

## A REVIEW ON NUTRITIONAL AND HEALTH BENEFITS OF SOYBEAN

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### ABSTRACT

Asia is the origin of soybean, a crop that is significant both economically and nutritionally. Soybeans are rich in folic acid and iso-flavonoids; used in healthy diets all over the world. Because of their possible positive effects on human health, dietary soy products are attracting more and more scientific attention. Protease inhibitors, isoflavones, proteins or peptides, and saponins are the significant soy components that demonstrate biological activity. Soybean and its constituents have anti-inflammatory, anti-oxidant, anti-diabetic, and anti-proliferative qualities. The eating of these foods has been linked to a number of potential health benefits, including the prevention of immune system diseases, obesity, diabetes, cardiovascular diseases, and certain types of cancer. Numerous studies have demonstrated that high-protein soy products contribute to cholesterol lowering. The topic of this review article is soybeans, their products, and their possible use in the diagnosis, treatment, and prevention of a range of chronic illnesses. Research on new bioactive components of soybeans that are beneficial to health may eventually lead to their use in pharmaceutical development and functional foods, which may eventually replace synthetic medications with a variety of negative side effects.

**KEYWORDS:** Soybean, Composition, Isoflavone, Genistein, Soyfood.

### INTRODUCTION

Soybean, also known as soja or soyabean, is an annual legume crop in the leguminosae family. It is economically significant, provide vegetable protein for millions and serving as a constituent for numerous chemical production.<sup>[1]</sup> Soybean, a staple food in china, have been a significant source of protein for thousands of years. They have gained popularity among Chinese and Japanese consumers and are now considered as a potential treatment for degenerative western diseases.<sup>[2]</sup> Other than proteins, Soybeans are rich source of vitamins, minerals, low saturated foods and fibres.

The presence of these many biologically active compounds made use of soybean in the pharmaceutical industry to make medicines and other dietary products.<sup>[3]</sup>

The nutrient and health benefits of soybean include:

- ❖ It has anti-diabetic properties.
- ❖ It has antioxidant effect.
- ❖ It possesses anti-cancer properties.
- ❖ It has anti-inflammatory properties.
- ❖ It can be used in coronary heart disease.
- ❖ It has anti-obesity properties.
- ❖ It has cholesterol lowering activity.

The review discusses the nutritional value of soybean their potential role in preventing and treating various chronic diseases.<sup>[1,4]</sup>

**Table 1: Nutritional composition of soybean.**<sup>[5]</sup>

Nutritional composition	Percentage[%]
Carbohydrate	16.31
Protein	37.69
Crude fat	28.2
Moisture	8.07
Fibre	5.44
Ash	4.29

- (a) **Protein:** Soybeans are a rich source of plant-based protein, with a protein content of 37-56% of dry weight. Boiling soybeans provides 31 grams of protein. Glycinin and conglycinin make up 80% of the protein, which may cause allergic reactions. Consumption of soy protein can reduce cholesterol levels.<sup>[6]</sup>
- (b) **Fat:** Soybeans are used to make soybean oil and are categorized as oilseeds. With minimal amounts of saturated fat, the fat content makes up about 18% of the dry weight and is primarily composed of polyunsaturated and monounsaturated fatty acids. About half of the fat content in soybeans is linoleic acid, which is the most common form of fat.<sup>[6]</sup>
- (c) **Carbohydrates:** Soybean carbohydrate primarily consists of fiber, with primary non-fibre carbohydrates being oligosaccharides, raffinose, stachyose, and verbascose. Sucrose is a significant non-structural carbohydrate present in processed soy, providing sweetness. Traditional Asian soy foods are low in carbohydrates, potentially beneficial for people with diabetes. Many soybean carbohydrates contain oligo-saccharides, which are poorly digested by intestinal enzymes and stimulate the growth of beneficial bacteria like bifidobacteria in the colon. These oligosaccharides are classified as prebiotics.<sup>[5]</sup>
- (d) **Isoflavones:** Soybeans are rich in isoflavones, unique phytonutrients resembling estrogen. The main types are genistein (50%), daidzein (40%), and glycitein (10%).<sup>[6]</sup> Certain individuals possess a unique gut bacteria that can convert daidzein into equol, a substance responsible for the numerous health benefits of soybeans.<sup>[5]</sup>
- (e) **Saponin:** Saponins, a primary class of plant compounds found in soybeans, have been found to decrease cholesterol levels in animals.

Soybeans are a rich source of essential vitamins and minerals, including molybdenum, vitamin K, iron, copper, manganese, phosphorus, and thiamine, sodium, vitamin C, potassium.

**Table 2: Mineral composition of Soybean.**<sup>[6]</sup>

Composition	Value (mg)
Calcium	277mg
Iron	15.7mg
Magnesium	280mg
phosphorus	704mg
Sodium	2mg
Potassium	1800mg
Vitamin C	6mg

- (a) Copper: Copper intake is frequently low in Western populations, which could potentially lead to adverse effects on heart health.
- (b) Manganese: Manganese, a trace element found in most foods and drinking water, is poorly absorbed from soybeans due to their high phytic acid content.
- (c) Phosphorus: Soybeans are a rich source of phosphorus, an essential mineral in the Western diet.
- (d) Thiamine: Thiamine, also known as vitamin B1, is crucial for various bodily functions.<sup>[6]</sup>

### HEALTH BENEFITS OF SOYBEAN

Soybean components have been extensively studied for their health benefits, including addressing various human health issues. However, some studies present less promising or unfavourable roles of soybean in human health, highlighting the need for further research and understanding.

#### Cancer

Recent studies suggest that consumption of soy food and soybean protein, rich in flavonoid genistein and phytoestrogens, may reduce cancer risks in various types of cancers including breast, prostate, Endometrial, lungs, Colon, Liver, bladder cancer.<sup>[7,8]</sup>

**(a) Breast cancer:** Soy has been extensively studied for its potential health benefits, particularly in relation to breast cancer. Its main bioactive component, isoflavone, has anti-cancer properties and isoflavone inhibits estrogenic effects, which are crucial for the development, progression, and treatment of some breast cancers. This protective effect is more evident among Asian women, possibly due to factors like microbiota, early soy consumption, high intake, and less processed foods. Observational studies show that high soy consumption reduces the risk of developing breast cancer, particularly in childhood and adolescence.<sup>[7,8]</sup> Low soy or isoflavone concentrations don't increase breast cancer risk compared to large-quantity diets. However, soy-rich diets can reduce recurrence and mortality rates by 25% and 15% in breast cancer patients. Soy isoflavone intake may reduce breast cancer risk in Asian women, but no association was found in western women.<sup>[7,8]</sup>

**(b) Prostate cancer:** The consumption of fresh vegetables, particularly soy, has been linked to a lower incidence of prostate cancer among Asian men. Studies have shown a significant reduction in cancer diagnosis after soy and/or isoflavone consumption among men at high risk. Isoflavone can regulate genes controlling cell cycle and apoptosis, and also has antioxidant defense, DNA repair, inhibition of angiogenesis and metastasis, and estrogen antagonism.<sup>[9]</sup>

(c) **Endometrial cancer:** meta-analysis found that soy consumption inversely related to endometrial cancer risk, even across subgroups like non-fermented soy foods, postmenopausal women, Asian origin, and non-Asian origin.<sup>[9]</sup>

### **Reducing the risk of type 2 Diabetes mellitus**

Soy isoflavones may decrease the risk of diabetes, although the exact mechanism behind this effect remains unknown. Soy isoflavones may enhance insulin sensitivity, enhancing cell response and glucose absorption.<sup>[10]</sup> The soybean diet can help reduce symptoms of type 2 diabetes by reducing hypertension, hypercholesterolemia, atherosclerosis, and obesity. It also reduces renal hyperfiltration, proteinuria, and renal acid load, reducing the risk of renal disease. Soluble fiber from soybeans is beneficial for insulin regulation and blood glucose levels improvement.<sup>[11]</sup> Isoflavone supplementation reduces blood glucose and insulinemia in non-Asian postmenopausal women, especially with long-term use. Soy products or soy constituents may reduce the risk of type 2 diabetes.<sup>[9]</sup> Significant reduction in fasting blood glucose concentrations in individuals with type 2 diabetes who consumed soy protein for 4 years.<sup>[11]</sup>

### **Cardiovascular Diseases**

A diet rich in soy foods is linked to a lower risk of cardiovascular disease, including stroke and coronary heart disease. Soybeans have been shown to lower total cholesterol and LDL cholesterol levels, both known risk factors of heart disease. Clinical trials suggest that 14g to 50g of soy protein can significantly reduce total blood cholesterol levels, LDL cholesterol levels, and triglycerides, while moderately increasing HDL cholesterol levels. The US Food and Drug Administration found that adults who include at least 25g of soy protein daily in a low-saturated fat and cholesterol diet can reduce LDL cholesterol by 3 to 4%. Whole soy products have a greater effect on improving cholesterol levels than processed soy products.<sup>[4]</sup>

Reduction in blood pressure of 2.5 mmHg in systolic pressure and 1.5 mmHg in diastolic pressure in individuals receiving isoflavone compared to the control group.<sup>[9]</sup>

Study found that increased consumption of isoflavones in the US is associated with a moderately lower risk of coronary heart disease. Isoflavones can help control blood pressure, glucose, obesity, and inflammation.<sup>[9]</sup>

### **Menopause**

Menopause is a natural process that occurs in all women as they age. Menopause can be a physically and emotionally miserable time for women due to thermoregulatory disturbances such as hot flashes, night sweats, mood swings, and lack of energy.<sup>[11]</sup> Soy, rich in phytoestrogens, may reduce menopausal symptoms like hot flashes, according to observations of women in Asia. These phytoestrogens function like mild form of menopausal hormone therapy, but regular consumption would take almost a year to achieve similar health benefits.<sup>[4]</sup> Epidemiological studies indicate that Japanese women consume soy products, compared to non-soy-consuming Western populations, have a protective effect against menopausal symptoms.<sup>[12]</sup>

### **Osteoporosis**

Soy isoflavones may be an effective alternative to hormone replacement therapy (HRT) for women with osteoporosis, a condition causing bone growth issues and easy fractures. HRT, which replaces estrogen, can cause severe side effects and increase the risk of stroke, breast cancer, and coronary heart disease. Studies suggest soy isoflavones are as effective.<sup>[13]</sup>

Studies found that genistein stimulates osteoblastic function, maintaining bone mass. Isoflavone improves bone mineral density, remodeling markers, and rigidity in postmenopausal women. While soy consumption may protect against male osteoporosis in animal models and tissue culture, few human studies show any significant prevention or improvement.<sup>[9]</sup>

### **Obesity**

Soy is a potential food for anti-obesity initiatives due to its high protein and isoflavone content. Studies showing that consumption of soy protein can reduce body weight, fat mass, and plasma cholesterol and triglycerides. In animal models, soy protein can improve insulin resistance, a hallmark of human obesity, and also reduce body weight and fat mass.<sup>[14]</sup> Certain compounds in soy isoflavones can prevent fat buildup around rodents' organs, suggesting that soy isoflavone supplementation may be beneficial for managing obesity.

### **Antioxidant Effect**

Soybean products have been found to have antioxidant effects, reducing oxidative stress and enhancing total phenolic, flavonoid, and antioxidant profiles.<sup>[1]</sup> Studies have shown that 28 commercially available fermented soy products, including douchi, natto, miso, fried yellow soybean sauce, stinky tofu, and Huizhou mouldy tofu, have antioxidant capacities. These products also show changes in isoflavone content, possibly due to  $\beta$ glycosidase activity, which contributes to their antioxidant properties.<sup>[1,15]</sup>

### **Hypotensive Activity**

Consumption of kochujang extract, a soy food, has been found to reduce hypertension.<sup>[7]</sup> The angiotensin I converting enzyme inhibitory peptide from soybean hydrolysate and Korean soybean paste has shown enhanced anti-hypertensive activity<sup>[7,16]</sup>, causing a decrease in blood pressure compared to thiazide diuretics or beta-blockers.<sup>[7,17]</sup>

### **Immunity and Immunomodulation**

Soy and its derivatives have been studied for their immunomodulatory properties, including isoflavones, saponins, and antocyanins, which suppress metabolic pathways.<sup>[22]</sup> Genistein, a component of soy, suppresses immune antigen-specific responses and lymphocyte proliferation, but increases cytotoxic T and NK cell responses and cytokine production. It has been used for disease treatment in animal models, inhibiting allergic inflammatory responses.<sup>[17]</sup>

### **CONCLUSION**

The review concludes by highlighting the nutritional and health benefits of soybeans. It's clear from several studies and study findings that soybeans provide many health benefits for people, which makes them an important part of diets all around the world. First of all, soybeans are an excellent source of high-quality protein since they provide every important amino acid required for human nutrition. Furthermore, soy protein has been connected to a number of health advantages, such as lower risk of cardiovascular disease and better cholesterol levels. Moreover, soybeans contain phytochemicals called isoflavones, which have been linked to a host of health advantages, including as a lower risk of developing certain malignancies, stronger bones, and a reduction in menopausal symptoms. Soybeans are heart-healthy due to their low saturated fat and cholesterol content, making them ideal for weight management and diabetes control. Their low glycemic index and high fiber content make them a staple in balanced diets. Further research and exploration can provide valuable insights into optimizing human health and nutrition.

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