

## Human Health Hazard Combating Effects of Soyabean: An Overview

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**Abstract:** An increasing amount of attention is being focused now days, on the emergence of nutritious and value added foods. The category has been described by several nomenclature such as nutritional foods, functional foods, medical foods, longevity foods, hyper nutritional foods, super foods and fitness foods etc. soybean and its products contain most of the nutrients in the quantitative and qualitative form required by the human body. They prevent several chronic diseases, are well known for their health fighting property and can be purchased at a reasonable rate even by a common man.

**Key words:** Functional foods • Combating effect • Diet • Nutrition

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### INTRODUCTION

Interest in healthy eating has developed all over the world, in recent years. Accordingly, the ingredients perceived as unhealthy such as fat, sugar and salt have been removed from the diets by health conscious human beings. This development is popularly termed as low and light movement low fat, no fat and reduced calorie foods i.e. the desires of the consumers to eat healthier. Most of the people like to eat healthier diets without fundamentally changing their eating pattern and sensory attributes, although poor feed choices and restricted diets can affect their nutritional status and long term life at any stage of life. Many people suffering from chronic disorders want to manage their conditions with food, loosing faith in modern medicines and are taking holistic approach to health maintenance. A growing segment of the younger population are living healthier lifestyles and perceive functional foods like soybeans to be an effective means to maintain good health and combat the diseases. Because of the negative image of the drugs, foods such as soybean are becoming more popular and most of them believe that these foods can replace drugs. Many people with chronic disorders want to manage their conditions healthy by using functional food such as soybean given the choice, most consumers would prefer to enhance or improve their diets by consuming food and drink related products rather than using the more traditional pills or capsules, which may some time cause health hazards.

Protein deficiency is the most prevalent and serious nutritional problem in India and other developing countries. The disease called “Kwasiorkar” is caused due to energy and protein malnutrition in children. This deficiency of protein when in acute form results in severe growth retardation and high mortality rates. Besides, lactating mothers, old people and patients also suffer from protein deficiency to a great extent soybean is rich in protein-the essential component of the diet for healthy person. Regular use of about 50 g soybean or soybean products in daily human diets enhances and protects human health and thereby resulting in longevity-the goal every human aspires to achieve since a long time, soybean has been utilized mainly as a human food in various forms i.e. the whole bean, sprouts, tofu, sauce, misq, tempeh, oil, milk and flour [1].

**Soybean as a Boon to Human Health:** Soybean has proved as a boon to people as it contains 38-42% protein, being richer than other sources of protein such as meat (18-20%), eggs (13-14%), fish (16-20%), groundnut (20-25%), rice (7-8%), wheat (10-15%) and milk (3-4%). Because of the presence of most of the essential amino acids, soybean is the best source of high quality vegetable proteins. Its protein is equivalent to animal protein in biological value. Sengar *et al.* [2,3] analysed few varieties of soybean and observed that crude protein content of these varieties varied from 36.73 (PK-1241) to 48.27 percent (PS-1092). Similarly, Wolf and Cowan [4] and

Table 1: Essential amino acid contents of important protein rich foods.

Name of amino acid	Fish	Meat	Skim milk	Soybean	Peanut
Lysine	6.6	8.3	8.6	6.8	3.0
Tryptophan	1.6	1.0	1.5	1.4	1.0
Phenylalanine	4.1	3.5	5.5	5.3	5.1
Methionine	3.2	2.8	3.2	1.7	1.0
Threonine	4.8	4.5	4.7	3.9	2.6
Isoleucine	7.7	4.7	7.5	6.0	4.6
Leucine	10.5	7.2	11.0	8.0	6.7
Valine	5.3	5.1	7.0	5.3	4.4

Table 2: Quality Parameters of Important Sources of Dietary Proteins

Name of food	Biological value	Protein score	Net Protein utilization
Egg	96	100	100
Soybean	72	70	56
Corn gram	54	45	55
Wheat flour	53	50	52
Rice (milled)	61	-	59

Patil and Sinha [5] reported 40.0 percent in whole soybean. Sachan [6] also recorded higher percentage of crude protein (44.6, 42.9 and 47.7) in shilajeet, Alankar and Bragg varieties of soybean, respectively.

Comparative amino acid contents of different dietary sources is presented in following table (Table 1).

From the above table it is quite evident that soybean at though the source of vegetable protein but like animal sources of protein is rich in amino acids content except methionine. It is also clear from the above referred table that in comparison to other vegetable source of protein, soybean is very rich in almost all the essential amino acids. Unlike common cereals with lysine limiting amino acid, soybean is abundantly rich in lysine.

Quality of protein of foods is determined on the basis of biological value and other quality parameters. This has been reported by Kaldy [7] as per following table.

Kim, *et al.* [8] have also pointed out that soybeans are unique among plant proteins by virtue of their relatively high biological value.

Soybean oil is made up of approximately 12-14 percent saturated oils balance being the unsaturated oils. The saturated fraction of soybean oil is made up primarily of palmitic and stearic acid. The unsaturated fraction includes about 30-35 percent oleic acid, 45-55 percent linoleic acid and 5-10 percent linolenic acid. Soybeans have been reported [9] an excellent and cheap source of calories. They contain 14-25 percent fat. Patel [10] recorded 19.5 percent fat in soybean gram, where as Sengar *et al.* [3] have observed a range from 15.28 percent (T-49) to 22.6 percent (PK-1092) while screening several newly evolved varieties of soybean.

Maximum (40.89%) and minimum (25.15%) figures of total carbohydrate recorded in PK-1241 and PS-1092 varieties of soybean were the findings of Sengar *et al.* [11]. In comparison to these results Wu and Change [11] have reported slightly higher values of total carbohydrates whereas the values recorded by Jain [12] were slightly lower.

**Disease Prevention Role of Soybean:** Last two decade's health benefits of using soybeans have been widely documented. Benefits of soybeans in the reduction of cholesterol level and menopause symptoms and lowering the risk of several chronic diseases such as cancer, heart disease and osteoporosis have been very well demonstrated globally.

**Cholesterol Level and Heart Diseases:** Several studies conducted in past have shown that soy protein is hypocholesterolemic. Low blood cholesterol level condition have been reported, where in soy protein was added to the diet or dietary animal protein was replaced with soy protein [13]. The cholesterol-lowering effect of soy have been attributed to the isoflavones, a class of phytochemical, present in soybeans [14]. In patients having high cholesterol levels, despite consuming a diet low in fat and heart health, soy protein drinks containing naturally occurring high levels of isoflavones, caused reduction in total cholesterol and LDL cholesterol, so called, "bad cholesterol" from health point of view. According to Anderson [15] every 1% reduction in cholesterol values is associated with an approximate 2-3% reduction in the risk of coronary heart diseases. Based on the observations made by several researchers [16-18] it was worked out that intake of 20-50 gms of isolated soy protein resulted in 20-30% reduction in heart diseases. Though the mechanism and component of soy responsible for the lowering of cholesterol have not been fully established but changes in endocrine status such as alteration in insulin to glucagons ratio and thyroid hormone concentrations are held responsible for the same Kritcherisky and Klurfeld [19] suggested that amino acids composition and ratio such as lysine to arginine and/or lysine to methionine appear to play an important role in lowering the cholesterol level and preventing from heart diseases.

Studies conducted by Pakaenkitvatana *et al.* [20] showed that adequate intake of soybean oil providing 10.6 percent of total dietary energy as 18:2 n-6 can increase serum 18:2 n-6 level in healthy men with concomitant decrease in serum level. Cholesterol and LDL-Cholesterol levels in the absence or presence of cholesterol intake. Linolenic 18:3 n-3 acid is a precursor to

the longer chain omega-3 fatty acid which is increasingly shown to have hypolipidemic functions.

**Cancer Prevention with Soybean:** Barnes *et al.* [21] demonstrated that diets composed of as little as 5% (wt/wt) soybeans significantly in habited chemically induced mammary cancer in rats by up to 40 percent. Lee, *et al.* [22] reported that 50% decreased risk of breast cancer was associated with regular soy food consumption in premenopausal women. The antiestrogenic effect of soy isoflavones is attributed to genistein and diadzeis, which are biphenolic compounds that bear structural to steroid hormones and which activates tissues with estrogen receptors. The isoflavones also inhibit enzymes such as tyrosine protein kinases involved in cancer growth shown in studies conducted by Sharma, *et al.* [23], Adlercreutz, *et al.* [24] and Adlercreutz [25].

**Role of Soybean in Preventing Osteoporosis:** A large number of dietary and non-dietary factors affect bone health. Dietary calcium, physical activity, genetics and protein intake are considered to be the major factors influencing the osteoporosis. Soy foods play important role in protecting bone health [26]. The isoflavones daidzen and gene stein, found in significant amounts only in soybean and soyfoods, may directly inhibit bone resorption [27, 28]. A study conducted by Erdman and Potter [29] clearly demonstrated significant increase in mineral content as well as density of the lumbar spine after 6 months consumption of 40 g isolated soy protein per day.

**Other Health Hazards Fighting Effects of Soybean:** Soy-based diets can help to control weight by providing high quality protein in a concentrated form and can be met in specially designed low-calorie/high nutrient, ready to eight meals [30]. It has been discovered by the researchers that antioxidant rich soy can prevent damage caused by free radicals, which are said to be responsible for aging and age-related forms of diseases. D' Amico *et al.* [31] and Kontesis, [32] Genistein is thought to out against cancer in several ways by interfering with cancer promoting enzymes, by blocking the activity of hormones in the body and even by interfering with the process by which tumors receive nutrients and oxygen [33] have reported that glomerulor filtration rate and renal plasma flow of patients were reduced after replacing animal protein diets with soy based diets. With the shown positive effect on kidney functioning, soy protein diets may find increasing role as a non-pharmacological and non-toxic approach in the treatment of kidney diseases.

## CONCLUSION

From the nutritional point of view, soybean contributes significantly as a source of supplementary and complementary protein as well as source of energy. Well processed soy protein based foods have a high digestibility value with an excellent profile of amino acids. As the consumers are eagerly looking for the health benefits from a food, not just the food that are less harmful. Given the choice, most consumers would prefer to enhance or improve their diet using food and drink related products rather than using the more traditional pills or capsules. Although it has very well been proved that soybean and their products offer positive nutritional and health benefits, the versatility of this food has still continued to be a source of inspiration for scientists to further expose its economical, functional and nutritional properties. It is therefore, envisaged that the utilization of soybean and their product will increase rapidly in the developing countries goal of "Health for all" is the current 21<sup>st</sup> Century.

## REFERENCES

1. Saio, K., 1999. Current development in soy food processing in East Asia. Proc: WSRC-IV held at Chicago, USA Aug., 4-7: 372-379.
2. Sengar, R. and S.K. Sharma, 2003. Varietal variation in chemical composition and effect of feeding treated and untreated commercial soybean grain on the growth of quails. Indian Journal of Animal nutrition, 20(4): 430.
3. Sengar, R., A.K. Guar and S.K. Sharma, 2005. Polymorphism in soybean on the basis of electrophoretic profile of seed protein. Physiology and molecular biology of plants. An International Journal of Plant Research, 11: 65-168.
4. Wolf, W.J. and J.C. Cowan, 1971. Soybean as a food sources. Butterworths Publication, London.
5. Patil, R.T. and A.K. Sinha, 2001. Role of soyabean in assuring nutritional security of tropical hilly and backward population of India. In: India soy forum 2001 on harnessing the soy potential for health and wealth, held at Indore, March 17-18.
6. Sachan, A.K., 1988. Milling characteristics of soyabean. M.Sc. Thesis submitted to GB Pant Univ. Of Agri and Tech. Pantnagar.
7. Kaldy, M.S., 1972. Protection yield of various crops as related to protein value. Econ. Bot., 26: 142-144.

8. Kim, J.H., D.H. Kim and W.J. Kim, 1994. comparison of soyabean varieties for soyabean sprouts and tofu processing. *Agri chem biotechnical*, 37(1): 19-24.
9. Hurburg, C.R., 1994. Long term soyabean composition pattern and their effect on processing. *J. Am. Oil Chem. Soc.*, 71(12): 1425-1427.
10. Wu, C.J. and K.C. Chang, 1995. Effect of soymilk solid content and press weight on tofu characteristics 9FT Annual Meeting, pp: 78.
11. Jain, A., 1985. Characteristics of soyapaneer prepared from different soyabean varieties. M.Sc. Thesis submitted to G.B. Pant University of agriculture and technology, Pantnagar.
12. Carroll, K.K., 1991. Review of clinical studies on cholesterol-lowering response soy protein. *J. Am. Diet. Assoc.*, 91: 820.
13. Potter, S.M., 1998. Soy protein and cardiovascular disease: the impact of bioactive compound in soy. *Nutr. Rev.*, 56: 231.
14. Anderson, J.W., B.M. Johnstone and M.E. Cook-Newell, 1995. Meta analysis of the effects of soy protein intake on serum lipids. *N. Engl. J. Med.*, 333: 276.
15. Anderson, J.J., W.W. Ambrose and S.C. Garner, 1995. Orally dosed genistein from soy and prevention of cancellous bone loss in two ovariectomized rat models. *J. Nutr.*, 125: 7995.
16. Bakhit, R.M., B.P. Klein, D.L. Essex-Sorlie, J.O. Ham, J.W. Erdman and S.M. Potter, 1994. Intake of 25 g of soybean protein with or without soybean fiber alters plasma lipids in men with elevated cholesterol concentration. *J. Nutr.*, 124: 213.
17. Potter, S.M., R.M. Bakhit, D.L. Essex-sorlie, K.E. Weingartner, K.M. Chapman, R.A. Nelson, M. Prabhudesai, W.D. Savage, A.L. Nelson, L. Winter and J.W. Erdman, 1993. depression of plasma cholesterol in men by containing soy protein. *Am. J. Clin. Nutri.*, 58: 501.
18. Widham, K., G. Brazada, B. Schneider and S. Kohl, 1993. Effect of soy protein diet versus standard low fat low cholesterol diet on lipid and lipoprotein levels in children with familial or polygenic hypercholesterolemia. *J. Pediatr*, 123: 30.
19. Kritchevsky, D. and D.M. Klugeld, 1979. Influence of vegetable protein on gallstone formation in hamsters. *Am. J. Clin. Nutri.*, 32: 2174.
20. Pakeenkitatana, R., R. Samasut and V. Tanphaehitr, 1989. The effect of soyabean oil intake on lipid status in healthy man. *ASA Tech. Bulletin*, Vol. HN8.
21. Barnes, S., C. Grubbs, K.D.R. Setchell and J. Carlson, 1990. Soybeans inhibit mammary tumors in models of breast cancer. In: M.W. Praiza, H. Aeschdacher, J.S. Fellon and S. Sato Eds *Mutagens and Carcinogens in the diet*. New York, NY: Willey-Liss, pp: 239-253.
22. Lee, H.P., L. Gourley, S.W. Duffy, J. Estene, J. Lee and N.E. Day, 1991. Dietary effect on breast cancer risk in Singapore. *Lancet*, 337: 1197-1200.
23. Sharma, O.P., H. Adlercreutz, J.D. Standberg, B.R. Zirkin, D.S. Colley and L.L. Ewing, 1988. Soy of dietary sources plays a preventive roles against pathogenesis of prostatitis in rats. *J. Steroid Biochem. Molec. Biol.*, 43: 557-567.
24. Adlercreutz, H., 1990. Western diet and western diseases: Some hormonal and biochemical mechanism and association. *Scand J. Clin. Lab. Invest*, 201: 3-23.
25. Adlercreutz, H., T. Fotsis, J. Lampe, K. Wahala, T. Makela, G. Branow and T. Hase, 1993. Quantitative determination of lignin and isoflavonoids in plasma of omnivorous and vegetarian women by isotope dilution gas chromatography mass spectrometry. *Scand J. Clin. Lab. Invest*, 54: 5-18.
26. Anderson, J.J.B. and S.C. Garner, 1997. The effect of phytoestrogens on bone. *Nutr. Res.*, 17: 1627.
27. Brandi, M.L., 1992. Flavanoids; Biochemical effects and therapeutic application, *Bone Mineral*, 19: 53.
28. Erdman, J.W. and S.M. Potter, 1997. Soybean and Bone health. *The soy connection*, 5: 1.
29. Soy Protein council, 1987. *Soy Protein Product: Characteristics. Nutritional Aspect and Utilization*. The council, Washigton, D.C.
30. D'Amico, G., M.G. Gentile, G. Amanna, G. Fellin, R. Ciccri, F. Cofono, C. Petrinium, F. Lauarda and Porrini, 1992. In: Effect of vegetarian soy diet on hyperlipidemia in nephritic syndrome. *Lancet*, 339: 1131-1134.
31. Konstein, P., S. Jones, R. Dodds, R. Trenison, R. Nosadini, P. Fioretto, M. Borasto, D. Sacerdoti and G. Viberti, 1990. Renal metabolic and hormonal responses to ingestion of animal and vegetable protein. *Kid Inter*, 38: 136-144.
32. Broihier, K., 1997. Fighting cancer with phytochemicals. *Food processing*, 58: 41.
33. Omi, N., S. Aoi, K. Muto and K. Ebawa, 1994. Evaluating the effect of soybean milk and soybean milk peptide on bone metabolism in the rat model with ovariectomized osteoporosis. *J. Nutr. Sc Vitamino*, 40: 201-211.