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Nutritional and health Benefits of soybean and soybean developed food

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Abstract
This review is a summary of nutritional and health benefits of soybean and its developed food. The important soy components that show biological activity are proteins or peptides, saponins, isoflavones, and protease inhibitors. There are many researches which shows that their consumption is effective in reducing total cholesterol, cardiovascular disease, oxidative stress, osteoporosis, diabetes mellitus, blood pressure, cancer-related issues and also alleviate menopause symptoms. This review elaborates the nutritional value of soybean and its products and their potential role in prevention and treatment of various chronic diseases.

Keywords: Soybean, nutritional benefits, health benefits, soybean products

Introduction
Soybean (*Glycine max*.) also known as soja bean and soya bean, which is an annual legume crop belongs to family Leguminosae. Economically soybean is the most important bean in the world, which offer vegetable protein for millions of people and constituents for hundreds of chemical products. Soybean is originated in China and has been cultivated for about 5000 years. Soybean was first introduced to Southeast Asia, then to Europe in 18th century and to America in 19th century (Karuga J, 2020) [33].

USA leads the world in the production of soybean with 108 million metric tons/year followed by Brazil 86.8 mmt, Argentina 53.4 mmt, China 12.2 mmt, India 10.5 mmt, Paraguay 10 mmt, Canada 6 mmt, Ukraine 3.9 mmt, Bolivia 3.3 mmt, Uruguay 3.2 mmt (FAOSTAT, 2020).

Soybean was first familiar with to India in the 10th century AD through the Himalayan routes and by Indonesian traders through Burma (now Myanmar). Soybean has therefore historically been produced on a small scale in Himachal Pradesh, the Kumaon Hills of Uttar Pradesh (now Uttaranchal), eastern Bengal, the Khasi Hills, Manipur, the Naga Hills, and parts of central India covering Madhya Pradesh. (DK Agarwal, 2013) [75].

Soybean creates one of the largest sources of vegetable oil and of animal protein feed in the world (Sugiyama *et al*., 2015) [63]. It has the highest protein content (40–42%) of all other food crops and is second only to groundnut with respect to the oil content (18–22%) among food legumes (He FJ, Chen JQ, 3013) [26]. The USA produced more than 50% of the world soybean yield until the 1980s. However, nowadays Brazil and Argentina are also among the top world nations of producing soybean, following the USA. The major producers of soybean in the world include the USA, Brazil, Argentina, China, and India with more than 92% of the world's soybean production. It has also been produced in Africa since the twentieth century (Rodríguez-Navarro *et al*., 2011) [76].

Soybean protein has played an increasing role in human nutrition over the last two decades in both developing and industrialized regions of the world.

Table 1: Nutritional composition of soybean (Ogbemudia Ruth Etiosa *et al*., 2018) [16].

Nutritional composition	Percentage (%)
Protein	37.69
Crude Fat	28.2
Carbohydrates	16.31
Moisture	8.07
Fibre	5.44
Ash	4.29

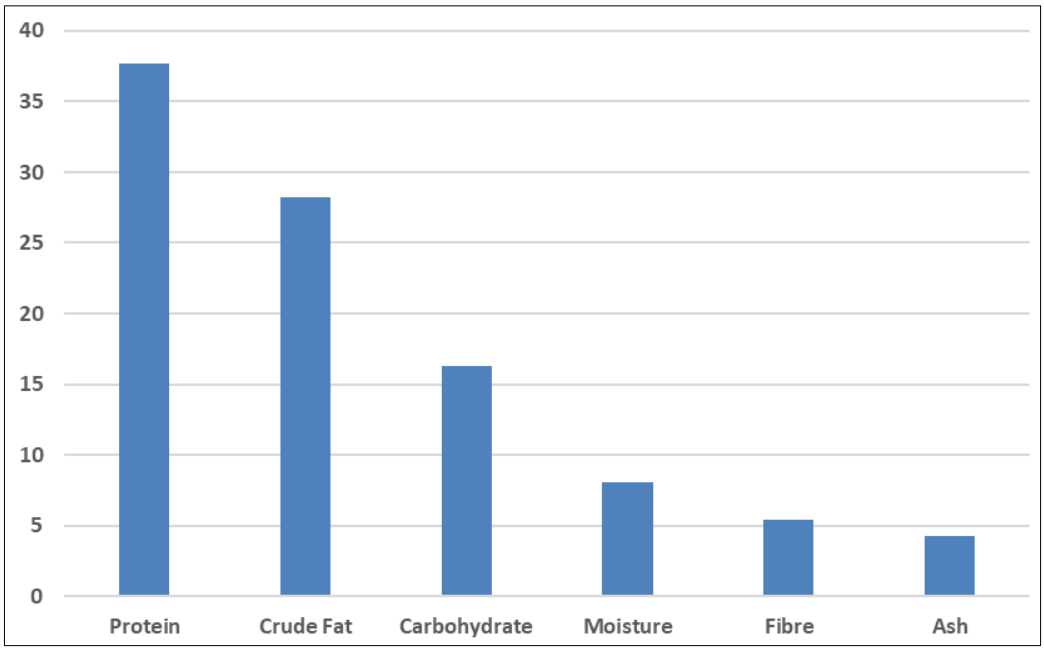

Fig 1: Show the Nutritional composition of soybean

Many years of scientific and clinical research has established that most of the components of soybean have useful health effects as considered by its protective potential for the so-called life-style-related diseases. The impact of most of the nutritionally and physiologically functional components of soybean (Sugano. *et al.* 2006) [62] are in the table below

Table 2: Nutritional and Physiological component of the soybean

Component	Advantages
α- Linolenic acid	Essential fatty acid, hypotriglyceridaemic, improves heart health
Isoflavones	Estrogenic, hypocholesteraemia, improves digestive tract function, prevents breast cancer, colon cancer, bone health, improve lipid metabolism
Lecithin	Improve lipid metabolism, improve memory and learning abilities
Lectins	Anti-carcinogenic, immunostimulatory
Linoleic acid	Essential fatty acid, hypocholesteraemia
Peptides	Readily absorbed, reduce body fat, anticancer
Phytosterols	Hypocholesteraemia, improves prostate cancer
Protein	Hypocholesteraemia, antiatherogenic, reduces body fat
Saponin	Regulates lipid metabolism, antioxidant

Nutrient Composition of Soybean

Protein

The soybean is an important legume because it does deliver all of the essential amino acids for humans; however, it is comparatively low in the sulphur containing amino acids, cysteine and methionine are consumed as a complete protein. The soybean is comprised of approximately 37-42% protein, of which, 90% is comprised of two storage globulins, 11S glycinin and 7S β-conglycinin (Medic J, *et al.* 2014) [49]. A small part of soybean proteins is characterized by soybean protease inhibitors. Among these, the best known are the trypsin–chymotrypsin inhibitor and trypsin inhibitor (Sarwar Gilani *et al.* 2012) [77] Various studies have confirmed how these proteins can inhibit pancreatic enzymes, thus reducing the digestibility of proteins (Medic J *et al.* 2014) [49]. Among these antinutritional factors, lectins also earn to be mentioned as they intrude with the immersion of micronutrients. Soybean protease inhibitors and lectins are both inactivated by heat treatment and fermentation (Medic J *et al*. 2014 and Hassan SM *et al*. 2013) [49, 25]. As for enzymes, lipo-oxygenase are not antinutritional factors but give the soybean their distinctive, undesirable, beany flavour (Rawal R *et al.* 2020), whereas urease is used mainly in production processes as an indicator of adequate heat treatment (Zverev S *et al.* 2018) [78].

The World Health Organization/Food and Agriculture Organization (WHO/FAO) adopted an evaluation methodology based on protein digestibility (increased by heating and fermenting soy) and the ability to provide an adequate amount of indispensable amino acid to meet organism requirement [digestible indispensable amino acid scores (DIAAS)] (Hassan SM, 2013) [25] (FAO, 2011) [14]. The protein digestibility corrected amino acid scores (PDCAAS) for soy protein range from 0.9 to 1.0 depending upon the specific soy food in question (Hughes *et al.* 2011 and Rutherfurd *et al.* 2015) [79, 80].

Lipid/Oil

Soybean contributes to 28% of the world's edible oil and is second in production of edible oils to palm oil (Kim H *et al.* 2015) [34]. Soybean itself contains roughly ~19% oil, of which the triglycerides are the major component. Soy oil is categorized by comparatively large amounts of the polyunsaturated fatty acids (PUFA), i.e., ~55% linoleic acid and ~8% α-linolenic acid, of total fatty acids (Messina *et al.* 1997) [52]. Many food products are made of edible oils from

soybean such as salad dressings, margarines, and spreads (Cherry JP 2006) [9]. The oil is obtained from the bean by solvent extraction from the bean pod. The lipid fraction is then processed and refined to remove impurities such as pigments, proteins, carbohydrates, and other chemicals that affect taste and appearance (Foster R *et al.* 2009) [20] Within the lipid fraction exists phospholipids (collectively called lecithin) (Carpenter AP, 1979) [8] and tocopherols (Evans JC, *et al.*, 2002) [17] A degumming process removes phospholipids. The tocopherols act as natural antioxidants, a positive role for soy oil since it is quite susceptible to oxidative rancidity (Choe E *et al.* 2006) [10].

The lipid content of soybeans in wild types is known for its high unsaturated fatty acid content (Hammond EG *et al.* 1991) [24].

Carbohydrate

The carbohydrate composition of the soybean consists mainly of fibre. The primary non-fibre carbohydrates in soy are the oligosaccharides, raffinose, stachyose and verbascose. Raffinose is a trisaccharide of galactose, glucose and fructose, bound by 1 to 6 and 1 to 2 glycosidic linkages respectively and stachyose is tetra saccharide of 2 galactoses, glucose, and fructose bound by 1 to 6, 1 to 6, and 1 to 2 glycosidic linkages respectively. Sucrose is the other non-structural carbohydrate that is present to a comparatively significant degree. The presence of sucrose delivers some sweetness to processed soy products (Medic J, *et al.* 2014) [49].

The low carbohydrate content of the soybean shows that several traditional Asian soy foods are also low in this macronutrient which may make them beneficial for people with diabetes (Feinman *et al.* 2015) [81] Also, much of the soybean carbohydrate is contained oligo-saccharides (predominately stachyose) (Karr-Lilienthal *et al.* 2005) [82], because they are poorly digested by intestinal enzymes, travel to the colon where they are able to stimulate the growth of bacteria such as bifidobacterial, that are considered to be beneficial to the host. For this reason, the soybean oligosaccharides are classified as prebiotics (Inoguchi *et al.* 2012) [83].

Role of Isoflavones in Soybeans

Isoflavones comes under the sub-group of heterocyclic plant phenolic category called flavonoids. Besides isoflavones, the other subclasses of flavonoids include flavones, flavanols, flavanols, aurones, red and blue anthocyanin pigments, and chalcones. The soybean is most rich source of isoflavones (up to 3 mg/g dry weight) in the nature (Kudou, *et al.* 1991) [37]. There are three types of isoflavone soybean comprise aglycone *viz*., daidzein, genistein and glycitein; each of them presents in three glycosidic forms in addition to their aglycone. Daidzein, genistein and their glycosides contribute to >90% of total isoflavone; whereas glycetein and its glycoside are present as minor component (<10%), only. The isoflavone content of the soybean ranges according to soybean genotype and environmental conditions during growth of the plant (Goyal R, *et al.* 2012) [23] Because genotype can influence the type and concentration of isoflavones, this is also an area of research in growing conditions for, breeding, and genetic engineering of the plant to yield high concentrations of isoflavones in the soybean (Bi Y, Li W, *et al.* 2015) [7].

In count of isoflavone metabolism, a notable difference among individuals is that only about 25% of non-Asians and 50% of Asians host the intestinal bacteria that turn daidzein into the iso-flavonoid equol (Satchell *et al.* 2010) [84]. In 2002, Satchell *et al.* (2002) [84] proposed that those individuals who host these bacteria are more likely to benefit from soy food consumption (Satchell *et al.* 2010) [84]. Since that time this hypothesis has been hotly debated. Equol does appear to offer health benefits over its precursor daidzein in possibly several different areas but especially in the alleviation of hot flashes (Utian *et al*. 2015 and Usui *et al*. 2013) [85].

Saponins

Saponins are triterpenoid compounds that form water-soluble structure with cholesterol, preventing its absorption. Soybean is a good source of this group of compounds also (Fenwick DF, *et al.* 1981) [18] Saponin content ranges largely depending on the genotype of the soybean from 11.0-35.6 mg/g seed (Goyal R, *et al.* 2012) [23]. Soya saponins are a group of non-volatile amphiphilic molecules that are present in a broad variety of legume seeds, such as SBs, peas, lentils and lupins (Lásztity, R. *et al.* 1998) [86] Soy-based products are the main food sources of soya saponins (Lásztity, R. *et al.* 1983) [86]. These are mostly involved in the cells of SB cotyledons and supply into the Okara after processing. It was stated by Garfinkel and Rao, in 2003, that they possess immunostimulant, antiviral, hepatoprotective and chemo preventive properties (Gurfinkel, D.M. *et al.* 2003) [87].

Incorporation of Soybean in Human diet

To fulfil their daily necessities of calcium, vitamin D, vitamin B12, and zinc, vegans should emphasize the consumption of soy products as tempeh, tofu, roasted soy nuts, edamame, calcium-fortified soymilk and soy-based meat analog. Some examples of meals and snacks that offer complementary proteins for them include cereal with soymilk, rice pudding made with soymilk, textured soy protein taco with a corn tortilla, soy hot dog in a bun, and tofu salad instead of egg salad.

Soybean milk

Soybean milk is an aqueous extract of whole soybeans. Soy milk is one of the most important soy products which inhibits oxidative stress in type 2 diabetes mellitus in human trials. There are many results which shows that fermented soy milk manages the total antioxidant, 8-iso-prostaglandin F2α, malondialdehyde, oxidized glutathione, glutathione peroxidase, and reduced glutathione (GSH), levels. The results of the study conclude that probiotic soy milk consumption could improve oxidative stress in type 2 diabetes mellitus (Miraghajani *et al*., 2017) [45].

Soy milk has been used for the making of different food products. Like In the study of 2015 by Nazanin Fatemeh Rahmati and Mostafa Mazaheri Tehrani, they made an eggless cake and use soy milk in the replacement of egg with the motive of making a nutritional and healthy cake (Rahmat, N.F., & Mazaheri Tehrani M., 2015) [56].

Fermented soy milk beverage with added apple juice was introduced by Filiz Lcier and others in 2015, with the aim of making a new fermented soy milk and deliver probiotic microorganisms to consumers.

Soy biscuits

Soy biscuits are healthy snacks among the other snacks

available in market. As soybean is high in protein provide all the nutritional components in one snack. (Gandhi, 2008b) [88]. In the study of 2018 [13] by F de Oliveira Silva and others, Biscuits were prepared with soybean meal to provide low-carb, high protein and high fibre and the consumption of these biscuits reduce the heart disease risk FDA claim related to soy protein as well as for the reduced breast and prostate cancer incidence literature data related to isoflavones (de Oliveira Silva *et al.* 2018) [13]. Roger P and others prepared the biscuits from wheat flour-sweet potato- soybean was high in protein and fibre and suitable of protein and mineral deficient consumers (Roger, P *et al.* 2022) [58].

Soybean incorporated Gulab-jamun

Soybean Gulab-jamun has different and unique taste due to its own nutritious values and deliver a complete protein. Soybean Gulab-jamun eating helps to prevent cancer, lower cholesterol levels, combat osteoporosis, and regulate menopause.

Rajni Kant and Arif, A Broadwayb showed in their study that Gulab jamun can be nutritious by adding Soymilk and using khoa which is made by soymilk. As soybean is rich in isoflavones, it can be helpful for people suffering from protein energy malnutrition (Kant, R., & Broadwayb, A. A. 2017) [32].

Tofu

Tofu is a good source of protein, B vitamins, and sodium (E.W. Lusas, M.N. Riaz, 2015) [15]. In many countries they are commonly served as desserts, side dishes and also as ingredients of soup. It is made by coagulation of extracted soymilk and can be stored up to one year. (Su, 2012) [89].

There are many other uses of tofu also exist like by-product of tofu – Soy Whey. This contains plenty amount of nutrients like protein, simple sugars, oligosaccharides, minerals and soy-isoflavones. There are many ways to utilize soy whey, ranging from compound isolation, production of new compounds through enzymatic or fermentation procedures, functional beverage production and biofuel production (Chua, J. Y., & Liu, S. Q., 2019) [11].

Soy bread

Soy bread is high in fibre and also has good fats. These breads help to lower the cholesterol and good for heart and artery. They have their own nutritious value as well as delicious too. (Gandhi, 2008b) [88]. Soybean incorporation of making of breads are also healthy and delicious option. In the study of 2017 by Ayele, H and others Made bread of wheat flour incorporated with cassava and soybean flour to enhance its nutritional value and reducing the rising price of bread from 100% wheat flour (Ayele, H *et al.*, 2017) [4].

Soy sauce

Soy sauce is a liquid condiment with good protein and carbohydrates and use as food product and also preservative. It supports healthy digestion and helps in gastric problems and also have anti-allergenic properties.

In 2021 Zhao, G. and others studied that germinated soybean sauce has better taste and aroma than the control one and the nutritional value of soy sauce of germinated soybean has different than control soy sauce (Zhao, G. *et al.*, 2021) [74].

Powdered soybean milk

There are two ways of making soybean milk powder from soybean protein isolates or by drying soybean milk. It contains about 50% higher protein as compared to skim milk powder. It is rich in omega-3 fatty acids which is healthy fat that our body cannot form own its own. (Yu-Ting-Li *et al.* 2021) [90].

Soybean infant formula

Soybean infant formulas are made from soybean protein isolates in which other nutrients such as amino acids, vitamins and minerals (generally methionine) are added. The main alternative of soybean infant formula is feeding children with allergy to cow's milk protein (E Verduci *et al.* 2020) [68].

Soybean yogurt

Soybean yogurt results from the fermentation of soybean milk. They have protein counts comparable to cow's milk yogurts and deliver Healthy and unsaturated fats. (Jin Hawan Lee *et al.* 2018) [38].

Mei Yang and Li L. (2010) [73] studied the Soymilk prepared from germinated soybean with different hypocotyl lengths was fermented to produce probiotic soy yogurt (sogurt). Probiotics are live microorganisms that naturally lives in our body and probiotic-fermented soy foods are helpful for increasing the many health problems like antihypertension, hypocholesterolaemia, improvement of immunity, alleviation of lactose intolerance, reduction of ovarian cancer and cardiovascular disease risks (Yang, M., & Li, L.2010) [73].

Tempeh

Tempeh is a traditional fermented soybean food which is prepared by the fermentation of dehulled and cooked soybeans with Rhizopus species (Nout and Kiers, 2005) [91]. Tempeh contains greater amounts of peptides, free amino acids, and gamma-aminobutyric acid than unfermented soybeans (Nout and Kiers 2005, Aoki *et al*. 2003a) [91, 92].

Vital, R. J. and others in 2018 [69] Produce white bean tempeh burger to compare its nutritional quality to soy tempeh burger. According to them white bean tempeh burger can be a good alternative for healthy eating and can be a good alternative for meat (Vital, R. J. *et al.*, 2018) [69].

Soy Supplements

Soy supplements contains isoflavones genistein, daidzein and glycitein. Dietary supplementation of soy protein helps to decrease levels of total cholesterol, triglycerides, and low-density lipoprotein cholesterol and to increase high-density lipoprotein cholesterol levels (Bell, D. S., & Montanya, E. 2001) [6].

Lule, V. K., and others in 2015 [44] Studied that Lunasin a peptide found in soybean seed has properties like anti-inflammatory and anti-cancerous properties and could also play a vital role in regulating of cholesterol biosynthesis in the body and this is why can use as a dietary supplement (Lule, V. K., *et al.* 2015) [44].

Health benefits of Soybean

The health effects of soy components have been extensively studied through human clinical trials, experimental animal studies, and *in vitro* cell culture studies. Going further, we will confine our discussion to various scientifically validated/supported health benefits of soybean consumption to ameliorate various human health issues, though there are few studies which present less promising and unfavourable role of soybean in human health.

Cancer

Many groups of researchers have suggested that the regular consumption of soybean is can lessen the risk of different cancers in countries that include soybean in their diets (Messina, *et al.* 1997) [52]. Different number of soy components have been explored for potential anticancer activity. Different anticancer activities which soybean contains such as, isoflavones, protease inhibitors, phytosterols, saponins, phenolic acids, and phytates. Most of the data support that predominantly isoflavones are responsible for the anticancer effects of soybean (Messina, *et al.* 1997) [52], (Lichtenstein, *et al.* 1998) [41]. One of the ways in which isoflavone genistein slows the growth of cancer cells is by inhibiting several enzymes involved in signal transduction, including tyrosine protein kinases (Akiyama T, *et al.* 1987) [1] MAP kinase (Thorburn J, *et al.* 1994) [65] and ribosomal S6 kinase (Linassier C, *et al.* 1990) [41]. Studies have reported that consumption of soy products in childhood is associated with a lower risk of breast cancer in adulthood (Korde LA, *et al.* 2009) [35] However, it is still controversial if soy should be regarded as a cancer protective agent, because not all research supports the protective value of soy towards breast cancer (Messina MJ. *et al.* 2001) [50].

Menopause

Every women experience menopause in their life as they aged and it is a natural process. Thermoregulatory disturbances like hot flashes (HF), night sweats, mood swings and lack of energy can make menopause one of the most physically and emotionally miserable times in a woman's life (Freedman, *et al.* 2005) [21] HF arises as a sudden feeling of heat in the face, neck, and chest (WHO. *et al.* 1990) [71] Dietary soy has gained much attention since reports of reduced menopausal discomfort and reduced morbidity incidence of several hormone-dependent diseases in soy consuming Asian compared with non-soy consuming Western populations. There are some epidemiological studies shows that in Japanese women consumption of soy products has a protective effect against menopausal symptoms (Nagata, *et al.* 1999) [54], (Albertazzi, *et al.* 1998) [2].

Diabetes

Vegetarians are less likely to develop Type 2 Diabetes due to the following reasons: higher fiber and lower saturated fat intake, a higher intake of lower-Glycemic Index foods such as nuts, legumes, fruits and vegetables, and lower rates of hypertension that prevent diabetic complications.

Soybean diet can help to reduce the symptoms of type 2 diabetes individuals due to its effect on hypertension, hypercholesterolemia, atherosclerosis and obesity, which are very common diseases in diabetic patients (Holt, S., *et al.* 1996) [27]. Likewise, substituting animal protein for soybean or other vegetable protein may also reduce renal hyperfiltration, proteinuria, and renal acid load and therefore reduces the risk of renal disease in type-2 diabetes (Jenkins, *et al.* 2003) [31]. Soluble fibre from soybean may be beneficial because of its insulin-moderating effect. It is commonly accepted that a high fibre diet, mostly soluble fibre, is useful to control plasma glucose concentration in diabetics. Soybean fibre intake has also been implicated for the improvement of the blood glucose levels of diabetics (Messina, *et al.* 1999) [51].

Cardiovascular disease

There are different studies on soybean suggesting the significant of soy protein on human health. On the basis of total diet and nutritional perspective, various studies have explained the difference in mortality rates from different types of cancer and cardiovascular disease (CVD) in various countries. A number of investigations described that animal protein such as casein, is more cholesterol emic and atherogenic as compared to plant derived protein (Silva FCDS *et al.* 2017) [60] and (Singh G, Kumar A, 2019) [61].

Cardiovascular disease (CVD) includes all diseases that affect the heart and blood vessels, such as coronary heart disease (CHD), coronary artery disease, dyslipidaemia, and hypertension (Van Horn, *et al.* 2008) [67]. Looking at present scenario CVD has become one of the major health problems around the world including developing countries.

The role of soy in the prevention of CVD, particularly LDL cholesterol–lowering effects, has been the subject of numerous controlled clinical studies. (Van Horn, *et al.* 2008) [67]. In 2006, a study (Jenkins DJ, *et al.* 2006) [30] reported findings from a 1-year trial in which 66 individuals who adhered well to the portfolio diet (31.8% of participants) experienced reduced serum LDL cholesterol levels by 29.7%. In response to increased interest and the expanding body of knowledge in soy and health (Anderson, J.W., 1995) [3] the U.S. Food and Drug Administration (FDA) approved in 1999 a health claim for use on food labels which stated that daily diet Containing 25 g/day of soy protein, which is also low in saturated fat and Cholesterol, may reduce the risk of heart disease (Md, 2000) Modest reductions in serum LDL cholesterol levels have been achieved with soy intake, especially for subjects with hypercholesterolemia (Van Horn, *et al.* 2008) [67]. Soy protein consumption in several Human controlled clinical trials ranged between 14 and 113 g/day (with a Median of 36 g/day). The beneficial effects which have been documented include decreased low-density lipoprotein (LDL) concentrations, triglycerides, lipoprotein, C-reactive protein, homocysteine, oxidized LDL, and blood pressure, and increased high-density lipoprotein (HDL) concentrations (Zhan, S, *et al.* 2005) [93] In these studies, the amount of isoflavones prescribed was up to 185 mg/day with a median of 80 mg/day.

Antioxidant effects of Soybean

Oxidative stress occurs as a result of an imbalance between the free radicals and antioxidant mechanism (Jayachandran *et al.* 2015) [94]. It is a main mechanism in a variety of diseases including diabetes, cancer, etc. The soybean and its products are efficient in scavenging the free radicals and reducing the oxidative stress (Yoon & Park, 2014). In recent study, it is found that 28 different commercially available fermented soy products having antioxidant capacities which include different varieties of douchi, natto, miso, fried yellow soybean sauce, one stinky tofu and Huizhou mouldy tofu. Different studies reveal that fermented soy products have enhanced the total phenolic content, total flavonoid content, antioxidant profile, and also bring different changes in the isoflavones content. The changes in the isoflavones may be due to the β-glycosidase activity (Xu *et al.*, 2015) [95].

Osteoporosis

During women's menopause, endogenous estrogen deterioration leads to an sudden bone loss (M.M. Shams-

White, 2018) [47]. Hormone therapy was among the most used treatments for menopausal osteoporosis till the very last decade (J.W. Pawlowski, 2015) [29]. As we know that soy products have high-quality proteins as well as rich in isoflavones and calcium, therefore soy-based products can help to improve bone health and prevent the risk of osteoporosis (G. Rizzo, 2018) [22].

Literature reviews on meta-analysis determined that soy protein intake affects bone mineral density (G. Rizzo, 2018) [22] (M.M. Shams-White, 2018) [47]. There are different controlled trials conducted which shows that, therapeutic treatment with soy proteins rich in isoflavones are helpful in reduction of the bone resorption turnover rate (J.W. Pawlowski, 2015) [29] (T. Sathyapalan, 2017) [64]. Furthermore, several studies showed that consumption of soy protein results in an improved bone calcium maintenance in females during the post-menopausal period, indicate a positive bone balance, thus maintaining bone volume and increasing bone strength. (J.W. Pawlowski, 2015) [29].

Abdominal Body Fat

The efficiency of taking soy protein on fat loss and intercept obesity has been showed in animal and human research (M. Van Nielen, 2014) [46]. Several theories for the anti-obesity influence of soy proteins contain constraint of hepatic lipogenic enzymes and FA production, simulated muscular FA oxidation, improvement of plasma adiponectin levels, and improved faecal matter excretion. Daily food consumption high in soy protein could have the possibilities to prevent hyperlipidaemia and obesity.

It has been investigated that the influence of soy intake on weight and other obesity-related characteristics are capable to unravel the underlying mechanisms by which soy products exert such health benefits. Some studies have showed that soy isoflavones activate the peroxisome proliferator-activated receptor, therefore it improves the lipid metabolism and generates the anti-diabetic benefits (O. Mezei, 2003) [96]. Also, researches proved that soy protein products rich in isoflavones have an anti-diabetic effect by defeating insulin resistance (D.Y. Kwon, 2010) [97]. Kim *et al.* (2008) [12] found that fermented soy product Cheonggukjang can control the blood glucose and increase the plasma insulin levels in mice, thus enriching the symptoms of diabetes (D.J. Kim, *et al.* 2008) [12]. A higher intake level of soymilk in There were some human trials conducted of higher intake of soymilk which showed the reduction of oxidative stress in the type 2 diabetes mellitus population (M Jayachandran, B. Xu, 2015) [94] (M. Miraghajani, *et al.* 2017) [45]. Moreover, soy isoflavones have proved potent effects on dropping cholesterol levels in both animal and human trials, and such advantageous effects are suggestively improved when consuming soy protein in the diet compared to purified bioactive compounds (S. Wang, *et al.* 2017) [70] (N, Behloul, G. Wu, 2013) [53].

Conclusion

The consumption of soy foods is getting increased around the world due to its nutritional value and many health benefits. There are many nutritional advantages that could be obtained by incorporating soybean-based foods in the diet. Soybean signifies an outstanding source of high-quality protein which reduces different diseases. In this review, various health benefits of soybean have been included like, anti-diabetic, anti-cancer, reduction of cardiovascular diseases, osteoporosis, and many other. This review also summarizes many soy-based foods which we can add in our daily diet easily.

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