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Soymilk- versatile oilseed milk

■ **Rewa Kulshrestha, Soumitra Tiwari and Yashwant Kumar**

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See end of the Paper for authors' affiliation

Correspondence to :

Shivani A. Pankar
Department of Agricultural Engineering, Maharashtra Insitute of Technology, **Auranganad (M.S.) India**
Email : shivanipankar1111@gmail.com

■ **Abstract :** The present paper describes inherent qualities of soymilk, preparation methods and the associated quality changes during processing. Being substitute of cow milk for lactose intolerant consumers, better digestibility, palatability and economics of soymilk offers versatile use for mass production.

■ **KEY WORDS :** Soymilk, Versatile oilseed milk

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Soybean is one of the most economical and valuable crop because of its high protein (36 %) and oil content (19 %) on dry weight basis (Liu, 1997). Soybeans produce significantly more protein per acre than most other uses of land. Soybean protein is one of the least expensive sources of dietary protein and is considered to be a good substituent for animal protein (Hassan, 2013). According to the standard for measuring protein quality, Protein Digestibility Corrected Amino Acid Score (PDCAAS), soybean protein has a biological value of 74, whole soybeans 96, soybean milk 91, and eggs 97 (FAO/WHO, 1989). The high nutritional content and presence of bioactive ingredients in soybean has led to its utilization in numerous ways, from animal feed (soybean meal) to value-added food protein ingredients, to industrial paints and an array of other industrial uses (Fig. 1).

Soy foods have grown in popularity in the western world due to the increased demand for alternative, vegetable based, sources of proteins, and the increased evidence of health benefits associated to their consumption. The health benefits of most of the nutritionally and physiologically functional components of soybean have been summarized in Table 1.

Soymilk :

The problem of lactose intolerance arising from consumption of cow milk is more prevalent in western countries which increased likeliness for soymilk. Soymilk is non-diary milk produced by soaking dry soybeans and grinding them with water. Soymilk is a stable emulsion of oil in water and protein and has nearly the same nutritional value as cow milk except that it has a low content of sulphur containing amino acids (Smith and Circle, 1972). The oldest evidence of soy milk production is from China where a kitchen scene proving use of soy milk was incised on a stone slab dated around AD 25- 225 (Shurtleff and Aoyagi, 2007). There are several processes for producing soymilk, all of which aim at heat treating the soybeans to inactivate trypsin inhibitors and lipoxygenase, tenderization of beans and reducing them to colloidal state to get a smooth mouthfeel. Creaming and sedimentation of soymilk is undesirable for the colloidal suspension of fat and protein. Traditional soymilk manufacturing process

Table 1 : Health benefits of functional components of soybean (Sugano, 2006)

Component	Health benefit
α-Linolenic acid	Essential fatty acid, hypotriglyceridemic, improves heart health
Isoflavones	Estrogenic, hypocholesterolemic, improves digestive tract function, prevents breast, prostate and colon cancer, improve bone health, improve lipid metabolism
Lecithins	Improve lipid metabolism, improve memory and learning abilities
Lectins	Anti-carcinogenic, immunostimulator
Peptides and protein	Readily absorbed, reduce body fat, antiatherogenic, Hypocholesterolemic
Phytosterols	Hypocholesterolemic, improves prostate cancer
Saponin	Regulates lipid metabolism, antioxidant

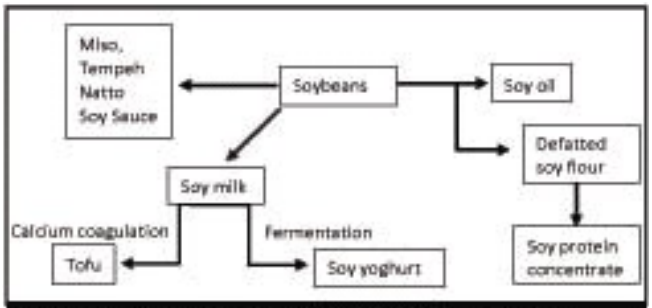

Fig. 1 : Commercial products of soybean processing

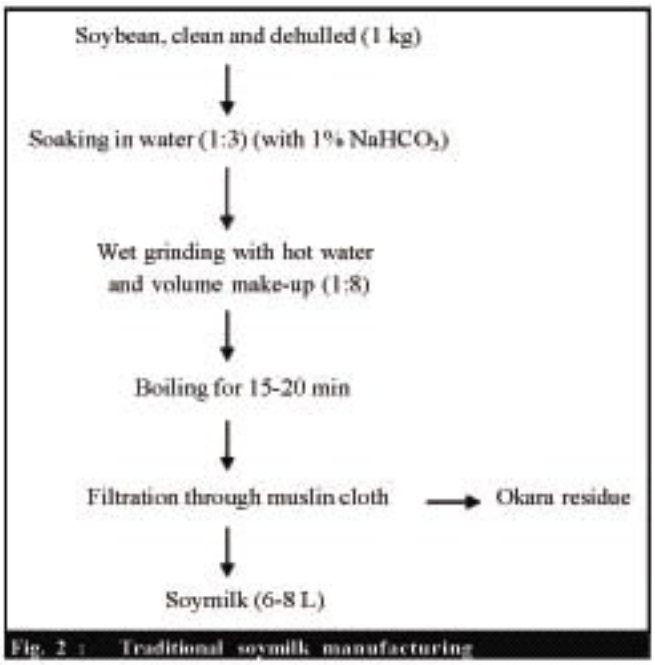

Fig. 2 : Traditional soymilk manufacturing

is presented in Fig. 2.

Method of preparation :

Soymilk can be produced by hot extraction or cold extraction. In hot extraction water at 80 – 100°C is used previously or during grinding to inactivate the lypoxigenase enzyme that causes the "beany" flavour. However, in cold extraction also called traditional oriental method, water at ambient temperatures is used previous and during the grinding. Hot extraction is preferred in the Western countries where the "beany" flavour is still largely unacceptable [4,20]. In contrast the traditional method of cold extraction is still highly followed in the Orient countries where the "beany" flavour is not quite unacceptable.

Traditional soymilk processes yield about 62% of the soybean solids in the milk fraction (Lo *et al.*, 1968). Johnson *et al.* (1981) evaluated a continuous direct steam-infusion process for the yield and quality of soymilk. They reported recovery of 90 % of the slurry, 86% of the solids, and 90% of the protein as soymilk with improved color and low Trypsin Inhibitor activity after processing at 154°C for 40 sec at 6.7 pH. Enzymatic methods have also been explored for soymilk production (Rosenthal *et al.*, 2003).

Nutritional value :

Soymilk contains high amounts of protein, iron, unsaturated fatty acids, and niacin, but low amounts of fat, carbohydrates, and calcium as compared with cow milk and human milk. Soy proteins contain two main fractions, glycinin and b-conglycinin, accounting for 40 % and 30 % of total protein, respectively (Krishnan and Nelson, 2011). Soymilk contains substantial amounts of all essential amino acids with less methionine. The fatty acid profile of soymilk is mainly poly- and mono-unsaturated fats, which do not lead to the deposition of fats in blood vessels including those in heart and are therefore do not lead to heart disease (Giri and Mangaraj, 2012). Soymilk contains 15.3 % SUFA, 22.1 % MUFA and 62.8 % PUFA and the major fatty acid is 54.8 %

Table 2: Nutritional values of soymilk (per 100g)

Component	Amount	Component	Amount
Water	93.0 (g)	Sodium	12.0 (mg)
Energy	138.0 (kJ)	Zinc	0.23 (mg)
Protein	2.8 (g)	Copper	0.12 (mg)
Fat	2.0 (g)	Manganese	0.17 (mg)
Carbohydrates	1.8 (g)	Selenium	1.3 (µg)
Fibre	1.3 (g)	Vitamin B_1	0.161 (mg)
Ash	0.27 (g)	Vitamin B_2	0.070 (mg)
Isoflavones	8.8 (mg)	Vitamin B_3	0.147 (mg)
Calcium	4.0 (mg)	Vitamin B_5	0.048 (mg)
Iron	0.58 (mg)	Vitamin B_6	0.041 (mg)
Magnesium	19.0 (mg)	Folic acid	1.5 (µg)
Phosphorus	49.0 (mg)	Vitamin A	3.0 (µg)
Potassium	141.0 (mg)	Vitamin E	0.010 (mg)

Source: Soya (2012)

linoleic acid (Peñalvo *et al.,* 2004). It also contains poor in the developing countries and as a nutritive supplement for the lactose intolerant population (Girigowda and Mulimani, 2006). Soyabean is available at Rs. 20 a kg round the year and the price is slightly reduced during harvests. As much as six litres to seven litres of milk can be produced from one kg of the grain while one litre of cow or buffalo milk costs Rs. 22 to Rs. 25. Soya milk is thus prepared at the cost of about Rs. 10 a litre. The only challenge is to make people accept that this milk can be used as an alternative to cow's milk. The only cause of the lesser popularity of soymilk is the presence of 'beany' flavour. The compounds responsible for the undesirable flavor profile of soymilk include lipoxygenase, isoflavone aglucones, and saponins. New processing innovations such as ultrafiltration (UF), high hydrostatic pressure (HHP), ultra high pressure homogenization (UHPH) and pulsed electric field (Li *et al.*, 2013) promises better shelf- life, higher nutrient retention, increased soy protein dispersion resulting in smooth mouthfeel and lower level of chalkiness and reduction in beany flavour. The present market of soymilk is promising with demand for various value added products from soymilk.

Authors' affiliations:
Soumitra Tiwari and Yashwant Kumar, Department of Food Processing and Technology, Bilaspur Univesity, **Bilaspur (C.G.) India**

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