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Soy and soy-based products in the athlete's diet

Soia şi produsele pe bază de soia în alimentaţia sportivilor

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Abstract

Proteins in the athlete's diet are used for muscle growth and repair; cell regulation; immune and neurological functions; nutrient transport and structural support. Protein needs depend on many variables: energy intake, exercise type (1.2 to 1.5 g/kg/day for endurance, and 1.2 to 1.7 g/kg/day for strength athletes), duration and intensity of exercise, and the training phase (novice vs. trained). The best sources of proteins preferred by athletes are whey, egg white and soy derivative products. Soy has many virtues, as well as a long record of unhealthy compounds (also called antinutrients): endocrine disruptors, saponins, enzyme inhibitors, goitrogens, phytates, pesticides, etc. Athletes prefer their convenience and ease of use, so they consume protein supplements such as protein concentrates and isolates, which are highly refined and processed forms of soy.

Beside the negative effects of soy antinutrients, high ingestion of soy protein supplements has detrimental results: dehydration and calcium loss (due to high protein intake); presence of toxic substances (aluminum, nitrites, lysinoalanine) in processed soy-based products.

During the last 3-4 decades, soy has become a very controversial and complicated topic. For every study showing the nutritional value of soy, another one claims the detrimental effects on health, so, reviewing the data on soy is very confusing. Moreover, in order to clarify the truth, many other confounding dietary factors should be taken into consideration.

For soy to be a healthy food, it is recommended to be organic, used in a properly fermented form, occasionally, and in moderate amounts.

Keywords: athletes, soy, soy-based products, proteins, antinutrients

Rezumat

Proteinele din dieta sportivilor sunt folosite pentru creşterea şi repararea musculară, reglarea celulară, în funcţiile imune şi neurologice, în transportul nutrienţilor şi ca suport structural. Nevoia de proteine depinde de multe variabile: aportul energetic, tipul de efort (1,2-1,5 g/kg/zi în sporturile de anduranţă şi 1,2-1,7 g/kg/zi în sporturile de forţă), durata şi intensitatea exerciţiului, şi faza de pregătire (novice vs. antrenat). Cele mai bune surse de proteine, preferate de sportivi, sunt zerul de lapte, albuşul de ou şi produsele pe bază de soia. Soia prezintă o pletoră de virtuţi, dar şi o listă lungă de compuşi nesănătoşi (antinutrienţi): perturbatori endocrini, saponine, inhibitori enzimatici, goitrogeni, fitaţi, pesticide etc. Sportivii preferă uşurinţa şi convenabilitatea, astfel că ei consumă suplimente proteice cum ar fi concentratele şi izolatele proteice, care sunt derivate de soia înalt rafinate şi procesate.

Pe lângă consecinţele negative ale antinutrienţilor din soia, ingestia crescută de suplimente proteice din soia are şi alte consecinţe: deshidratare şi pierderi de calciu (datorită ingestiei crescute de proteine); prezenţa de substanţe toxice în produsele procesate (aluminiu, nitriţi, lizinoalanină).

În ultimele 3-4 decade, soia a devenit un subiect extrem de controversat şi complicat. Pentru fiecare studiu care-i demonstrează valoarea nutritivă, un alt studiu vine să-i dovedească efectele dezastruoase asupra sănătăţii, astfel că literatura de specialitate privitoare la soia este foarte contradictorie, reflectând cacofonia alimentară şi nutriţională din zilele noastre. Mai mult, pentru a clarifica adevărul, ar trebui luaţi în calcul mulţi alţi factori dietetici care pot interveni.

Pentru a fi un aliment sănătos, soia este recomandată să fie organică şi să fie folosită sub o formă fermentată, în mod ocazional şi în cantităţi moderate.

Cuvinte cheie: sportivi, soia, produse pe bază de soia, proteine, antinutrienţi

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Nutritional value of soy

Soy has been present in the food chain for over 5,000 years. Since many years, soy has been an everyday food safely consumed in Asia (China, Japan), mostly in a fermented form (Saljoughian, 2007). Basically, soy has invaded the entire food chain, hiding in a great number of industrial products: hamburgers, bread, almost all margarines, ice creams, most groceries (mainly in the form of lecithin, E322, supposed to be allergenic).

During the 80's and the early 90', soy bean represented a real culinary revolution for vegetarians, vegans and lactose-intolerant people. This "new miracle food" was promoted as a healthy protein substitute for meat, and was incorporated into nutritious meals.

Since 1999, the FDA (Food and Drug Administration) has stated that a daily use of 25 grams of soy protein may reduce the risk of heart disease (***, 1999).

In 2000, the American Heart Association recommended the inclusion of soy protein in heart-healthy diets (Erdman, 2000).

Soy is a protein-rich plant (containing arginine that facilitates the work of blood vessels) as much as meat (34-40%); it is full of fiber, potassium, magnesium and vitamins; it has vegetable fats (with no cholesterol); and contains phytoestrogens like other foods such as whole grains, leafy greens, beans, and garlic (Laza, 2004).

Among the ways of assessing **protein** quality (i.e. the protein efficiency ratio - PER, the net protein utilization - NPU, and the biological value - BV), PER is an outdated measure and is not longer used, and NPU is not much used, either. The most accurate indicator of biological activity is BV, which measures the amount of protein deposited per gram of protein absorbed. Proteins with high BV are better for nitrogen retention and IGF-1 (insulin-like growth factor) stimulation, and superior in reducing lean tissue loss during wasting states (anti-catabolic).

The BV of soy protein (74) is lower than the BV of other protein sources (especially animal ones): whey (104), whole egg (100), egg white (88), and casein (77), one reason being the lack in sulfur-containing amino-acid methionine. Besides cysteine, methionine is important for protein synthesis and growth, immune system function, and the body's production of glutathione (GSH), an antioxidant protecting cells by detoxifying some harmful compounds (hydrogen peroxide, carcinogens, reactive oxygen species), and partly preventing the negative effect of low density lipoproteins (Misner, 2001).

Soy proteins are inferior to animal proteins not only in terms of efficacy, but also in terms of assimilation (90% for milk vs. <80% for soy), and digestion speed (soy is between whey protein and casein).

Phytoestrogens (part of a larger group of plant compounds called polyphenols, which have an antioxidant effect) contain four families: isoflavones, the best-known; lignans; coumestans, and stilbenes (resveratrol from nuts and red wine). Because of many contradictory results, to date, phytoestrogens are one of the most controversial foods in women's nutrition (Saljoughian, 2007).

Phytoestrogens are endocrine disruptors which, having a structural similarity to 17-beta-estradiol (E2,), can mimic the action of estrogen (estrogen-like) and therefore may protect against bone loss and alleviate hot flashes, vaginal dryness, and mood swings in menopausal women; or they can block the effects of estrogen, by binding to estrogen receptors. Unfortunately, we still have a limited understanding of the physiological effects of soy phytoestrogens (Wei et al., 2012).

Isoflavones (genistein and daidzein) found in soy, along with soy proteins (1 to 2 servings daily) lower the bad cholesterol (a 10% decrease in LDL-cholesterol concentration) and improve the arterial dilatation of postmenopausal women but worsen that of men (Anderson & Bush, 2011; Clarkson, 2002; Zhang et al., 2003). According to studies, LDL levels dropped by approximately 1-2%, but this required about 50 g soy per day. The reduction of cholesterol is significant in individuals with cholesterol levels over 250 mg/dl, but insignificant in those with values under 250 mg/dl.

Studies on the health effects of phytoestrogens have yielded mixed results, some of them (Rietjens et al., 2017) suggesting that isoflavones do not significantly reduce cardiovascular risk, but lignans may do so in smokers.

In men, these two isoflavones mimic estrogen so well that they have also been linked to side effects in men, including breast enlargement (gynecomastia), decreased facial and body hair growth, mood swings and frequent crying jags, erectile dysfunction, decreased libido, and lowered sperm count (Tse & Eslick, 2016).

The amount of phytoestrogens in different soy products varies from 8.5 mg per 3½ ounces (dry soy noodles), to 15 mg per 3½ ounces (soy hot dog), 16 mg per 3½ ounces (tofu yogurt), 25 mg per ¼ cup (soy flour), 30 mg per ¼ cup (miso), 40 mg per ½ cup (soybeans, tempeh, and tofu), 40 mg per 1 cup (soy milk), 135 mg per 3½ ounces (green soybeans), 138 mg per 3½ ounces (TVP), and 162 mg per 3½ ounces (roasted soybeans) (Franke et al., 1994).

In the traditional Japanese diet, intake of isoflavones is between 15 and 200 mg/day, while approximately one million American infants ingest large doses of phytoestrogens in soy-based formulas every year. American infants have a plasma phytoestrogen concentration of up to 7,000 nm/L, compared to an average of 744 nm/L in adult Japanese women (Saljoughian, 2007). The daily exposure to phytoestrogens from baby formulas is 10 to 11 times higher than a hormonally active dose in adults (Setchell et al., 1998). However, scientific data on human exposure to higher doses are difficult to find.

Regarding hormone-dependent breast cancer, the effects of soy products are different in pre- and post-menopausal women, and "depend on age, health status, and the presence or absence of specific gut microflora (microbiota) in the population of concern" (Rietjens et al., 2017). Most of the studies suggest that soy consumption is inversely related to breast cancer incidence, recurrence, and mortality before menopause (Hooper et al., 2010; Liu et al., 2012), and has an increased risk of breast cancer after menopause. The European Food Safety Authority (EFSA) concluded that observational human data do not suggest an increased risk overall, but that isoflavone-based food supplements may pose a risk to postmenopausal women (Cohen et al., 2000; Ferris-Tortajada et al., 2012; Messina, 2016; Zhang et al., 2015).

There are some studies indicating that isoflavones could negate the inhibitory effect of some treatments (tamoxifen, an anti-estrogen) on tumor growth (Kang et al., 2010; Helferich et al., 2008; Shu et al., 2009).

In men, a study published in International Journal of Cancer suggests that foods high in soy compounds might raise by 91% the risk of aggressive prostate cancer (Mori et al., 2009).

Among prostate cancer survivors, soy foods might lower PSA (prostate-specific antigen) levels, but the effects are very different from one man to another, allowing for the influence of other factors in decreasing PSA concentrations (Anderson & Bush, 2011).

Prostate cancer is the second leading cause of cancer among men worldwide, after lung or bronchial cancer (CDC, USA). Prostate cancer could be inherited (5-10%); the rest of the cases occur due to environmental factors (hormones). Some endocrine-disrupting compounds (lead, mercury, arsenic, DDT, dioxin, bisphenol), known as "hormone mimickers", increase hormone levels and generate or facilitate the progression of prostate cancer. While prostate cancer rates are higher in developed countries, some experts suggest that the Western diet and lifestyle could be a factor. According to data published in the medical journal *Cancer Epidemiology, Biomarkers & Prevention*, foods rich in lycopene (tomatoes, and tomato juice, baked beans) could reduce by 18% the risk of prostate cancer (Kolonel et al., 2000; Kristal, 2010; Laza, 2004; Laza, 2015; Thomas et al., 2012; Zuniga et al., 2013).

Soybeans, soy nuts and edamame all contain fiber. And a diet high in fiber may lower the risks for several cancers, including colorectal cancer (Vucenik & Shamsuddin, 2006; Cheng et al., 2010; Schlemmer et al., 2009; Urbano et al., 2000; Yi et al., 2016).

Negative effects of soy and soy products (tofu, soy milk, soy powder)

The Food and Drug Administration (FDA) has promoted soy as a healthy food by allowing the soybean industry a health claim indicating on labels that "diets low in saturated fat and cholesterol that include 25 grams of soy protein a day may reduce the risk of heart disease" (***, 1999). As a result, for decades, sales of soybeans have skyrocketed, and soy has been added to many products for marketing purposes (it is inexpensive) and to boost protein content, earning a stellar reputation. This could be correlated with the misconception that Asian people, great consumers of soy, live longer than Americans. In truth, a Japanese man eats about 8 grams of soy a day, while in USA, one soy burger alone contains 9 grams of soy, and soy is present in some form in most processed foods. Besides, the Japanese eat traditionally fermented soy (natto, tempeh, miso), while the Americans eat unfermented soy. Fermented soy is a form of digestion-friendly soy that contains probiotics (friendly bacteria) which nourish the gut flora (microbiota), and help digestion, the absorption of nutrients and immune function. Fermented soy is lower in phytonutrients and high in vitamin K2 or menaquinone (MK), produced by the microbiota. Unfortunately, most Western consumers eat unfermented soy: tofu, soy protein isolates in bars and shake powders, soy milk, fresh soybeans (raw or cooked), soy chips, soy flour, and many other soy derivatives/soy oil foods.

In unfermented soy there are many compounds which may have negative effects on human health, such as toxic phytonutrients. Many of these phytonutrients nourish the plants, and most of them fight against predators (bacteria, parasites, pests and insects). The human GI tract does not have the ability (the enzymes) to digest them, so they enter the blood unchanged and become antinutrients. They have many undesirable effects on human health.

1. Antinutrients (phytonutrients) may have a toxic effect in excessive amounts, more than 35 grams of soy per day (20 grams of soy in a single serving of soy food).

a) Lectins (phytoagglutinins) are abundant glycoproteins that protect the plant against predators. Lectins (i.e. soybean agglutinin - SBA) pass through the gut wall, enter the blood unchanged and have agglutinating properties on blood cells in the area of target organs. These substances diminish the activity of enzymes (e.g. amino peptidase or enterokinase) and alter intestinal absorption.

Some of them (insulin mimicking lectins) bind to the insulin receptors of the body's fat cells, and so, they signal the fat cells to stop burning fat and accumulate extra calories as fat, and therefore will promote insulin resistance.

The good news is that some lectins inhibit the growth of tumor cells and the development of some viruses (preliminary studies), and, most importantly, hydration, germination, fermentation and cooking (boiling, autoclaving, and microwave cooking) could significantly (not entirely) deactivate the amount and the agglutinant power of hemagglutinin (Rasha et al., 2011).

b) Saponins are steroid alkaloids found in soybeans (2-5 g saponins per 100 g), but also in other plants such as tomatoes, eggplants, asparagus, potatoes, quinoa, agave, yucca, alfalfa, aloe, olives, grapes, garlic, red onions, paprika, ginseng. They are natural biopesticides, of two types: group A saponins (in soybean germs), which have an unpleasant astringent taste, and group B saponins (in soybean germs and cotyledons), with health properties (Kamo et al., 2014).

Soy saponins have many health properties:

- *Antioxidative* (Ishii & Tanizawa, 2006)
- *Cholesterol reduction* (Lee et al., 2005), a property discovered in 1979 by Potter; saponins form emulsions (micelles) with bile salts in the GI tract, and bile salts form micelles with cholesterol, facilitating its absorption; bile salt binding by soy reduces the absorption of cholesterol. Some saponins inhibit cholesterol absorption by forming insoluble complexes with cholesterol.
- *Anticancer*. Cancer cells need cholesterol to grow, and saponins bind cholesterol from the membrane of cancer cells and so, limit their growth (Kerwin, 2004; Zhang & Popovich, 2010), or they may be effective in preventing colon cancer by affecting cell morphology, cell proliferation enzymes, and cell growth (Tsai et al., 2010; Roa & Sung, 1995).
- *Inhibition of HIV* – Soy saponin B1 may have an inhibitory effect on HIV infection. This is a Japanese in vitro study; consumption of soy saponin is not a medicine to cure HIV (Nakashima et al., 1989).
- *Reduction of blood glucose levels* (Tanaka et al., 2006)
- *Anti-kidney disease progression* (Philbrick et al., 2003)

- *Anti-inflammatory* (Lee et al., 2010)
- *Renin inhibition* (Takahashi et al., 2008)
- *Hepatoprotection* (Kinjo et al., 1998)

Washing and soaking soybeans only partially remove saponins, while fermentation and dehulling considerably reduce the saponin content (Hu et al., 2004).

c) Enzyme inhibitors: protease inhibitor (Bowman-Birk soy protease inhibitor or BBI), amylase inhibitor, trypsin inhibitor

Raw soybeans (unfermented) contain enzyme inhibitors, which inhibit the pancreatic enzymes designed to facilitate protein digestion, and make carbohydrates and proteins incompletely digested. The bacteria in the large intestine try to do the job, and this can cause discomfort and bloating. Trypsin is needed in protein digestion and allows vitamin B12 to be assimilated. By blocking trypsin activity, soy increases vitamin B12 requirements and causes vitamin B12 deficiency. It is noteworthy that thorough cooking can destroy up to 90% of the trypsin activity. The overall content of raw soybean trypsin inhibitor is 1509 units per gram (Wan et al., 2000). Trypsin inhibitors aggravate the shortage of amino acids occurring in the plant kingdom, and delay growth.

d) Phytates (or phytic acid)

Phytic acid is the main reserve of phosphorus in plants (in the hulls of all seeds and in the bran). Because of its negative charge, phytic acid can bind the positively charged essential minerals (calcium, magnesium, zinc, iron, copper) and form insoluble complexes, preventing their absorption. Unfermented soy (soy milk, soy chips, soy protein bars, soy flour, soy protein isolates) contains many phytates that work in the GI tract to bind minerals and lead to a malabsorption of minerals and to a mineral deficiency, especially in vegetarians and in third world countries. As a result of zinc elimination (zinc is needed in more than 50 enzymatic reactions, especially in those of the nervous system), the child's development is affected and the immune system is more fragile. Hydration, germination or fermentation might reduce the content of phytates.

Phytates could somewhat be reduced by proper slow cooking, but the only satisfactory method is traditional, ancient fermentation, which transforms these anti-nutrients into more available and digestible products.

When soy products (such as tofu) are associated with meat, the effect of phytic acid is diminished, so there is only a risk for vegetarians.

The phytates from raw soybeans have been an item of academic interest for many years and studies are sometimes controversial.

Some papers assert that there is no intestinal adaptation to a high-phytate diet (Brune et al, 1989), while other studies have demonstrated that humans adapt to high intake of phytates by degradation of phytates (70-86%) in the intestinal tract (gut), as a result of an increase in phytase production in the small intestine (Joung et al., 2007). Other papers report that 50 grams of vitamin C can cancel the effects of 175 grams phytates on mineral absorption (Siegenberg et al., 1991).

Phytase (an enzyme that neutralizes phytic acid, releasing phosphorus) co-exists in plant foods that contain phytic acid. On a regular basis, humans do not synthesize enough enzymes, but the endogenous gut microflora (probiotic lactobacilli) could produce phytase (Famularo et al., 2005). Phytase can be activated by sprouting, while the nutritional value is not reduced.

There are papers supporting the powerful anti-cancer potential of phytates. As an antioxidant, phytic acid protects the body from cancer (by binding to iron and reducing oxidative damage to colon cells) and other every day stressors, being used in treatments for colon and rectal cancers (Admassu, 2009; Lonnerdal et al., 1989), or may help prevent colon cancer (Vucenik & Shamsuddin, 2003; Jenab & Thompson, 2000).

In animal studies, dietary phytates prevent the growth of tumor cells in the liver and pre-tumor cells in pancreas (Admassu, 2009); other studies have shown that phytates stop the growth of human leukemia cells, melanoma, muscle cancer and cervical cancer (Arnarson, 2015), but additional research is needed to assess the beneficial health effects of phytic acid.

Binding to proteins and starches, phytic acid can decrease the availability of these nutrients (Admassu, 2009), which can benefit people with kidney diseases who have to limit calcium and magnesium intake, thereby reducing the risk of kidney stone formation. On the other hand, phytic acid can act as a chelator, bind to lead (and other toxic minerals), and promotes detoxification, being used in the treatment of acute lead poisoning (Admassu, 2009). Phytic acid is also used as one of the few chelating therapies for uranium removal (Cebrian et al., 2007).

2. Soybeans can block (interfere with) the function of the thyroid gland

Because of the high content of goitrogens (substances that can block the synthesis of thyroid hormone and interfere with iodine metabolism), soy consumption could impact thyroid function, and cause goiter formation, with all its symptoms: low level of energy, reduced heart activity (oxygenation), anxiety, mood swings, insomnia, weight gain, food allergies, and digestive problems. This is rather a problem with isolated soy protein, because when soy protein is processed, goitrogenic isoflavones (daidzein, genistein) are concentrated and preserved. These isolated soy proteins are added to many functional processed foods such as energy bars, health drinks, protein powders, breakfast cereals, and pill supplements. So, persons with thyroid problems should avoid soy consumption (Ikeda et al., 2000). Isoflavones inhibit the function of thyroid peroxidase, an enzyme essential for the synthesis of thyroid hormones (Divi et al., 1997), and can induce goiter and thyroid neoplasia in rodents. A study in Japanese adults concluded that 30 grams of soybeans for 3 months raised the TSH (thyroid stimulating hormone) level (Ishizuki et al., 1991).

Other studies revealed that soy has either no effect or only a very mild effect on thyroid function in humans (Messina & Redmond, 2006; Dillingham et al., 2007; Teas et al., 2007). So, to date, there is not enough conclusive data to support that isoflavones could contribute to hypothyroidism in humans.

3. Soy is allergenic

Soy is one of the eight most allergenic foods in the world besides dairy, peanuts, wheat, eggs, fish, tree nuts (e.g. cashews or walnuts), and shellfish. These few foods are responsible for 90% of all allergies. The symptoms can cover reactions from mild to severe (Sicherer et al., 2009; Cordle, 2004). At least 16 soy protein allergens are responsible for this kind of allergy (e.g. soy hydrophobic protein, soy hull protein, soy profilin, soy vacuolar protein, glycinin, β-conglycinin, Kunitz trypsin inhibitor, etc.) and could affect even infants presenting an intolerance or allergy to cow's milk-based formula. The daily 25 mg of soy protein allowed (considered healthy) by FDA could reduce the levels of low-density lipoproteins (LDLs), but increase the risk for soy allergenicity.

4. Soy is genetically modified

Most of the soybeans consumed all over the globe (more than 90% of those grown in USA) are *genetically modified* (GM), leading to hormonal disruption and miscarriages, infertility and low birth weight, allergies and digestive problems, birth defects, and a 5 times higher offspring death rate, and are used to create soy protein isolates (Goda et al., 2002).

5. Soy contains pesticides. Soy contains a great dose of glyphosate (herbicide), an endocrine buster that interferes with aromatase which produces estrogen, and disrupts the female hormonal balance. Glyphosate is toxic to the placenta (responsible for delivering vital nutrients to the child and eliminating waste products). If the placenta is damaged/ destroyed, miscarriage is possible. Children whose mothers were exposed to glyphosate (even in small amounts) could present severe birth defects (Bøhn et al., 2014), or carcinogenic effects (Thongprakaisang et al., 2013).

Fermented soy vs. unfermented soy

Japanese people, heavy soy consumers, enjoy a long, healthy life span. At the same time, they also consume green tea, smaller portions of food, and take regular exercise. Not to mention the fact that the Japanese use healthful fermented soy (tofu, miso, natto and soy sauces), very different from the unfermented soy found in the American or European diet. Tempeh is a fermented soybean cake with a firm texture and nutty, mushroom-like flavor. Miso is a paste with a salty, buttery texture. Natto has a sticky texture and strong, cheese-like flavor. Soy sauce is traditionally made by fermenting soybeans, salt and enzymes. Fermented soy has many beneficial effects: fermentation makes soy nutrients more available, enzyme inhibitors are reduced, and blood lipids are positively influenced. Unfermented soy products are loaded with toxins (enzyme inhibitors) and deficient in isoflavones. Fermented soy (especially natto) may be safe in small amounts, and contains great doses of vitamin K2, important for heart and bone health (Thingom & Chhetry, 2011).

Supplemental forms of soy protein:

a) SPC - soy protein concentrate (a moisture-free form that is left at the end of the defatting process), which contains over 65% protein and most of carbohydrates from soybeans.

b) SPI - soy protein isolate (the most refined and pure form, with almost all carbohydrates removed), which contains over 90% protein. This form is used in different meal-replacement drinks such as baby formulas and some brands of soy milk (Torum, 1979). The high temperature process used to obtain the isolates denatures the protein and diminishes its nutritional value, while increasing the likelihood of forming carcinogenic compounds (Constantinou, 2000; Dees et al., 1997), but does not reduce phytates, thyroid-depressing phytoestrogens, and enzyme inhibitors (Stob, 1966).

c) TSP - textured soy protein (made from protein concentrates), present in different soy products, imitating pork, chicken, and steak.

SPI is a dry powder food isolated from soybean, containing 90-95% proteins (with all essential amino acids needed for growth, similarly to animal products), with almost no fat (less than 1%) or carbohydrate.

SPI is used to increase protein content or enhance texture and may be found in a lot of foods sold in the health food section: liquid soymilk, power bars, soups and sauces, bottled fruit drinks, meat analogs, breads, breakfast cereals, and many muscle gain products.

SPI are obtained as a result of a high heat process which damages the proteins, keeps the phytates, phytoestrogens and enzyme inhibitors at high levels (Stob, 1966), and increases the likelihood of generating carcinogenic products (Constantinou, 2000; Dees et al, 1997).

The processing of SPI first needs an alkaline solution to remove fiber, then acid washing for precipitation and separation and, finally an alkaline solution for neutralization. Acid washing takes place in aluminum tanks, leaching high levels of aluminum (Al) into the final product. The high temperature used to obtain the different forms of soy protein could denature the protein (lysine 23), leaving a large part of antinutrients (trypsin inhibitors) which reduce weight gain (Stob, 1966; Torum, 1979). Potent carcinogens (nitrites) are formed during drying, and a toxin (lysinoalanine) is formed during the alkaline process. A plethora of artificial flavors (MSG) is added to SPI to mask the beany taste in favor of a meat taste, and phytic acid inhibits zinc and iron absorption, leading to the development of enlarged pancreas and thyroid gland (Wang et al., 2004).

Unfortunately, SPI and textured vegetable proteins are still used in many school lunch programs, diet beverages, fast food products and commercial baked goods, being promoted in third world countries, and in many giveaway programs.

Effects of SPI in sport and exercise

Some athletes who work on the weight machines or bodybuilders consume protein shakes as a nutritional supplement, drinks made from protein powders (from whey, soy, and milk). The proteins give them a special ability to help muscle protein synthesis, provide the fuel, and stimulate faster muscle recovery, especially if they are consumed after exercise. The daily recommended intake of proteins is 1.2 to 1.7 g/kg (Rosenbloom, 2009).

These protein powders could be used even by an average everyday athlete, in order to grow, build muscle, train for a marathon, or pursue a vegan/vegetarian lifestyle. As a result of the high content in phytoestrogens (genistein and daidzein), they change the testosterone-estrogen ratio, leading to an increase in body fat, and modify (enhance) the athlete's performance (Dwyer et al., 1994).

In experiments on swimming-trained mice, Elia et al. (2006) found that consuming soy and whey protein isolates allows athletes to train at a higher exercise intensity, as a result of the antioxidant effect of the two proteins.

Athletes who ingest both soy and whey protein in their nutritional regimens may benefit from their different rates of digestion and amino acid absorption. Whey protein (high in branched-chain amino acids) digests more quickly, while soy protein (high in arginine and glutamine) digests more gradually. Arginine is a stimulant of anabolic hormones that promotes muscle formation. Together, whey and soy may provide a more prolonged, deliberate release of amino acids to key muscle groups. The soy protein can combat free radical generation during exercise, which might help speed muscle recovery after a workout and reduce muscle soreness and inflammation following exercise (Köhne et al., 2016).

Soy protein may improve the antioxidant status of an athlete and supplies all amino acids for the muscles, making them larger and stronger. In terms of its ability to promote gains in lean muscle mass, soy is as effective as whey (gold standard in protein supplementation), if no more so. The post-workout use of an isonitrogenous and isoenergetic soy drink is statistically significant in accelerating mass, fat-bone free mass gain, and increases in strength, when compared to other post-workout formulations such as skim milk and maltodextrin beverage (Hartman, 2004).

Tara et al. (2013) showed that supplementation with whey protein decreased lipid peroxidation in female endurance athletes, suggesting a potential antioxidative action, while soy protein did not improve biomarkers of oxidative damage and inflammation.

High amounts of proteins ("Western"-type diet) could have a concerning effect on athletes: they form acids and slightly increase calcium loss in the urine. Calcium comes from bone to buffer the acid, and over time, bone loss and fractures are possible. A diet high in fruits and vegetables seems an effective strategy to inhibit these negative effects (Heaney & Layman, 2008).

Another negative effect on health is dehydration; intake of over 2.5 g proteins/kg results in the production of urea from deamination (Dunford & Smith, 2006), which is osmotically active and draws water into the renal tubules, decreasing total body water.

In aerobic and endurance exercises and in strength training, carbohydrates are critical. They diminish in muscle after a weight training and weight-lifting session, and sufficient carbohydrate and fluid intake should accompany the protein intake in order to improve performance (Phillips et al., 2007).

Conclusions

1. There is no other food with so many opponents and so many lobbyists as soy. For every study showing the nutritional value of soy, another one claims its detrimental effects on health, so, reviewing the data on soy is extremely confusing. Sometimes, information is manipulated in order to discredit one or another; sometimes information is false.

2. There are two contradictory messages regarding soy (pro and con), generated by groups driven by ideology, profit, or both. Most of the studies on the beneficial effects of soy were sponsored or supported by the major producers of chemically processed soybean products (soy industry), and by pharmaceutical companies who hold the patents for genetically engineered soybeans. However, this does not invalidate the researches. Others have an ecological/health oriented agenda: they promote the vegetarian or vegan lifestyle.

3. Anti-soy people are motivated by a pro-meat and dairy ideology.

4. In this context, whom to believe, who is right, where is the truth? The interests of food and pharmaceutical industries are not convergent, and the interests of consumers and food industry are seldom and partially convergent.

5. Anyhow, respecting the precautionary principle, for women who are pregnant or plan to become pregnant, or are breastfeeding, as well as for infants, it is important to avoid soy products. However, evidence is currently inconsistent, inconclusive and too weak to support that moderate doses of soy have negative effects on human health. Greater amounts of soy or soy protein isolates used by sportsmen could affect their health due to toxic compounds.

6. To summarize, for soy to be a healthy food, it is recommended to be organic, used in a properly fermented form, occasionally, and in moderate amounts.

7. Nowadays, soy is threatened by a new food revolution: mycoprotein, produced in the laboratory, a single cell protein derived from bacteria, yeast, or fungi, a very cheap alternative to meat, with many nutritional, functional, and chemical benefits.

Conflicts of interest

There are no conflicts of interest

References

Admassu S. Potential Health Benefits and Problems Associated with Phytochemical in Food Legumes. East Afr J Sci. 2009;3(2):116-133.

Anderson JW, Bush HM. Soy protein effects on serum lipoproteins: a quality assessment and meta-analysis of randomized, controlled studies. J Am Coll Nutr. 2011;30(2):79-91.

Arnarson A. Phytic Acid: 101; Everything you need to know. Authority Nutr. 2015. http://authoritynutrition.com/phytic-acid-101/.

Bøhn T, Cuhra M, Traavik T, Sanden M, Fagan J, Primicerio R. Compositional differences in soybeans on the market: glyphosate accumulates in Roundup Ready GM soybeans. Food Chem. 2014; 153:207-215. doi: 10.1016/j.foodchem.2013.12.054.

Brune M, Rossander L, Hallberg L. Iron absorption: no intestinal adaptation to a high-phytate diet. Am J Clin Nutr. 1989;49(3):542-545.

Cebrian D Tapia A, Real A, Morcillo MA. Inositol hexaphosphate: a potential chelating agent for uranium. Radiat Prot Dosimetry. 2007;127(1-4):477-479.

Cheng G, Remer T, Prinz-Langenohl R, Blaszkewicz M, Degen GH, Buyken AE. Relation of isoflavones and fiber intake in childhood to the timing of puberty. Am J Clin Nutr. 2010;92(3):556-564.

Clarkson T. Soy, Soy Phytoestrogens and Cardiovascular Disease. J Nutr. 2002;132(3): 566S-569S.

Cohen JH, Kristal AR, Stanford JL. Fruit and vegetable intakes and prostate cancer risk. J Natl Cancer Inst. 2000; 92(1):61-68.

Constantinou A. Interaction between genistein and estrogen receptors may enhance mammary tumor growth. American Association for Cancer Research, reported in The Power of Soy, Guterman L. Today's Chemist at Work (publication of the American Chemical Society). 2000,47.

Cordle CT. Soy Protein Allergy: Incidence and Relative Severity. J Nutr. 2004;134(5):1213S-1219S.

Dees C, Foster JS, Ahamed S, Wimalasena J. Dietary estrogens stimulate human breast cells to enter the cell cycle. Environ Health Perspect. 1997; 105 (Suppl 3):633-636.

Dillingham BL, McVeigh BL, Lampe JW, Duncan AM. Soy Protein Isolates of Varied Isoflavone Content Do Not Influence Serum Thyroid Hormones in Healthy Young Men. Thyroid. 2007;17(2):131-137. https://doi.org/10.1089/thy.2006.0206.

Divi RL, Chang HC, Doerge DR. Anti-thyroid isoflavones from soybean: isolation, characterization, and mechanisms of action. Biochem Pharmacol. 1997;54(10):1087-1096.

Dunford M, Smith M. Dietary supplements and ergogenic aids. In: Dunford M, ed. Sports Nutr: A Practice Manual for Professionals. 4th ed. Chicago, IL: Am Diet Assoc; 2006:116-141.

Dwyer JT, Goldin BR, Saul N, Gualtieri L, Barakat S, Adlercreutz H. Tofu and soy drinks contain phytoestrogens. J Am Diet Assoc. 1994;94(7):739-743.

Elia D, Stadler K, Horváth V, Jakus J. Effect of soy- and whey protein-isolate supplemented diet on the redox parameters of trained mice. Eur J Nutr. 2006;45(5):259-266. DOI: 10.1007/s00394-006-0593-z.

Erdman JW Jr. AHA Science Advisory: Soy protein and cardiovascular disease: A statement for healthcare professionals from the Nutrition Committee of the AHA. Circulation. 2000; 102(20): 2555-2559.

Famularo G, De Simone C, Pandey V, Sahu AR, Minisola G. Probiotic lactobacilli: an innovative tool to correct the malabsorption syndrome of vegetarians? Med Hypoth. 2005;65(6):1132-1135.

Ferris-Tortajada J, Berbel-Tornero O, Garcia-Castell J, Ortega-Garcia JA, Lopez-Andreu JA. Dietetic factors associated with prostate cancer: protective effects of Mediterranean diet. Actas Urologicas Espanolas. 2012;36(4):239-245.

Franke AA, Custer LJ, Cerna CM, Narala KK. Quantification of phytoestrogens in legumes by HPLC. J Agric Food Chem. 1994;42:1905-1913.

Goda Y, Akiyama H, Suyama E, Takahashi S, Kinjo J, Nohara T, Toyoda M. Comparison of soyasaponin and isoflavone contents between genetically modified (GM) and non-GM soybeans. Shokuhin Eiseigaku Zasshi. 2002;43(6):339-347.

Hartman JW, Bruinsma D, Fullerton A, Perco JG, Lawrence R, Tang JE, Wilkinson SB, Phillips SM. The effect of differing post exercise macronutrient consumption on resistance training-induced adaptations in novices. Med Sci Sports Exerc. 2004;36(5):S41-S42.

Heaney RP, Layman DK. Amount and type of protein influences bone health. Am J Clin Nutr. 2008; 87(5):1567S-1570S.

Helferich WG, Andrade JE, Hoagland MS.. Phytoestrogens and breast cancer: a complex story. Inflammopharmacol. 2008;16(5):219-226.

Hooper L, Madhavan G, Tice JA, Leinster SJ, Cassidy A. Effects of isoflavones on breast density in pre- and post-menopausal women: a systematic review and meta-analysis of randomized controlled trials. Hum Reprod Update. 2010;16(6):745-760.

Hu J, Zheng YL, Hyde W, Hendrich S, Murphy PA. Human fecal metabolism of soyasaponin I. J. Agric. Food Chem. 2004; 52(9):2689-2696.

Ikeda T, Nishikawa A, Imazawa T, Kimura S, Hirose M . Dramatic synergism between excess soybean intake and iodine deficiency on the development of rat thyroid hyperplasia. Carcinogenesis. 2000;21(4):707-713.

Ishii Y, Tanizawa H. Effects of soyasaponins on lipid peroxidation through the secretion of thyroid hormones. Biol. Pharm. Bull. 2006; 29(8):1759-1763.

Ishizuki Y, Hirooka Y, Murata Y, Togashi K. The effects on the thyroid gland of soybeans administered experimentally in healthy subjects. Nihon Naibunpi Gakkai Zasshi. 1991;67(5):622-629.

Jenab M, Thompson LU. Phytic acid in wheat bran affects colon morphology, cell differentiation and apoptosis. Carcinogenesis 2000;21(8):1547-1552.

Joung HI, Jeun BY, Li SJ, Kim J, Woodhouse LR, King JC, Welch RM, Paik HY. Fecal phytate excretion varies with dietary phytate and age in women. J Am Coll Nutr. 2007;26(3):295-302.

Kamo S, Suzuki S, Sato T. Comparison of bioavailability (I) between soyasaponins and soyasapogenols, and (II) between group A and B soyasaponins. Nutrition. 2014;30(5):596-601. doi: 10.1016/j.nut.2013.10.017.

Kang X, Zhang Q, Wang S, Huang X, Jin S. Effect of soy isoflavones on breast cancer recurrence and death for patients receiving adjuvant endocrine therapy. CMAJ. 2010; 182(17):1857-1862. doi: 10.1503/cmaj.091298.

Kerwin SM. Soy saponins and the anticancer effects of soybeans and soy-based foods. Curr. Med. Chem. Anticancer Agents. 2004;4(3):263-272.

Kinjo J, Imagire M, Udayama M, Arao T, Nohara T. Structure-hepatoprotective relationships study of soyasaponins I-IV having soyasapogenol B as aglycone. Planta Med. 1998; 64(3):233-236.

Köhne JL, Ormsbee MJ, McKune AJ. Supplementation Strategies to Reduce Muscle Damage and Improve Recovery Following Exercise in Females: A Systematic Review. Sports 2016;4(4):51. doi:10.3390/sports4040051.

Kolonel LN, Hankin JH, Whittemore Alice S, Wu Ana H, Gallagher RP, Wilkens Lynne, John Esther, Howe GR, Dreon Darlene, West Dee W, Paffenbarger RS. Vegetables, Fruits, Legumes and Prostate Cancer: A Multiethnic Case-Control Study. Cancer Epidemiol Biomarkers Prev. 2000; 9(8)795-804.

Kristal AR, Arnold KB, Neuhouser ML Goodman P, Platz EA, Albanes D, Thompson IM. Diet, supplement use, and prostate cancer risk: results from the prostate cancer prevention trial. Am J Epidemiol. 2010;172(5):566-577.

Laza V. Tomatoes and lycopene in the athlete's diet. Palestrica of the Third Millennium-Civilization and Sport. 2015;15(1):72-79.

Laza V. Valoarea nutritivă a alimentelor de origine animală. Chap 25. In: Ionuţ C. Compendiu de Igienă. Ed Med Univ "Iuliu-Haţieganu" Cluj-Napoca. 2004, 447-460.

Lee IA, Park YJ, Yeo HK, Han MJ, Kim DH. Soyasaponin I attenuates TNBS-induced colitis in mice by inhibiting NF-κB pathway. J. Agric. Food Chem. 2010;58(20):10929-10934.

Lee SO, Simons AL, Murphy PA, Hendrich S. Soyasaponins lowered plasma cholesterol and increased fecal bile acids in female golden Syrian hamsters. Exp. Biol. Med. 2005; 230(7):472-478.

Liu X, Suzuki N, Santosh Laxmi YR, Okamoto Y, Shibutani S . Anti-breast cancer potential of daidzein in rodents. Life Science. 2012; 91(11-12):415-459.

Lönnerdal B, Sandberg AS, Sandström B, Kunz C. Inhibitory Effects of Phytic Acid and Other Inositol Phosphates on Zinc and Calcium absorption in suckling Rats. J Nutr. 1989;119(2):211-214.

Messina M, Redmond G. Effects of Soy Protein and Soybean Isoflavones on Thyroid Function in Healthy Adults and Hypothyroid Patients: A Review of the Relevant Literature. Thyroid. 2006; 16(3):249-258. https://doi.org/10.1089/thy.2006.16.249.

Messina M. Soy and Health Update: Evaluation of the Clinical and Epidemiologic Literature. Nutrients. 2016;8(12):754. DOI: 10.3390/nu8120754.

Misner WD. The Great Hammer Protein Debate: Which Protein Is The Best, How Much And When? The J Endur. 2001:8.

Mori M, Masumori N, Fukuta F, Nagata Y, Sonoda T, Sakauchi F, Ohnishi H, Nojima M, Tsukamoto T. Traditional Japanese diet and prostate cancer. Molecular nutrition and food research. 2009; 53(2):191-200.

Nakashima H, Okudo K, Honda Y, Tamura T, Matsuda S, Yamamoto N. Inhibitory effect of glycosides like saponins from soybean on the infectivity of HIV in vitro. AIDS, 1989;3:655-658.

Philbrick DJ, Bureau DP, Collins FW, Holub BJ. Evidence that soyasaponin Bb retards disease progression in a murine model of polycystic kidney disease. Kidney Int. 2003; 63(4):1230-1239.

Phillips SM, Moore DR, Tang JE. A critical examination of dietary protein requirements, benefits and excesses in athletes. Int J Sports Nutr Exerc Metab. 2007;17 Suppl:S58-S76.

Rasha MK, Gibriel AY, Rasmy NMH, Abu-Salem FM, Abou-Arab EA. Influence of Legume Processing Treatments Individually or in Combination on Their Trypsin Inhibitor and Total Phenolic Contents. Australian J Basic App Sci. 2011;5(5):1310-1322.

Rietjens I, Jochem L, Beekman K. The potential health effects of dietary phytoestrogens. Br J Pharmacol. 2017;174(11):1263-1280. DOI: 10.1111/bph.13622.

Roa AV, Sung MK. Saponins as anticarcinogens. J Nutr. 1995;125(3 Suppl):717s-724s.

Rosenbloom C. Protein for Athletes: Quantity, Quality, and Timing. Nutrition Today. 2009;44(5):204-210.

Saljoughian M. Phytoestrogens (Isoflavones) in Infant Formulas. US Pharm. 2007;32(12):HS-27-HS-32.

Schlemmer U, Frølich W, Prieto RM, Grases F. Phytate in foods and significance for humans: Food sources, intake, processing, bioavailability, protective role and analysis. Mol Nutr Food Res. 2009; 53 (Suppl 2):S330-S375.

Setchell KD. Phytoestrogens: the biochemistry, physiology, and implications for human health of soy isoflavones. Am J Clin Nutr. 1998;68(6 Suppl):1333S-1346S.

Shu XO, Zheng Y, Cai H, Gu K, Chen Z, Zheng W, Lu W. Soy food intake and breast cancer survival. JAMA. 2009; 302(22):2437-2443. doi: 10.1001/jama.2009.1783.

Sicherer SH, Sampson HA. Food allergy. J Allergy Clin Immunol. 2009;125(2):S116-S125. DOI: http://dx.doi.org/10.1016/j.jaci.2009.08.028.

Siegenberg D, Baynes RD, Bothwell TH, Macfarlane BJ, Lamparelli RD, Car NG, MacPhail P, Schmidt U, Tal A, Mayet F. Ascorbic acid prevents the dose-dependent inhibitory effects of polyphenols and phytates on nonheme-iron absorption. Am J Clin Nutr. 1991; 53(2):537-541.

Stob M. Estrogens in Foods, Chapter 2 in Toxicants Occurring Naturally in Foods. National Academy of Sciences/National Research Council, Washington, DC. 1966; Publication 1354:18-23.

Takahashi S, Hori K, Shinbo M, Hiwatashi K, Gotoh T, Yamada S. Isolation of human renin inhibitor from soybean: soyasaponin I is the novel human renin inhibitor in soybean. Biosci. Biotechnol. Biochem. 2008;72(12):3232-3236.

Tanaka M, Watanabe T, Uchida T, Kanazawa T, Osanai T, Okumura K. Hypoglycemic effect of soyasaponin B extracted from hypocotyl on the increasing blood glucose in diabetic mice (KK-Ay/Ta) J. Jpn. Soc. Clin. Nutr. 2006;27:358-366.

Tara MK, Park JS, Mathison BD, Kimble LL, Chew BP. Whey protein, but not soy protein, supplementation alleviates exercise induced lipid peroxidation in female endurance athletes. Open Nutr J. 2013;7:13-19.

Teas J, Braverman LE, Kurzer MS, Pino S, Hurley TG and Hebert JR. Seaweed and Soy: Companion Foods in Asian Cuisine and Their Effects on Thyroid Function in American Women. J Med Food. 2007;10(1): 90-100. https://doi.org/10.1089/jmf.2005.056.

Thingom P, Chhetry GKN. Nutritional Analysis of Fermented Soybean (Hawaijar). J Sci & Technol: Biol Environ Sci. 2011;7(1):96-100.

Thomas JA, Gerber L, Banez LL, Moreira DM, Rittmaster RS, Andriole GL, Freedland SJ. Prostate cancer risk in men with baseline history of coronary artery disease: results from the REDUCE Study. Cancer epidemiol, biomarkers prev. 2012; 21(4):576-581.

Thongprakaisang S, Thiantanawat A, Rangkadilok N, Suriyo T, Satayavivad J. Glyphosate induces human breast cancer cells growth via estrogen receptors. Food Chem Toxicol. 2013;59:129-136. doi: 10.1016/j.fct.2013.05.057.

Torum B. Nutritional quality of soybean protein isolates studies in children of preschool age. Chap in Soy Protein and Human Nutrition. Wicke HL et al. (eds). Academic Press, New York, 1979.

Tsai C-Y, Chen YH, Chien Y-W, Huang W-H, Lin S-H. Effect of soy saponin on the growth of human colon cancer cells. World J Gastroenterol. 2010;16(27):3371-3376. doi: 10.3748/wjg. v16.i27.3371.

Tse G, Eslick GD. Soy and isoflavone consumption and risk of gastrointestinal cancer: a systematic review and meta-analysis. Eur J Nutr. 2016;55(1):63-73.

Urbano G, López-Jurado M, Aranda P, Vidal-Valverde C, Tenorio E, Porres J. The role of phytic acid in legumes: antinutrient or beneficial function? J Physiol Biochem. 2000;56(3):283-294.

Vucenik I, Shamsuddin AM. Cancer inhibition by inositol hexaphosphate (IP6) and inositol: from laboratory to clinic. J Nutr. 2003;133(11):3778S-3784S.

Vucenik I, Shamsuddin AM. Protection against cancer by dietary IP6 and inositol. Nutr Cancer. 2006; 55(2):109-125.

Wan XS, Lu LJ, Anderson KE, Ware JH, Kennedy AR. Urinary excretion of Bowman-Birk inhibitor in humans after soy consumption as determined by a monoclonal antibody-based immunoassay. Cancer Epidemiol Biomarkers Prev. 2000; 9(7):741-747.

Wang H, Johnson LA, T. Wang T. Preparation of soy protein concentrate and isolate from extruded-expelled soybean meals. J Am Oil Chemists' Soc. 2004;81(7):713-717.

Wei P, Liu M, Chen Y, Chen DC. Systematic review of soy isoflavone supplements on osteoporosis in women. Asian Pac J Trop Med. 2012;5(3):243-348. doi: 10.1016/S1995-7645(12) 60033-9.

Yi Y, Xiaoli J, Hui L, Xiang Z, Dongping W. Soy isoflavone consumption and colorectal cancer risk: a systematic review and meta-analysis. Sci Rep. 2016;6:25939. doi: 10.1038/srep25939.

Zhang GQ, Chen JL, Liu Q, Zhang Y, Zeng H, Zhao Y. Soy Intake Is Associated With Lower Endometrial Cancer Risk: A Systematic Review and Meta-Analysis of Observational Studies. Medicine (Baltimore). 2015;94(50):e2281. doi: 10.1097/MD.0000000000002281.

Zhang W, Popovich DG. Group B oleanane triterpenoid extract containing soyasaponins I and III from soy flour induces apoptosis in Hep-G2 cells. J. Agric. Food Chem. 2010; 58(9):5315-5319.

Zhang X, Shu XO, Gao YT, Yang G, Li Q, Li H, Jin F, Zheng W. Soy food consumption is associated with lower risk of coronary heart disease in Chinese women. J Nutr. 2003;133(9):2874-2878.

Zuniga K, Clinton SK, Erdman JW. The interactions of dietary tomato powder and soy germ on prostate carcinogenesis in the TRAMP model. Cancer Prev Res. 2013;6(6):548-557. DOI: 10.1158/1940-6207.CAPR-12-0443.

***. Food and Drug Administration, "Food labeling; health claims: soy protein and coronary heart disease," FDA 21CFR, Part 101; Docket No. 98P-0683, October 26, 1999. Article from NOHA NEWS, Vol. XXVI, No. 4, Fall 2001.