only expensive, it was no longer available.

Harrison’s novel remains, at least for now, a work of fiction. Soybeans, considered the “crop of the century,” are plentiful and “are likely to have unseated corn as the most widely sown crop in the U.S.” (Meyer et al, June 20, 2017, *The Big Read: Agricultural Commodities*).



Soybeans can be black or yellow.

Source: Wikimedia Commons/Public Domain



Soybeans are grown across a wide area of the U.S. and are even exported to China.

Farmers throughout a vast swath of the Midwest (e.g. Ohio, Indiana, Illinois, Iowa, Nebraska, and now North Dakota) cultivate soybeans. (U.S. Department of Agriculture)

Soybeans can be black or yellow but when harvested prematurely, they are green and can be boiled in their pods and served with salt as edamame. The soybean is incredibly versatile. Soybeans can be non-fermented (e.g. soybean sprouts or soy milk, made through boiling or, when curdled, as tofu), or fermented, a process that can take months, to make soy sauce, miso, and tempeh. In Chinese cooking, soybeans with black hulls can be served as fermented black beans. There is also soybean oil, which contains both omega-6 and omega-3 fatty acids (Messina, *Nutrients*, 2016), and soy flour (finely ground roasted soybeans with the coat removed) that can be used in baking products. Soy flour washed with water can become soy protein, which is 70 percent protein by weight. (Barnes, *Lymphatic Research and Biology*, 2010). Even higher concentrations of protein (greater than 92 percent) can be created to form soy protein isolate. Both hydrolyzed vegetable protein and vegetable protein contain soy (Barnes, 2010). In general, soybean protein is higher than any other plant protein and similar to animal protein, and it is low in carbohydrate content. Further, it is a rich source of vitamins and minerals, including Vitamin K₂, calcium, and iron (Messina, 2016). Soy products can be used as “filler” for veggie burgers (i.e., as a meat alternative), processed into protein bars or shakes, or made into a nut butter similar to peanut butter. Soy can also be used in industrial products such as soaps, plastics, crayons, solvents, clothing, and even biodiesel fuel.

Source: U.S. Department of Agriculture



Soybeans are often ground into meal for use in feeding livestock and fish. Those allergic to soy may be getting second-hand exposure through eggs, chickens, or even fish.

Source: Wikimedia Commons/Public Domain

Further, much of the U.S. soybean crop is used for livestock feed, and there is even concern (“a clear and present danger”) that people allergic to soy may have reactions to eggs and dairy foods that have soy residue from this feed given to cows, chickens, and fish without realizing this source. This “second-hand soy” has been called the “soy-ling of America,” (Daniel, July 23, 2012, *The Weston A. Price Foundation*).

And due to genetic engineering and the new technology of CRISPR, we no longer have to worry about soybeans being poisoned by insecticides. CRISPR, an acronym for “clustered regularly interspaced short palindromic repeats,” is the “holy grail of gene manipulation.” It acts as a

“pair of designer molecular scissors” that will eventually eliminate many genetic diseases, wrote Doudna and Sternberg, researchers instrumental in developing CRISPR technology, in their book *A Crack in Creation* (2017).

For years though, plant biologists have used CRISPR to edit genes in many crops, including soybeans (Jacobs et al, *BioMed Central Biotechnology*, 2015). For example, it has been used in corn, soybeans, and potatoes to enable these crops to develop natural resistance to insecticides. Further, by altering two soybean genes, researchers can produce a much healthier soybean oil with a “fat profile” that is similar to olive oil (Doudna and Sternberg, p.122).

There is some question regarding how long (and exactly where) soybeans (*Glycine max*) became domesticated from a wild variation (*Glycine soja*), but some archeological researchers believe it occurred from 3,000 to 9,000 years ago in several areas of East Asia, (Lee et al, *PLoS One*, 2011). Soybeans came to Europe and were first grown in the U.S. in Georgia in the late 18th century. They attract nitrogen-fixing bacteria so they can be used in crop rotation to restore nitrogen to the soil, (Barnes, 2010). Ironically, we are now shipping huge quantities of U.S. soybeans to China.

Soy is the main source of plant isoflavones, which are classified as both phytoestrogens and selective estrogen receptor modulators (SERMs). (Messina, 2016.) The two main isoflavones are genistein and daidzein and have a chemical structure similar to estrogen (Messina, 2016), but



The 25 acres of soybeans, grown by David Shapiro, M.D., Clinical Professor of **Psychiatry**, Weill Cornell Medicine, in the Berkshires, for livestock feed for dairy cows.

Source: Photo, courtesy of David Shapiro, M.D.



"The Bean Eater" by Annibale Carracci (1560-1609), in the Palazzo Colonna, Italy.

Source: Wikipedia Commons/Public Domain

should not be equated with estrogens since they have 100 times *weaker* affinities than physiological estrogens, (Barnes, 2010). Initially, there was concern for soy exposure in postmenopausal women, but many (not all) believe there is no evidence of a negative effect on breast, thyroid, or uterus, (Messina, 2016).

Over the past 25 years, there have been overwhelming numbers of studies (2000 peer reviewed articles a year) that are “understandably challenging for health professionals to interpret” on the benefits of soy, (Messina, 2016). Furthermore, animal studies have limited applicability to humans because many animals (rodents and even nonhuman primates) metabolize isoflavones very differently from the way we do, (Messina, 2016). Nevertheless, soy intake has been associated with better skin, decreased depression, and even less incidence of menopausal hot flashes, postmenopausal osteoporosis, as well as improved blood pressure, (especially fermented soy) (Nozue et al, *The Journal of Nutrition, Nutritional Epidemiology*, 2017), metabolic parameters (e.g. glucose, cholesterol), and overall cardiovascular health (Messina, 2016). Allison and colleagues (Cope et al, *Obesity Reviews*, 2008) conducted the most comprehensive evidence-based review of soy research and found many of the “proposed benefits” of soy “have yet to be clearly supported or refuted.”

For some studies, the isoflavone component seems to be the most important part of soy, but biological efficacy and protective effects can vary, depending on the type of soy, the amount of soy used, the brand, and the processing technology. For example, tempeh has 3.1 mg of isoflavone per gram of soy protein, while tofu and some soymilk have 2 mg, (Kou et al, *Food & Function*, 2017). Isoflavones may help reduce blood pressure, for example, by causing vasodilation. For control of glucose, whole soy products like soy nuts may be more beneficial than textured soy protein, which suggested to researchers that other

components in soy (e.g. fiber, polysaccharides) may be involved, (Ramdath et al, *Nutrients*, 2017). For reported cholesterol-lowering effects of soy, the gut microbiome may be a factor, (Ramdath et al, 2017).



"Edamame (Soy Beans)," Late 18th-early 19th century, a Japanese ivory Netsuke, Gift of Mrs. Russell Sage, 1910.

Source: Met Museum, use for scholarly purposes

Further, since breast cancer incidence is much lower in Asian women (and increases in prevalence once these women adopt a Western diet), researchers have suggested that soy intake may have a "chemopreventive effect." A recent prospective study (Baglia et al, *International Journal of Cancer*, 2016) of over 70,000 Chinese women (with follow-up of over 13 years) found that high intake during both adolescence and adulthood (greater than 16.4 grams a day) significantly reduced breast cancer risk. In those with breast cancer, a meta-analysis indicated soy consumption led to a statistically significant reduction in breast cancer recurrence and

mortality and even may enhance tamoxifen treatment. These researchers caution that breast cancer is a "heterogeneous disease," and that factors such as hormonal and menopausal status, and the timing of exposure, can be important factors in influencing the relationship between soy exposure and breast cancer (and likewise affects the varying evidence in breast cancer studies). Furthermore, they note that other studies have not necessarily found soy as protective in Western populations, possibly due to considerably lower intake and a shorter period of exposure. (Baglia et al, 2016) Messina cautions, "The evidence that isoflavones reduce the risk of breast (as well as prostate cancer) is more preliminary." Some researchers recommend overt caution in using soy during or after breast cancer treatment, (Czuczwar et al, *Menopause Review*, 2017).

Allison and colleagues (Page et al, *Nutrition*, 2003), explain reasons for difficulties in studying the relationship of soy to breast cancer: should researchers study "breast tissue, the immune system, study humans, rats, or cell lines, look at short- or long-term exposure, and at what concentration? Or should researchers use whole soy, processed soy, or a component?"

What about the effect of soy on weight control and body composition? Some years ago, Allison and colleagues conducted two studies (Allison et al,



Salvador Dalí's "Soft Construction with Boiled Beans," ("Premonition of Civil War," 1936.) The Philadelphia Museum of Art/Art Resource NY. The Louise and Walter Arensberg Collection, 1950. Copyright, 2017, Salvador Dalí, Fundacio Gala-Salvador Dalí, Artists Rights Society.

Source: Artists Rights Society/Art Resource NY/ used with permission from both.

European Journal of Clinical Nutrition, 2003; Fontaine et al, *Nutrition Journal*, 2003) and found soy replacement meals can lead to weight loss, though they are not well-tolerated by some people, as evidenced by high drop-out rates (not uncommon in nutrition studies). More recently, Ramdath et al (2017) concluded: "soy protein does not seem to be an effective weight loss aid."

Bottom Line: Soy products are an excellent source of protein and a healthy alternative to meat. There is no convincing evidence that soy protein is a better protein source than other proteins, though, or that it improves satiety or leads to weight loss when compared to other diets of comparable caloric restriction. There are countless studies that suggest soy intake may be beneficial for many conditions, but researchers continue to recommend further studies.

Special thanks to David Shapiro, M.D., Clinical Professor of Psychiatry, Weill Cornell, for information on soy in livestock feed.



Edamame, a Japanese dish, often served with salt. These are soybeans harvested prematurely, boiled, and served in their pods. Used under Creative Commons Attribution, Flickr, Tammy Green (aka Zesmerelda.)

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About the Author



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In Print: *The Gravity of Weight: A Clinical Guide to Weight Loss and Maintenance*

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