Nat. Volatiles & Essent. Oils, 2021; 8(6): 3001-3013

Consumption Of Soybean Products Prevent Cardiovascular Disease And Improve Mental Health: A Systematic Review

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Abstract

Background: Cardiovascular disease and mental health have become the leading health issues in the world. As many researchers suggested that food products derived from soybean give many beneficial effects on the nutrition and health of humans.

Purpose: This paper aims to review the risk of cardiovascular disease, their prevention and mental health improvement through soybean food consumption.

Methods: Systematic reviews were conducted through analysis of articles published with the title of prevention of cardiovascular disease and mental health improvement with consumption of soybean food products. Papers were searched systematically using keywords such as cardiovascular disease and Soybean, risk of Cardiovascular and food, brain-boosting, soybean, health benefit, and Soybean. Different search engines were used by inserting the

keywords into google scholar, PubMed, Research Gate, and Medline. The abstracts of the related papers were skimmed systematically and twenty-four papers were incorporated to review this paper. The findings of the articles were analysed thematically using predesigned outline questions.

Outcomes: Soybean is a great source of plant protein, have high content of polyunsaturated fatty acids, and is also source of phytochemicals such as is of lavones and lignans, and fiber, which have antioxidant properties, to prevent and reduce the risk of cardiovascular disease. The bioactive compounds of soybean have promising properties to reduce the risk of cardiovascular diseases. Integrating daily food pattern with soybeans products have significantly changed people health suffering from cardiovascular disease. Consumption of soybean foods four times and more per week resulted in 22% lower risk of cardiovascular disease. Soybean protein formulated as soymilk reduced 4% LDL cholesterol when compared to consumption of animal protein.

Conclusion: From the review integrating daily dietary pattern with soybean products significantly prevents cardiovascular disease and improves mental health. Therefore, large scale production, lower cost and market availability will prevent risk of cardiovascular disease and improve mental health of the consumers globally.

Keywords: food consumption; soybean; cardiovascular disease; mental health; prevention

Introduction

During the past few years, the popularity of plant-based butter (nut and seed butter) has become increased as food taboo [1]. Formerly peanut butter was the only alternative dairy butter over the era of technology and also consumer awareness toward plant-based butter has led to the development of myriad diversities of butter with different nuts and seeds[2], which are a very good source of protein, fiber, essential fatty acids, and other nutrients[3]. These days' different varieties of plant-based butter are available in the market viz., peanut butter, soy butter, almond butter, pistachio butter, cashew butter, and sesame butter[4]. The soy butter prepared from defatted flour, sprouted, cooked and fried seeds were compared to commercial peanut butter, in terms of nutritional, microbiological, textural, and sensory values[2], [5]–[7]. Also, it has vitamins and minerals which are very essential nutrients to maintain human health. Investigators finding publicized that soybean has been consumed for hundreds of years by various Asian nations, and they supposed that regular intake of this plant type of protein from soybean reason for the lower rate of heart disease, stroke, and cancer in these countries[8], [9].

Nutritional quality of soybean products

The popularity and acceptability of food products derived from soybeans are increasing due to their beneficial effects on nutrition and health[10]. Soy-butter is a relatively new product with limited commercial availability, and it is a healthy alternative to peanut butter for consumers who are allergic to peanut butter[11], and healthier too. The process of soy butter preparation comprises of removal of skins from soybeans, roasting beans to a dark brown color, reducing

the roasted beans to a fine powder, and then mixing the powder with edible vegetable oil to make a paste[7]. Gorrepati et al. (2015) mentioned an improved method for the preparation of soy butter as soaking of beans for 12 h, removing the skins and then boiling in any nut oil until beans attain good brown color, making them into a fine powder, the addition of desired nut oil to yield a proper viscosity and then salting it. Pichel and Weiss (1967) described another improved method without 'grassy' or 'beany' flavor. It has been described that the moisturizing step should be controlled to avoid the weakening of the structure of the bean. Such control is assured by adding only enough moisture to remove 'grassy' or 'beany' flavor constituents, but not so much moisture that the beans are saturated with water. Glas (2006) reported that the addition of low-calorie sweetener (sucralose) in homemade soy butter increased the force, decreased water activity and the overall quality is comparable with soy butter made with sugar.

Soy butter had higher protein and lower fat content compared to commercial peanut butter. Sprouted and cooked soy butter might, however, be more susceptible to oxidation, but less invaded by total bacteria, yeasts, and molds[6]. Sprouted soy butter was less significantly hard and the least adhesive, gummy and chewy of all treatments. Also, it had the highest sensory hedonic score, while fried soy butter had the lowest one[10], [12]–[14]. Besides, it has an added value for those who are concerned about soybean and its butter as an important functional food and low-fat content other than commercial peanut butter[8].

Soybean (Glycine max L) is a unique pulse cum oilseed crop, which occupies a place of pride in agriculture[6], [15], [16]. Soybeans are unique because they are the only commonly eaten food that contains a group of compounds called Isoflavin which have a similar chemical structure with the hormone Estrogen[8], [13]. Soybean, with 40% protein and 20% fat, assumes the most predominant position in overcoming the malnutrition problem. While soy nuts are gaining popularity as a nutritious snack, soy-butter is a relatively new product with limited commercial availability[17]–[19]. Sprouting, a non-thermal and nonchemical process has been used as a technique to minimize the disadvantages of undesirable flavor and odor in soybean and its products[2], [20]. Soybeans are an excellent source of high-quality protein containing 40 g/100 g of high-quality protein with all the essential amino acids needed for growth[5], [8]. It contains many essential amino acids that our body cannot make. Soybean and soy food provides a variety of health benefits including prevention of cardiovascular disease, osteoporosis, diabetes, asthma, cancer as well as menopausal treatment[3], [6], [12], [21].

Animal meat is the source of protein that is necessary for the growth, tissue repairment, and other systemic function of the human body[6], [22]. It is also a great source of energy, to perform daily tasks and fight many diseases with regulate body hormones. Even though, the protein from animals contains a complex biochemical structure with saturated fatty acid[23]. An alternatives food source with protein, free of cholesterol can be made accessible anywhere by cultivation on land. As many researchers reported that soy is the protein that comes from soybeans, a type of legume. It is a rich source of plant protein and high content of polyunsaturated fatty acids, linoleic (C18:2), and linolenic (C18:3) acids. It also contains low amount of saturated fat and is rich in fiber[4], [6], [24].

Epidemiological data suggested that the prevalence of the cardiovascular disease has become the leading disease burden in the world. The burden continues its decades-long rise in almost all countries in the world. Studies showed that the total CVD case became nearly

double from 271 million 550 million from 1990-2019 worldwide [25]. Among the three major CVD cases, ischaemic heart disease, rheumatic heart disease, and stroke are popular [26]. Mental disorder has became a global problem today. The study reviled that the global burden of mental disorders was 56.7%. It significantly contributes to global disease burden [27]. Mental health has long been neglected in health and public health practice. Researchers and public health professionals must work together to resolve the enormous public health crisis presented in the world[27].

Risk of cardiovascular disease and mental disorder

Therefore, the consumption of soy products reduces the risk of cardiovascular disease and mental disorders. This effect has been attributed to the chemical constitution of soy products with soy protein and isoflavone fractions[3], [13], [20], [24]. It is an organic source and easily cultivated everywhere in the world. The grains can be found in all markets as cooked beans, soy sauce, soymilk, and tofu (soybean curd)[15]. Since, it is a good basis of phytochemicals such as isoflavones and lignans, compounds with antioxidant properties[28], focus on implementing existing cost-effective and organic-based policies and interventions to reduce the disease burden in the world.

Significant of paper

As noted by different scholars, chronic disease is a pronounced public health problem, and many people are manifested widely with disrespected to gender, age, ethnicity, and lifestyle. The mortality rate and morbidity of cardiovascular disease have increased considerably. The prevention and treatment of disease conditions are very important to reclaim the disease burden globally. Therefore, this paper encourages the readers and researchers for further investigation specifically on cardiovascular disease prevention using organic plants of soybean products. Since, it is a plant source of protein, integrated into daily food, to maintain their health against cardiovascular disease and mental problems. Moreover, organizational bodies may use the paper as a reference to design policy, supports, and promote people to consume soybean products for the positive benefit on their life to prevent cardiovascular disease.

Objectives

- To identify the biochemical constituents of soybean products
- To determine the benefits of soybean on mental health

Method and materials

Data source and searches strategy

Research conducted globally in the area of cardiovascular disease with the consumption of soybean products was incorporated for systematic review. The papers, which have been published in the known journals in this area, and fulfilled the criteria set, were collected together to review this article. Systematically search strategies were used to collect articles online with keywords: cardiovascular or soybean, cancer or soybean, cardiovascular and Soybean, Cancer and Soybean, Chronic disease or Soybean, Chronic disease, and Soybean, Consumption soybean strategy, prevention, Nutrition, Effectiveness and like key terms were used to search articles related to the paper.

Study design and selection

The systematic paper review was conducted on the papers, published from 2010-2021. Studies were selected based on the topic and objective as well as results noted on the paper. The detail selection criteria were used to screen out the reliable article.

Inclusion criteria: Inclusion criteria were following.

(1) The paper with the English language.
(2) The year of publication range from 2010-2021.
(3) The title on cardiovascular disease and soybean product.
(4) All types of study design conducted on the topic.

Exclusion criteria: Exclusion criteria were following.

(1) Year of publication below 2010.
(2) The paper with other than English word.
(3) The topic and objectives are not relevant to the article.
(4) The results of the paper are not clear for understanding.

Outcomes

The primary outcome of the paper was biochemical constitute in soybean products, and effect on the treatment and prevention of cardiovascular disease and improve mental problems for the consumers.

Data extraction

After loading the paper from the published journal, rough skimming of the article was done to prepare the questionnaire, and afterward, the valuable data was identified and extracted through detail reading of the full article. This pre-designed questionnaire was significantly guided and support during data extraction.

Data synthesis and analysis

Data were extracted and interpreted, collecting the papers according to design type, country, and the number of participants involved in the studies. A simple descriptive presentation of data was used to show the effect of soybean on the prevention of cardiovascular disease.

Results and discussion

The bioactive compound of soybeans

Food of soybean products constitutes an important amount of bioactive compounds such as oligosaccharides, globulin proteins (glycine, beta-conglycine), antioxidants, isoflavones(genistein, daidzein, glycitein), phytosterols (sitosterol, sitostanol, campesterol), phyto-esteogen[3], [7], [23], [24]. The legumes of soybeans are composed of group of nutrients, which are very special to maintain and protect human health[8]. It is the most excellent source of unsaturated fatty acids, isoflavones, and antioxidants. Soybeans are also fiber-rich, nutrient-dense, and high-quality sources of protein[29], [30]; all are necessities of a dietary intervention to reduce the risk of cardiometabolic effects. However, the contents and bioavailability of protein, fats, minerals, and isoflavones in dry beans and soy foods vary according to their processing methods and phytate content[31]–[33].

For example, texturizing of the four leads to a decline in the isoflavone content in the TSP. Dehulling process also decreases the isoflavone content and is prepared from raw seeds[34]. Heat treatment of soy raises the digestibility of the protein and enhances the nutritional quality of soybeans[13], [15], [22]. The soy cotyledon storage proteins can be extracted most efficiently through the dehulled and defatted process. Soybeans must be provided only minimal heat treatment to prevent the proteins being denaturation[23], [35].

Soybean can be processed in a different form to simplify the ways of processing and cooking for human consumption[36]. The product is formulated as soymilk, oil, and soy flour. Consumption of the soymilk resulted in a modest decrease of 4% in LDL- cholesterol compared to animal – protein and soy four diets [32], [37].

Table 1. Effect of soybean consumption on risk of cardiovascular disease prevention

Reference	Study design	Participants Age	Dose Format	Risk factor	Results
[38]	RCT	>22 years	40g of soybean	E-selectin & leptin	-3.93ng/ml & - 2089.8pg/ml
[28]	Cohort		4 times or more per week soybean	LDL cholesterol	11% lower risk of cholesterol & RR 0.89
[34]	Random crossover trial		55% carbohydrate, 30% fat, 15% protein & 7.5% experimental protein contain products made of soybean	LDL cholesterol	4% reduction
[39]	Experimental random order		30% energy as the fat of 2/3 of soybean oil, low-saturated fatty acid soybean oil(LoSFA-SO), high-oleic acid soybean oil(HiOleic-SO), low-alpha-linolenic acid soybean oil(LoALA-SO), or partially hydrogenated soybean oil(Hydrog-soybean)	LDL cholesterol	Mean & SD 3.66+_0.67 3.53+-0.77 3.70+-0.66 3.70+-0.64
				HDL cholesterol Mean & SD	1.32+-0.32 1.32+-0.35 1.36+-0.33 1.32+-0.33
[40]	Cohort	40-69 years women	Soybean products(bean sprouts,tofu,fermented	LDL cholesterol	Tofu;HR 0.39 Total

			soy past, and soymilk)		soyfood;HR 0.36 Soy isoflavones HR0.44
[3]	RCT		25g/d soybean	LDL cholesterol	4.76mg/l
				Total cholesterol	6.41mg/l

RR; Relative risk, HR; hazard ratio, mg; mili gram, LDL; low-density lipoproteins

Effect of soybean dietary on cardiovascular disease

The health effects of soybeans, as well as the impact of soybean's active ingredients, have a positive benefit on human health. Processed soybean products have different nutrient contents compare to unprocessed one[41]. For instance, roasted soy-nuts are made from whole soybeans, which are non-processed products[16]. These hypolipidemic properties of soybeans products decreased the risk of the cardiovascular property[15], [23], [38], [39]. Isoflavones are the most abundant phytoestrogen in soybeans that structurally resemble 17 B- estradiol. Researchers have reported that isoflavones have been investigated as the treatment and prevention of cardiovascular disease with inhibiting hormonal function[16], [22], [42]. The bioactive compounds of soybean have ability to reduce the risk of cardiovascular diseases. Thus potentially decreases the cholesterol level of humans, which is the cause of cardiovascular disease[23], [39]. Integrating soybean products in the daily diet to get an important health benefit up on lowering cholesterol contents. The best example of the diet of soybean on human health is the Mediterranean diet style, with a focus on grains that have been proven by researchers to reduce the risk of cardiovascular disease[13], [22]. Consumption of legumes 4 times or more per week compared with less than once a week was associated with a 22% lower risk of CHD[28]. The greatest improvement in cardiovascular outcomes was observed in patients with advising food-based treatment for cardiovascular disease[43].

Soybean as a mental health booster:

Soybeans are high in protein and are a good source of both carbs and fats. The germinated soybeans are also a good source of ascorbic acids and riboflavin[44]. The soybeans are also rich in various vitamins, minerals, and beneficial plant compounds such as the isoflavones and for this purpose, the regular intake of the soybean may reduce the risk of many diseases[13].

As soybeans are a good source of riboflavins, the emerging evidences suggested that the dietary derived flavonoids have much potential to improve human memory and also the neuro-cognitive performance[45]–[48], by their ability to protect the vulnerable neurons, by enhancing the existing neuronal function and stimulating neuronal regeneration [49]. Long-term potentiation (LTP) is known to be controlled at the molecular level by activating several neuronal signaling pathways. The pathways include phosphatidylinositol-3 kinase/protein kinase b/Akt, protein kinase C, protein kinase A, Ca-Calmodulin kinase, and mitogen-activated protein kinase pathways. The growing evidences showed that flavonoids exert an effect on long-term memory and cognitive performances[50]–[53], through the interaction of flavonoids

with these signaling pathways. Of particular interest is the ability of flavonoids to activate the extracellular signal-regulated kinase and the Akt signaling pathway that lead to the activation of cAMP- response element-binding protein, which is a transcription factor responsible for increasing the expression of several neurotrophins important in long term memory[50], [52], [53].

Near-infrared spectroscopy (NIRS) was used to analyze the brain's cerebral blood flow. The number of cells increases in the group that has fewer leukocytes and decreases in the group that have more leukocytes[54]. In the lymphocyte-rich type groups, the lymphocytes counts tend to decrease while the granulocytes number increases; while for the granulocytes rich type, both the granulocytes and lymphocytes counts increases[47], [55], [56]. The soybean peptide tends to decrease the level of adrenalin level in the plasma but it increases the level of dopamine (a feel-good neurotransmitter)[24]. Near-infrared spectroscopy shows that a significant increase in the amplitude of θ, α-2, and β-L frequency band after the ingestion of the peptides[11], [30].

Depression is one of the most common mental disorders among elderly subjects. A study was conducted in which the association between depression and soybean consumption was estimated[49], [54], [55], [57], [58]. The prevalence of the depressive symptoms was 8.9%. Women have a higher prevalence of depressive symptoms than men (13.3% vs 4.6%) [52]. The individuals consuming soybeans 4 times/week have statically lowered the possibility to have depressive symptoms than those who rarely consumed it (3.6% vs 12.5%). The frequent consumption of the soybean or soybean product for 2-3 times/week has significantly decreased the risk of depressive symptoms among the elderly in rural Northeast China[59].

Dietary intake and nutritional components are the important factors that affect mental health. The majority of the scientific evidences related to mental health focus on depression, dementia, and cognitive functions[50], [51], [60]. As the life span of the human increases the risk of mental health disorders also increases[58]. A list of the suggested nutritional components that are beneficial for mental health is the omega-3 fatty acids (which are present in the soybean), cholesterols, phospholipids, and many more[46], [47], [56].

A study was conducted in which the association of food security with the socio-demographic characteristic, nutrient intakes, and the mental status among the older Korean adults were investigated[45]. The result showed that the rate of food insecurity among older adults was 14.3% and the nutrient intake was significantly different according to the food security status[61]. The consumption of the amount of soy and soya beans products, vegetables, mushrooms, etc. were lower in the food insecure groups [60]. As a result, the mental stress, depression, and suicide ideation are higher in the food insecure groups independent of the gender and income group [53], [62]. So this study showed that food security is closely related to mental health as well as nutritional status, proper food security programs are needed which will help in boosting mental health[60], [63]–[65].

Limitation of the study

The study focused only on the areas of cardiovascular disease and mental health factors treated with consumption of soybean products, but soybean has many more health benefits including prevention of cancer and other chronic conditions, which are not addressed in this paper.

Conclusion

Cardiovascular disease and mental health problems are among the common leading causes of morbidity and contributory factors for death of human in the world. As different literatures results showed that consumption of soybean products can significantly reduce these global burden of diseases. Therefore, health policy makers and those works on human nutrition and supplementation as dooner (aider), should promote soybean consumption, encourage the availability of soybeans products in world market with reduced cost.

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