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Review on Soy Milk and Other Soy Milk Based Products

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ABSTRACT

Soy bean widely grown as edible bean having numerous uses is classified as an oilseed rather than a pulse by the UN Food and Agricultural Organization (FAO). This paper aims to review soy bean status, nutritional value and various soy milk based products that can be made from soy bean. Nutrient rich soy beans are considered as a complete protein. From soy bean, various edible products are commercially made. Soy milk, a product of soy bean is considered as alternate milk. From soy milk, various soy milk based products can be made similar to milk. It was concluded that soy milk is considered to be a good nutritional alternate milk and may help to some people in reducing risk to heart diseases and prevention from diabetes and increase in bone density.

Key words: Soybean, soy milk, nutritional value, FAO, lactose

INTRODUCTION

Soy bean is widely cultivated as a species of legume of East Asia. Keeping in mind excellent nutritional values, in China these nutritious beans are also known as Yellow Jewel and Great Treasure, whereas in America it is called as Miracle Crop. Its botanical name is *Glycine max*. According to Food and Agriculture Organization (FAO), soy bean plant is classified as an oilseed rather than pulse. From soy bean different types of non-fermented foods prepared are soy milk and from the latter tofu and tofu skin. Beside these, various fermented foods like sauce, fermented bean paste, natto and tempeh can be prepared from soy bean. Leading soy bean producing countries are United States, Brazil, Argentina, China, India and others^{1,2}. This paper aims to review soy bean status, nutritional value and various soy milk based products that can be made from soy bean.

HISTORY OF SOY BEAN

Origin of soy bean happened in south-eastern part of Asia and China was the first country to domesticate the soy bean cultivation. From China, soy bean was introduced to India. Traditional small scale soybean cultivation practices may be found in Himachal Pradesh, Uttarakhand, eastern part of West Bengal, Manipur etc. regions of India including Central India since long time back.

Beneficial effects of soybean on human health and positive effects of its cultivation on soil fertility are well known, for which soy bean cultivation was promoted in India. Promoting soy bean cultivation was not that much successful because of farmers ignorance about soy bean cultivation practices, unavailability of high-yield seeds, unorganized market and unpopularity about the utilization of final produce, i.e., soybean. G.B. Pant University of Agriculture and Technology, Pantnagar (Uttaranchal-India) and the Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (Madhya Pradesh-India), in collaboration with the University of Illinois (USA) worked together for popularizing this highly nutritious bean cultivation in India, for addressing the protein malnutrition problems in India during mid 1960's³.

SOY MILK

Soy milk (also called soybean milk, soy juice and sometimes referred to as soy drink/beverage) is a beverage made from soybeans. Soy milk is a stable emulsion, which is considered as staple Asian cuisine. Overnight soaked soy beans are crushed with water and filtered to get the soy milk. Composition of soy milk and cow's milk are quite similar⁴. Similar to milk, soy milk or plain soybean beverage is the pale liquid, which, is rich in protein and other nutrients with or without adding optional additives or ingredients. One advantage of soy milk over cow/buffalo milk is, this milk doesn't contain lactose or cholesterol and the fibres present can be removed from the final product⁵.

NUTRITIONAL IMPORTANCE OF SOY MILK

Soy milk has the same amount of protein as cow's milk, though the amino acid profile differs. Unlike cow's milk, it has little saturated fat and no cholesterol⁴. Soy is naturally high in essential fatty acids, proteins, fiber, vitamins and minerals. These nutrients provide energy and keep the body functioning at its optimum level. Below are the six most important health benefits of drinking soy milk⁶.

- Improve lipid profile
- Strengthen blood vessel integrity
- Promote weight loss
- Prevent prostate cancer
- Prevent postmenopausal syndromes
- Prevent osteoporosis

Compositional details of soy milk are provided in Table 1.

Table 1: Composition of plain soy milk⁷

Constituents	Percent composition
Protein	4.50
Carbohydrate	10.00
Fat	4.30
Crude fiber	0.20
Ash	0.66
Moisture	80.34
pH	6.34
Total energy (cal)	96.70

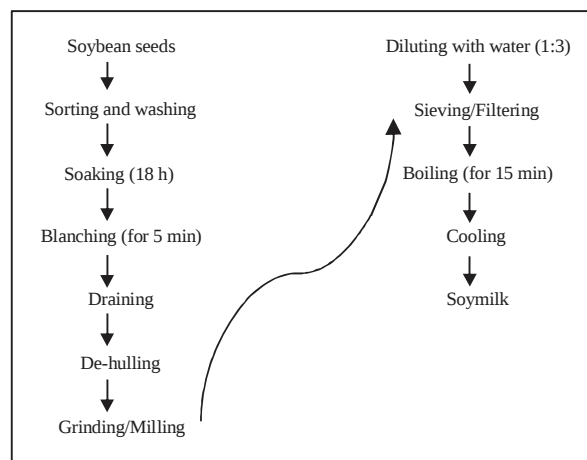


Fig. 1: Flow chart for soymilk production⁷

SOY MILK MANUFACTURING PROCESS

Soy milk manufacturing process is demonstrated in a flow chart shown in Fig. 1. Soy beans were soaked overnight for 18 h in warm potable water to give a bean: water ratio of 1:3. During soaking of soy beans at room temperature, 0.5-1% sodium bicarbonate solution is also used.

The beans are then drained, rinsed with potable water and blanched for 5 min in boiling water. The blanched beans are drained, de-hulled and ground with potable water in a blender. The resulting slurry is filtered through a muslin cloth and the extract (milk) obtained is boiled for 15 min⁷.

MARKET OF SOY MILK

In developing countries like India, with the increasing health consciousness among the general people, the use of soy milk is getting acceptance. The soybean and its products have traditionally played an important role in the dietary habits in Asian countries⁸. Soy milk is nutritionally close to cow's milk. Soy is popular as a rich source of protein. It is also known to have diabetes management properties like controlling blood sugar, good source of lecithin and vitamin. This milk is a plant based product, hence is free from cholesterol and is safe for lactose intolerant population, since the milk is free from

lactose. Soy food products are needed on African market to improve the nutritional status of consumers⁹. According to FAO-STAT⁵, soy bean production in India was 11.5 million tonnes with harvesting area of 10.8 million ha of land. Calculated production yield was 1064.8 kg ha⁻¹. India being mainly the country of vegetarians, India has indeed a very great potential for Soy milk. Experts predict that the Soy food industry will grow 20% annually over the next few years¹⁰.

SOY MILK PRODUCTS

Similar to milk, various soy based products can be made from Soy milk. The flow chart shown in Fig. 2 depicts the processing of soy milk to produce different products. Following products can be obtained by soy milk processing.

Okara: By-product obtained during soy milk processing is okara, which is obtained during filtering/ sieving soy bean slurry (Fig. 1). Okara is flavorless and is often used as a base material for animal feed, though it may be used for human consumption. It is used for preparing vegetarian burger patties and in few other recipes^{11,12}. Proximate composition of okara is provided in Table 2.

Soy milk powder: Soy milk powder is produced as a substitute for skim milk powder, having low fat and high protein content. Proximate composition of soymilk powder is provided in Table 2. It has other potential applications such as production

of low fat chocolate, low fat ice-cream etc. For production of soy milk powder, first soy milk is produced by the process described previously. The obtained milk is oven-dried at 60°C for 14 h and then air-cooled. The dried soy milk is then pulverized and sieved to get fine soy milk powder¹³.

Tofu: Tofu is analogous to paneer, an Indian dairy product made from cow or buffalo's milk. The soy milk is coagulated either by salt or by acid followed by pressing to form tofu. Proximate composition of tofu is provided in Table 2. Calcium chloride, magnesium chloride, citric acid and acetic acid are the commonly used coagulants. This product came into existence about three decades ago. Now, with novel pasteurization and packaging techniques, it can be stored up to one year¹⁴.

Soy yogurt: The process of making soy yogurt is almost identical to that of cow milk yogurt. The only difference is that some simple carbohydrate such as sugar needs to be added to compensate for the lactose in cow's milk. The soy yogurt is made by fermenting pasteurized soy milk with lactic acid bacteria, mainly *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Some thickening agents are also required to be added to reduce surface separation of water in the yogurt. It takes around 6-10 h for setting of yogurt at the incubation temperature of 40°C^{15,16}. Proximate composition is provided in Table 2. Flavored yogurts can also be prepared by adding artificial or natural flavors such as strawberry and mango.

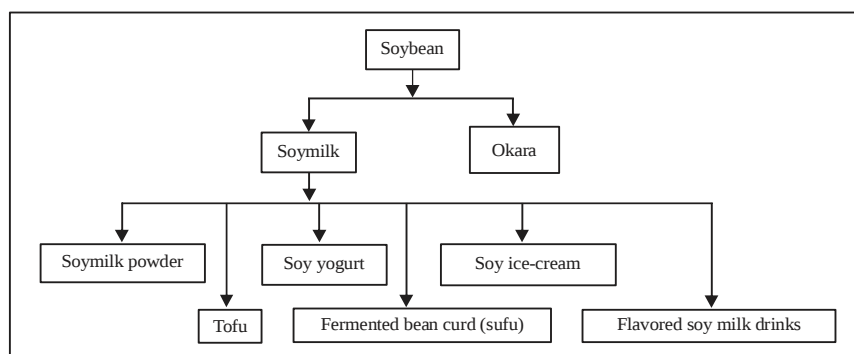


Fig. 2: Flow chart for soy milk processing

Table 2: Approximate composition of soya products

Soy products	Lipid (%)	Protein (%)	Ash (%)	Carbohydrate (%)	References
Whole soybean	17-21.0	39.5-45.0	4.8-5.4	15.2-19.0	Hou and Chang ¹⁹ , Van der Riet <i>et al.</i> ²⁰
Okara	9.3-10.9	25.4-28.4	3.0-3.7	3.8-5.3	Van der Riet <i>et al.</i> ²⁰ , Li <i>et al.</i> ²¹
Soy milk powder-spray dried	18.0	40.0	6.0	32.0	Anonymous ²²
Tofu	30.2-35.0	52.4-53.9	6.3-7.2	2.5-3.7	Van der Riet <i>et al.</i> ²⁰
Soy yogurt	4.7	2.7	--	3.2	Anonymous ²³
Fermented bean curd (sufu)	8-12	12-17	4-9	6-12	Han <i>et al.</i> ²⁴
Soy ice-cream (milk based)	10.11±0.01	5.09±0.03	0.52±0.01	18.34	Sutar <i>et al.</i> ²⁵

Fermented bean curd (sufu): It is a mold-fermented, soft cheese kind of product, made from soy curd by the action of fungal culture. The organisms used for fermentation are *Mucor* and *Actinomucor* species and *Aspergillus oryzae*¹⁴. For production of fermented bean curd, tofu bricks are fully air-dried under hay and slowly fermented with the selected microorganisms. Proximate composition of fermented bean curd (sufu) is provided in Table 2. The fermented tofu was soaked in brine or other flavorings to get the desired product¹⁵.

Soy ice-cream: The process of making soy ice-cream was similar to traditional ice-cream making process. The only difference was that additional oil and emulsifiers are required to be added to compensate for the lacking saturated fat in the soy milk. This was necessary because fat gives the mouth-feel associated with most of the commercial ice-creams. Since soy milk retains the beany flavor, it needs to be deodorized in case of making mild-flavored ice-cream such as Vanilla. In case of strong flavors such as chocolate, this step can be omitted^{17,18}. Proximate composition of soy ice-cream is shown in Table 2.

Flavored soy milk drinks: Flavored soy milk is produced by adding sweeteners and flavors to the soy milk base. As flavoured soymilk was prepared by adding flavor and sweeteners to plain soy milk, the proximate composition of flavoured soy milk and plain soy milk is quite similar. Vacuum deodorization is done to mask the bland flavor of soy milk, if required. These flavored drinks are sold in UHT/aseptic packages with long shelf-life¹⁷.

CONCLUSION

Soy milk may be considered as best alternate to milk, since nutritionally, it is similar to traditional milk when it comes to protein and calcium. Milk contains lactose, which is known as the milk sugar or the main carbohydrate of milk. This lactose possesses digestion problems to some lactose-intolerant groups of people for whom soymilk can be used as a supplement because nutritional composition, appearance and flavor of good quality soymilk is remarkably similar to that of cow's milk. Soy milk is cheaper than the milk so it has high importance in developing and under developed countries. It may help some people reduce their risk of heart diseases. It contains components for prevention of diabetes and also helps to increase bone density. Similar to milk, a wide range of soy milk based products can be made for wide range of consumers. Soy bean processing has a good potential in global market.

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