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# Therapeutic Effect of Glycine Max (Soybean) Bioactive Components in Cvd and Obesity

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## Abstract

The cardiovascular diseases (CVD) and obesity are amongst the most prominent diseases across the globe. Hyperlipidemia is an underlying factor in the proliferation of these diseases. Food substances like soybean have been reported for its hypolipidemic property and decreased the risk of obesity and CVD by lowering the lipid concentration in serum profile. Many advanced researches explored that soya bean and soy related food products constitute a significant amount of bioactive components like oligosaccharides, globulin proteins (glycinin, beta-conglycinin), antioxidants, isoflavones (genistein, daidzen, glycitein), phytosterols (sitosterol, sitostanol ,campesterol) and phyto-estrogen. These components have eminent characteristics for the improvement of health that was seen in both humans and animals. After studying the results of different experimental researches, glycine max constituents and its supplements lowered cardiovascular parameters; lipid profile, triglycerides, and obesity level.

**Keywords:** Soybean; CVD; Hyperlipidemia; obesity; isoflavones; phytosterol.

## Introduction

Plant-based foods are gaining popularity because of their antioxidant properties, dietary fiber, and phytonutrients that provide several health benefits. Focusing especially on soybean, from a legume family known as Poacea, is an essential edible crop especially for the vegetarian community because of its high-quality plant protein (animal protein substitute) and oil component [1].

Soybean seeds contain protein 36.5%, lipids 19.9%, carbohydrates 30%, and dietary fiber 9.3%. It has an oil concentration of about.

**protein;** according to FAO, soy proteins have all essential amino acids except for methionine and tryptophan [2]. "soybean" reckoned to be a high source of proteins in Asian countries and could be considered a suitable substitute for meat and dairy products [3].

**Phytosterols**; Soybeans are rich in phytosterols (sitosterol, sitostanol, campesterol) and phytoestrogen.

**Phytochemicals**; soy like supplements of isoflavones (isoflavones; genistein, daidzein, and glycitein. when consumed in higher quantities have resulted in the eradication of cholesterol from blood serum. Isoflavones are present abundantly in soy and its products [4,5]. It is also a source of many other nutrients such as fiber, vitamins, and oligosaccharides.

Boiled soybeans, BVCmiso, roasted soybean, soy cheese, soymilk, soy mayonnaise, soy sauce, soy yogurt, tamari, tempeh, textured vegetable protein (TVP), and tofu are numerous types of soy products [6].

### Malabsorption syndrome and Disease prevalence

Cardiovascular disease has a high-level mortality rate and responsible for 1/3 deaths all over the world. CVD is associated with multiple factors like lifestyle, genes, and environment [7]. Likewise, the prevalence of obesity is increasing in the modern world. Obesity is a result of the high consumption of fats that are associated with many chronic diseases (WHO, 2016). People with a BMI greater than 25kg/m$^2$ expanding all over the world [8]. According to the global burden of disease study (2013), 30% of the mortality rate was because of cardiovascular disease. It was calculated by statistics that 17.3 million deaths per year are caused by cardiovascular disease and it is expected to increase up to 23.6 million to the end of 2030. According to literature, it is documented that in Pakistan, 30-40% of the mortality rate is due to cardiovascular disease [9]. The occurrence of such diseases such as CVD, diabetes mellitus, insulin resistance and obesity, hypertension, physical inactivity, poor diet is related to dietary habits and lifestyle [10]. In Pakistan, Hyperlipidemia has been reported 16% in men and 24% in normal women and 68% in the obese population, which is significantly correlated with obesity and CVD [11]. In addition, soybean components (genistein, daidzein) proved to be beneficial in many diseases like some cancers and lower PSA levels [12]. Diseases involving hormones help in maintaining bone mineral density and also reduces the blood lipid levels [13]. Soy possesses with protein isoflavones that have made better cardiovascular markers and has decreased 27% risk of coronary risk of heart disease in ten years, 37% decrease in MIR (myocardial infarction rate), 24% decrease in CVD and 42% decrease in heart disease mortality rate. Moreover, protein of the soybean shows a positive influence in lowering the cholesterol levels and thus provides anti-atherosclerotic properties and obesity [14].

Soybean having proteins with isoflavones that make improvement in the lipid profile which lead to decrease the chances of CVD and obesity. LDL receptors are present on the liver cell membrane. Receptors are protein made up of 839 number of amino acids and facilitate the process of endocytosis for LDL-C. Abnormal functioning of receptors makes LDL to stay in the blood for a long time that deposits into walls of arteries. Insulin and triiodothyronine boost LDL and receptor binding while glucocorticoids lessen its binding. The endoplasmic reticulum is manufacturers of receptors and moves them to the surface of the cell. SREBP (sterol regulatory element-binding protein) is a transcription factor that controls transcription factor for LDL-receptor. The occurrence of sterol on the promoter site elevates the LDL receptor transcription process. SCAP (SREBP cleavage-activating protein) senses sterol, which binds SREBP to ER.

Apolipoproteins B-100 is only present in LDL that gets attached to the clathrin-coated pit present in the cell surface. After endocytosis of C-LDL, the receptor is detached from the LDL molecule and recycled to the membrane. The molecule of LDL is captured by lysosomes and destroyed. As a result, free cholesterol at the cellular level is either become part of a membrane or its metabolism stars that gives steroids and bile salts [15].

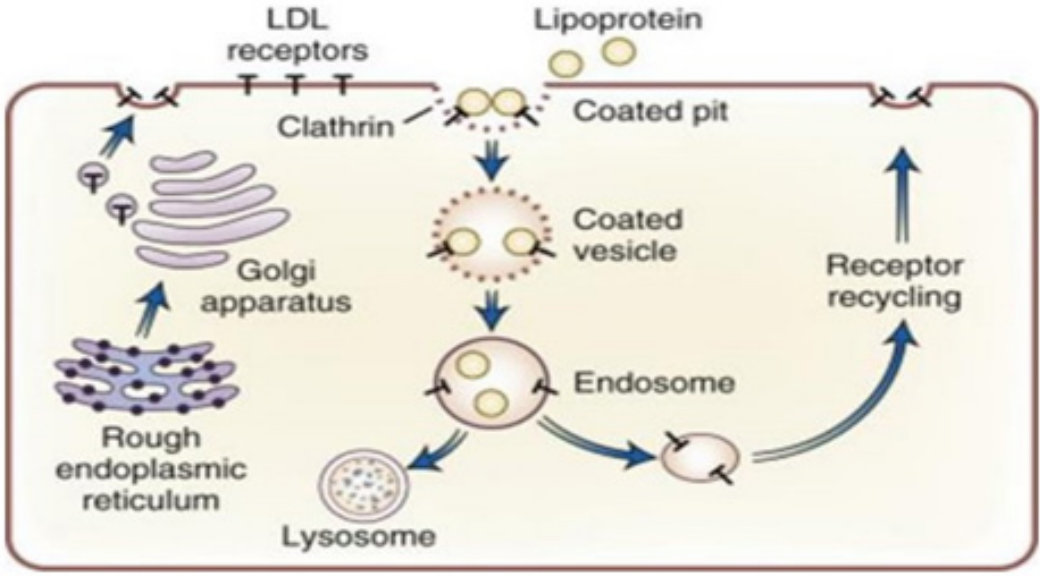


Figure 1: lipid metabolism and degradation of LDL molecule inside the cell [15].

## Literature review

A study investigated the impact of fermented soybean products with Okara supplementation on cardiovascular disease incidence. It was a placebo-controlled and randomized trial. Normal cholesterol level men were divided into two groups. One group was having 18 men (n=18). 100g fermented soy product along with lactis Bb-12, La-5(lactobacillus acidophilus) and subsp: Bifidobacterium was given on daily basis. To the second group, the dose of 100g unfermented soy product was given. It was a placebo group and the duration for the study was eight weeks. The results showed limiting lipid reduction effect of soy product with Okara and low CVD risk factors were studied in men with normal cholesterol [16].

In this study, the effect of glycine max (crude methanol seed extract) was seen on the lipid profile. For this, 25 rats were given a high cholesterol diet of 2000mg/kg daily. These 25 rats were further divided into five groups; A, B, C, D and E. Group A was given glycine max 400mg/kg and group B 200mg/kg. Group C was given atorvastatin 20mg/kg. Group D was given no treatment dose and group E was presented as a control group. After two weeks, the first two groups A and B, lowered LDL, TG and increased HDL level was documented, as compared to control group [17].

In another experimental study, soybean paste fermented with B.Licheniform-67 was examined the obesity and related parameters on the 40 rats 4 weeks of age. One of its groups was given a diet with 30% fermented B.Licheniform-67. After 13 weeks, serum and tissue sample was examined and found out the lower level of serum lipid profile, blood glucose, insulin, and leptin level along with body weight, in comparison with high-fat control group [18].

In a recent study, the mice were given experimental diets for eight weeks: Normal control, high fat, and high fat supplemented with soybean-fermented paste, brown rice fermented paste, brown rice-rice bran fermented paste, or brown rice-red ginseng marc fermented paste. A combination of brown rice and fermented paste of soybean have shown significant results on oxidative stress and glucose metabolism. The soybean and brown rice-red ginseng marc fermented pastes were the most effective in improving the glucose metabolism and antioxidant defense status in mice under high-fat diet conditions. These findings illustrate that brown rice, in combination with red ginseng marc, may be useful in the development of fermented paste with strong hypoglycemic and antioxidative activities [19].

The present study is a parallel double-blinded, interventional study. In this study, the milk phospholipid effect on lipid metabolism and cardiovascular risk factors were examined. Further, the comparison was drawn with control (milk fat) or soya-PL. in the first trial, 62 obese men given milk added with 2g of phospholipid milk or 2g of milk fat (control). The trial has proceeded for eight weeks. In the second trial, 57 men were given milk with either 3g phospholipid milk or 2.8g phospholipid (soya). The duration of this trial was seven weeks. Supplemented milk (phospholipid) decreased waste in comparison with control. And in comparison with phospholipid (soya) and control fat [20].

It was observed soyasaponin controlled fat absorption and lessen the level of cholesterol. For this study, rats were induced obese by fed on a high-fat diet. Then the response of soyasaponins was studied. The duration for this experimental study was 8 days. After that, the results revealed potential in soyasaponins to normalize TG and cholesterol [21].

Thirty-two adult male rats have been used in this study, were randomly selected and equally divided into four groups as follows C, T1, T2, T3.They were treated orally (daily) for 42 days as follows; C:control group, were given distilled water by gavage needle, rats of this group were given soybean lecithin only (430 mg kg day) orally; T2: rats of this groups were given only cholesterol (10gmday) orally; T3: rats of this groups were given soybean lecithin (430 mg kg day) orally, and high cholesterol (10gmday) orally. The daily supplementation of soybean lecithin induces a significant decrease ($p > 0.05$) in total cholesterol (TC) and triglyceride (TG) in both intact and hypercholesterolemic infected rats respectively. The results from this experiment confirm that soybean lecithin supplementation to rats has an important protective role in the cardiovascular system and liver in hypercholesterolemic infected rats. This supplementation can overcome the deleterious effect of hypercholesterolemia on heart and liver basically [22].

In experimental trial soy, the obese group of rats fed a high-fat diet took probiotic drinks regularly. Those obesity-induced rats were given soy probiotic drinks for 9 weeks. After nine weeks, reduction in weight gain and degree of adipocyte hypertrophy was seen [23].

Rats were divided into six groups. Three groups were fed on high fat, medium fat, low-fat diet respectively with casein and the other three groups were fed on high fat, medium fat, and low fat with b-conglycinin instead of casein. After five months, in the result, lower body weight and white adipose tissue was observed in groups that were fed with b-conglycinin [8, 24].

In another recent study, rats were given feed for four months on a sucrose-rich (62.5%) diet (SRD). Half of them continued the same diet for 4 months and 50% of them were fed on SRD (casein was replaced by soya). The result from the trial showed, which diet replaced casein with soya, improved dyslipidemia, glucose homeostasis and insulin resistance [25].

In a group of six rats, the 2$^{nd}$ and 3$^{rd}$ groups were fed with maize and soybean in 4:1 and 3:2 ratio. 4$^{th}$ and 5$^{th}$groups were fed with maize and moringa in 4:1 and 9:1 ratio. The first group was normal chow and 6 was fed with maize. Group 2 and 4 showed a significant reduction in cholesterol and LDL [26].

In a recent study, 20 rabbits were induced diabetes mellitus by a high-fat diet for eight weeks. Those were grouped in 4. 2, 3 and 4 groups were given fermented soya bean supplement 12.5%, 25%, and 50% respectively for 6 weeks. As a result, there was a significant reduction in LDL, TG and increase in HDL in a group that was fed with 50% fermented soya bean, in comparison with diabetic control group no1 [27].

## Conclusion

It is concluded that Glycine max (soybean protein) had reported having useful therapeutic effects on heart disease and obesity. Many recent studies had explored that soy foods and soybean supplementation have a remarkable role in the prevention of obesity and heart diseases by lowering its parameters; serum lipid profile and the level of triglycerides and HDL. Our diet should have antioxidants rich food like soybean, containing additional components like soy protein, isoflavones, lecithins, saponins and fiber that may guard us against many other chronic diseases. There must be basic and advance research in the exploration of soybean food and her supplements. Such advancements can further disclose anti-hyperlipidemic and cardio-protective properties of soybean in the prevention of these diseases and protection from the toxic results of lipid-lowering drugs used for curing these diseases.

| Treatments& control group | | Subjects | Duration | Outcome | References |
|---|---|---|---|---|---|
| 1 | G1. milk-PL (2g) | 62 | 8weeks | Reduced fat and waist. controlled GGT activity | weiland A et.al;2016 |
| | control group | 57 | 7 weeks | | |
| | G2.soya-PL (2g) | | | | |
| 2 | soyasaponins | 6 | 8days | Reduce cholesterol and triglycerides | Singh RG et.al;2016 |
| 3 | fermented soya bean with B.Licheniform | 40 rats, 4 weeks of age | 13 weeks | Reduced weight, lipid profile, BG and leptin | choi JH et.al;2016 |
| | control group | | | | |
| | high fat group | | | no significant result | |
| 4 | A. glycin max(400mg/kg) | 5 | 2 weeks | A, B lowered LDL, TG, rise in HDL as compared to the control group | Kingsley UI et.al; 2017 |
| | B. glycin max 200mg/kg | 5 | | | |
| | C. atorvastatin 20mg/kg | 5 | | | |
| | D. no treatment | 5 | | | |
| | E. control group | 5 | | | |

Table 1: Original evidence regarding the therapeutic effect of soybean components in CVD and obesity

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