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Effect of processing methods on nutritional and organoleptic properties of soy milk beverage

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Abstract
The purpose of this study was to improve the food quality of soy milk and to increase its functional qualities by germination during processing. Soy milk sample was examined for protein, fat, carbohydrate, moisture, ash, pH, total solids and sensory qualities. The moisture protein, fat, carbohydrate, ash, dietary fiber content of germinated soy milk samples was 93.14±0.46, 3.11+0.19, 1.45±0.22, 1.15±0.06, 0.63±0.14, 0.52±0.10 (%) respectively while those made with sodium bicarbonate method was 91.34±0.20, 2.54±0.05, 2.66±0.04, 2.29±0.06, 0.61±0.10, 0.56±0.01 (%) respectively. The pH, (%) acidity and total solids content of milk by germination method was 6.7, 0.13%, 6.86 mg/100 gm. And that of milk with sodium bicarbonate treatment was6.9, 0.11%, 8.66 mg/100 gm of liquid soy milk. The soy milk made with germination method was liked much by the people as per its taste, colour, texture, flavour and mean score for all attributes as per overall acceptability was 8.0 out of 10. Thus, Soy milk developed by germination method of soybeans have enhanced functional attributes and improved the food quality.

Keywords: Soybean, germination, sodium bicarbonate, nutrition, organoleptic

1. Introduction
Everyone enjoy milk because it is regarded as a complete food. However, as people's attitudes toward animal rights and their preferences for lactose-free foods. More individuals are turning vegan, which is boosting the market for plant-based milk all over the world. Because of its nutritional content and variety in satisfying appetite, milk is one of the most often consumed foods enjoyed by the human population from ancient times. However, modern clinical investigations have shown that various milk ingredients are linked to harmful health effects such cow milk allergy (CMA), lactose intolerance (LI), anaemia, and coronary heart disease, which has caused alarm among the risk-averse and health-conscious public. For those seeking dairy-free options, plant-based milk can be a decent option. Because of this, customers are more interested in choosing vegan diets over traditional mammalian milk (Kundu *et al.*, 2018) [12].

Because most plant-based milks are low in fat and do not contain cholesterol, they are ideal for persons with digestion issues or those who are concerned about their weight. Non-dairy milk substitutes are liquids made by soaking plant material in water, draining the water, and then combining it with clean water. After filtration, the mixture has an appearance and viscosity that are somewhat similar to that of cow milk. To make vegan milk beverages it involves using a variety of plant sources, including oats, rice, soy, peanuts, cowpeas, almonds, and coconut (Sethi *et al.*, 2016) [14].

Soybean (Glycine max) is leguminous plant which contains 20% oil, 40% high-quality protein, and other nutrients, has a large potential to treat protein-calorie malnutrition in India at a fair price (Sigh *et al.*, 2016) [16]. According to the Department of Agriculture & Farmers Welfare India's soybean planting area for the 2021–22 growing season was 121.76 lakh hectares as of September 17th, 2021, up from 121.20 lakh hectares for the preceding growing season. With 55.84 lakh ha, Madhya Pradesh was the largest state, followed by Maharashtra (46.01 lakh ha), Rajasthan (10.62 lakh ha).

Soybeans have a high nutrient density and are a good source of minerals like calcium (276 mg/100 g), magnesium (280 mg/100 g), potassium (1,797 mg/100 g), iron (16 mg/100 g), and zinc (4.8 mg/100 g) (Niyibituronsa *et al.*, 2019) [13].

Soy milk, made from soy beans, has been marketed as an inexpensive, high-protein beverage for use in developing countries where the thronging millions of people lack access to affordable animal-based protein meals, (Kahn *et al.*, 1990) [10]. Soy milk is composed of 90.8% moisture, 3.6% protein, 2% fat, 2.9% carbohydrate, and 0.5% ash.

Soy milk contains about 15 mg of calcium per 100 grammes, (Sharma *et al.*, 2020) [15]. Soy is a complete protein from plants and is more cheap than other plant-based milks since it contains all 10 essential amino acids, (Sunidhi *et al.*, 2021) [17].

Some people may not like the beany flavour of soy milk (Feng *et al.*, 2001) [7]. The presence of lipoxygenase enzymes in soybeans, which become active as soon as the cotyledons are split, is responsible for the beany flavour seen in soymilk. When lipoxygenase enzymes come into contact with water, oxygen, and lipids, they combine to produce the beany flavour (Arai *et al.*, 1967) [4]. The beany flavour in soymilk can be eliminated by deodorising the milk, eliminating the remaining flavour by partially inactivating the enzyme, and then concealing the remaining flavour with natural flavourings (Tripathi *et al.*, 2015) [18].

In the present research article two different types of methods namely germination and soaking with sodium bicarbonate method were used for the production or extraction of soymilk.

2. Material and Methods

2.1 Raw material

Good quality of soybean variety MAUS-71 was procured from Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra. Chemical used in the research are of analytical grade and they were obtained from the Department of Food Engineering, Department of Food Chemistry and Nutrition, College of Food Technology, V.N.M.K.V. Parbhani.

2.2 Preparation of soy milk

2.2.1 Sodium bicarbonate treatment

Soy milk was prepared by soaking soybeans for the 6-8 hrs in 0.5 (%) sodium bicarbonate solution and draining the alkali solution afterwards. It was then boiled again in fresh 0.5 (%) sodium bicarbonate solution for 10 min which was drained again followed by hot water grinding of soybean. The soy slurry was then heated temperature below 100 ℃ and filtered to remove okara.

2.2.2 Germination treatment

Soybean were soaked overnight (~6-8 h) at room temperature with a water. The soaked beans were drained, rinsed and placed in moist cloth and water was applied everyday to provide moisture to the seeds during sprouting process. The germination process was carried out at room temperature (~25 - 28 °C) for 28 hours. The Germinated Soybeans are used for soy milk preparation.

2.3 Chemical analysis

The sample were analysed for moisture content, total solid content and ash content as per standard methods described in (AOAC 2000) [1]. The protein content was determined by standard kjeldahl method described in (AOAC 2005) [2]. Fat content was estimated by Gerber Method (BIS 1977). Mineral content was estimated by AAS method given by (AOAC 1990) [3]. Titrable acidity was estimated by titrating against 0.1N NaOH as per (AOAC 2000) [1] method. pH was measured with the help of glass electrode and Acidity was measured by titration method (Khodke *et al.*, 2007) [11].

2.4 Sensory Evaluation

Sensory evaluation of soy milk samples was carried out in triplicate using 9-point Hedonic scale by a panel of 6 semi trained judges. Different milk samples were evaluated for their colour, flavour, mouthfeel, taste, flavour and overall acceptability.

3. Results and Discussion

3.1 Physiochemical properties

The proximate composition of soymilk samples is shown in (table 1) study revealed that the moisture content of the germinated soy milk is slightly higher than soy milk made sodium bicarbonate method i.e., 93.14±0.46, 91.34±0.2 (%) respectively. The values are resembling with (Bansal and Kaur 2014) [6]. Protein content of the soy milk made from germinated soybean was found to be higher than the soy milk produced with sodium bicarbonate method i.e., 3.11+0.19, 2.54±0.05 respectively. which is similar with the values obtained by (Singh *et al.*, 2015, Jiang *et al.*, 2013) [16, 9]. Whereas fat content of soy milk with sodium carbonate method is higher than the germinated soy milk i.e., 2.66±0.04, 1.45±0.22 (%) respectively, which is similar with the values obtained by (Bansal & Kaur, 2014) [6]. The carbohydrate content of soy milk made with germination treatment was 2.29±0.06 and that of soy milk made from germinated soybean was recorded as 1.15±0.06 respectively, (Bansal and Kaur, 2014) [6] reported similar findings.

Table 1: Proximate composition

Parameter	M1*	M2*
Moisture	91.34±0.20	93.14±0.46
Protein	2.54±0.05	3.11+0.19
Fat	2.66±0.04	1.45±0.22
Carbohydrate	2.29±0.06	1.15±0.06
Ash	0.61±0.10	0.63±0.14
Dietary fiber	0.56±0.01	0.52±0.10

Each value represents the average of three determinations; M1 Soy milk with sodium bicarbonate method; M2* Soy milk with germination method

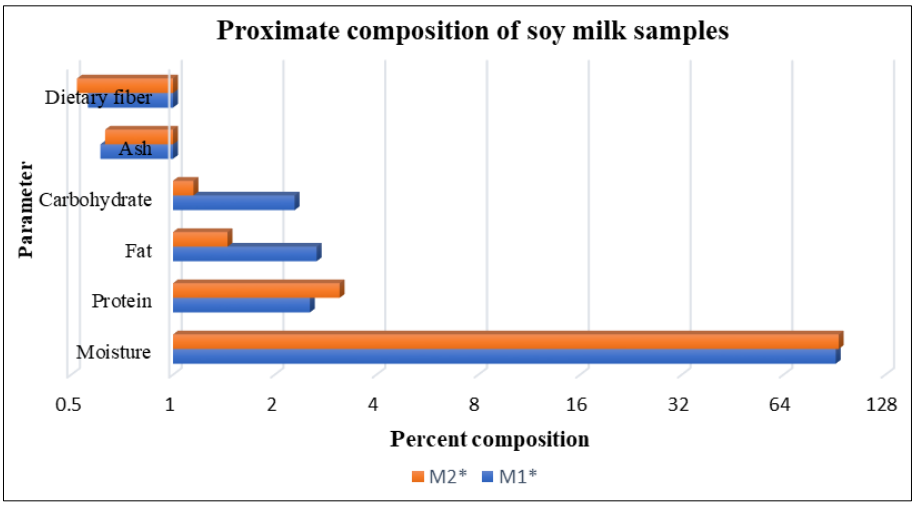

Fig 1: Representation of proximate composition of soy milk samples; M1* Soy milk with sodium bicarbonate method; M2* Soy milk with germination method

From the (table 2) it is clear that pH of soy milk made with sodium bicarbonate method is within the normal range i.e., 6.9, whereas it was decreased a little in case of germination method i.e., 6.7. But this small change was not supposed to have any bigger effect on the quality of sou milk samples (Bansal and Kaur 2014; *Khodke et. al.*, 2014) [6, 11]. Acidity of the germinated soy milk sample was 0.11 (%) and that of sodium bicarbonate method 0.13 (%). The values of acidity samples were resembled to the values given by (Khodke *et al.*, 2014; Harjai and Singh 2007) [11, 16]. The total solid content of germinated soy milk is lower than the soy milk made by sodium bicarbonate method i.e., 6.86 and 8.66 gm./100 gm liquid soy milk respectively.

Table 2: pH, acidity and total solids

Parameter	M1*	M2*
pH	6.9	6.7
Acidity (%)	0.11	0.13
Total Solids (gm/100gm liq. soy milk	8.66	6.86

Each value represents the average of three determinations; M1 Soy milk with sodium bicarbonate method; M2* Soy milk with germination method

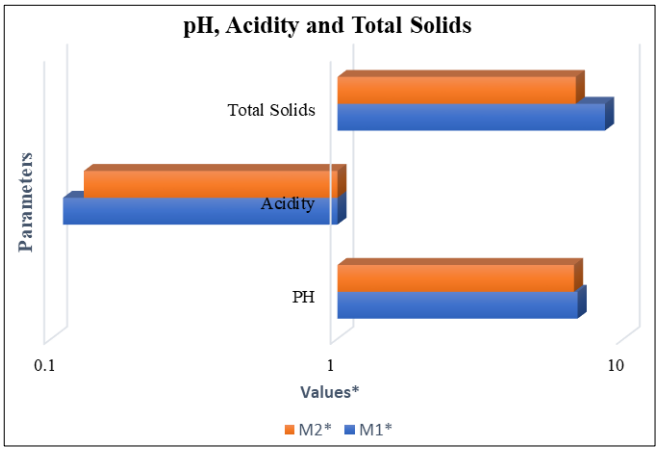

Fig 2: Representation of pH, Acidity and Total solids; M1* Soy milk with sodium bicarbonate method; M2* Soy milk with germination method

3.2 Organoleptic evaluation of soy milk sample

Results of evaluation of sensory attributes shown in the (table 3) The table clearly indicates that germination method has great impact on the overall sensory or organoleptic attributes in the sense of colour, sweetness, flavour, mouthfeel. With the help of table, we conclude that the overall acceptability of germinated soy milk is better than the milk made with the help of sodium carbonate method. The sensory panel gave overall acceptability score for germinated soymilk equivalent to 8. Likewise, for colour, sweetness, flavour and mouthfeel the score given as 8.0, 7.5. 8.0, and 8.0 respectively.

Table 3: Organoleptic evaluation

Sample	Organoleptic attributes				
	Colour	Sweetness	Flavour	Mouthfeel	OAA
M1*	7.0	7.0	6.6	6.3	6.5
M2*	8.0	7.5	8.0	8.0	8.0

Each value represents the average of three determinations; M1 Soy milk with sodium bicarbonate method; M2* Soy milk with germination method

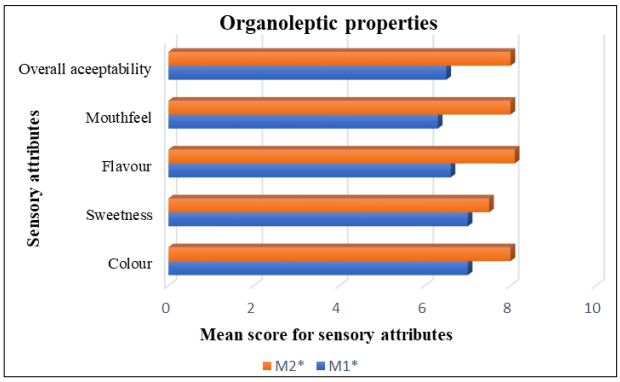

Fig 3: Representation of mean sensory score for sensory attributes; M1* Soy milk with sodium bicarbonate method; M2* Soy milk with germination method

4. Conclusion

With respect to the analytical reports the germination of soybeans involves a large number of metabolic changes. Many of these result in modifications that are directly related to nutritional out the quality of soy milk. Germination of soybean prior to grinding cum blanching unit produced soymilk gives better quality products in the sense of improved nutritional and organoleptic profiles. It will be good

alternative for the dairy based milk and also add value to the changing vegan trend in the developing world.

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