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A Review based study on Soymilk: Focuses on production technology, Prospects and Progress Scenario in last Decade

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Abstract
Soy food has been consumed for more than a thousand years, but only in the last 15 years they have made way for Western cultures and diets. Soymilk is a cheap, decent protein source that does not contain lactose. It replaces bovine milk as well. Though, soy milk protein is less digestible and more anti-nutrient than milk protein, it resolves the lactose intolerance problem and acts as a vegan milk supply. Soy milk is typically divided into two categories: fermented and unfermented. In comparison with unfermented one, fermented soy milk is less favorable. But there are also some inconveniences, such as low stability, shorter shelf-life and anti-nutritional causes. Different technology should overcome all these disadvantages such as Ultra high temperature, Microwave processing, Ultra-high pressure homogenization, Pulsed electric field and High pressure processing. Besides both of these soy milk, bioactive compounds like isoflavones, genistein, daidzein, and glycitein can also be minimized by thermal processing. A brief description of the importance, production technology, nutritional properties and development concerns over the decade has been discussed in this article.

Keywords: Soymilk, shelf-life, production technology, anti-nutritional factors, bioactive compounds and beany flavor.

Introduction
Milk and milk products are increasing around the world with the future has been expected. More than 6 billion people consumed milk and milk products in the world. Worldwide milk production has been estimated 843 million tons in 2018, with an increase of 2.2 percent from 2017 [1]. In India, about 66.8 million metric tons of milk was consumed in 2018. Bovine milk is consumed world widely and contains some antimicrobial agents which have good health effect on calf and also contains a complex combination of lipids (3-6%). It contains macronutrients as well as micro-nutrients. Macronutrients contain fat, protein, carbohydrates, and fiber whereas micronutrients contain vitamins and minerals. When the storage temperature is sufficiently high for psychotropics, the growth of fatty bacteria in milk causes the milk spoilage. Further, lactose intolerance is a type of milk allergy in which a person is not able to digest the milk lactose or milk products. Lactose intolerance has usually the result of not producing enough lactase enzymes in the body [2]. Lactase is an enzyme produced in the small intestine that helps to digest lactose in the body. Lactase deficiency means that your body does not produce enough lactase. It is a harmless disease but symptoms can be uncomfortable. The symptoms of lactose intolerance manifest from 30 minutes to 2 hours after eating lactose products results in diarrhea, gas, bloating, nausea, and abdominal cramps [3]. The demand for milk is increasing day by day and fulfilling the future need will be a big challenge. About 55-58 percent of the human population has little or no ability to digest lactose after infancy [4]. That's why there is need of a substitute which can replace the bovine milk. Soy milk has been considered as an excellent economic dairy substitute.
Soymilk is a cheaper source of high-quality protein withmany other health-promoting properties. Currently, it is most popular non-dairy alternative for bovine milk. It has the same profile of protein as cow milk even it gives fewer calories on consumption than bovine milk. Per cup consumption of soymilk provides about 7 grams of protein whereas per cup of cow milk gives 8 grams. It is one of the high-quality "complete" proteins of plant-based sources. Soymilk has contains all essential amino acids in high amount which exerts positive impacts on cardiovascular health [5].

It is rich in potassium as well as calcium and contains very little saturated fat. Functional soymilk contains extra bio-active compounds and may enhance health or lower the risk of diseases. In Asian countries, fermented soy milk has become the healthiest drink. Soy milk has been used in many products like soy cheese, soy yogurt, tofu etc. The products of soymilk are generally rich in omega fatty acids and phyto-antioxidant and thereby strengthen blood vessels completely. It has also contains phytoestrogen that decreases the risk of prostate cancer. The presence of calcium and vitamin D makes it suitable solution to fight against osteoporosis. The low glycemic index and high fibre content of soymilk makes it suitable for making healthy diets for diabetic patients [6]. Soymilk has been an excellent source of high-quality proteins, isoflavones, and B complex vitamins. Soy milk is a good choice for lactose intolerant due to absence of lactose sugar. People with lactose intolerance have started shifting towards consuming other alternatives for bovine milk like soymilk. People with a vegan diet and people who are seeking for healthy diets are also considering soymilk as an alternative to bovine milk. Galactose is not present in soymilk, which makes it completely safe for children with galactosemia.

The main process steps involved in the production of soymilk are milk extraction and wet grinding. Wet grinding involves both physical and chemical changes. Throughout the process of wet grinding in the reaction of water and air lipids are oxidized and the reaction has been carried out by lipoxygenase undesirable taste causing enzyme in soymilk. These attempts were made in the soy milk production to regulate lipoxygenase function. In soybean grinding, at either high or low temperature the low pH was effective in reducing off-flavor generation. Soybean was wet grinding in two batch grinders: a mixer grinder and a stone grinder. Grinding was done in short bursts to prevent generating too much heat during the process. With 840 mL of added water, pre-soaked soybean was ground in a stone grinder [7]. To extract stones and weakened, deformed seeds, soybean was sorted. The soybean was washed and immersed in water for 12 hours (500g in 1 Liter). For 30 minutes, it was rinsed and blanched in 1.25 % NaHCO3. The soybean was cleaned, dehulled by hand, and rinsed. To cut the okra, the soybean seeds were ground in a blender in a 3:1 ratio [8]. The muslin was wrapped around the pulp of soya and squeezed to remove all liquids (whey). The collected filtrate was boiling at 80°C in a water bath. The soy milk was cooled and refrigerated [9]. The slurry is made up of 0.1 percent sodium benzoate, 0.1 percent potassium sorbate, 2% sucrose, and 1% propy gallate. The milk was heated for 15 seconds at 71ºC before being bottled and processed at ambient and refrigeration temperatures. Baghbadorani *et al.*, 2017 reported that the fermenter was found to alter the isoflavones distribution profile to soymilk. Fermented soymilk has a higher content of the bioactive isoflavones aglycone, which is higher than its untreated counterpart. Soymilk fermentation with lactic acid bacteria provides a means of preserving soy milk and the possibility to modify the characteristic taste and texture to make it more acceptable for western tastes. The final product of fermentation of soymilk is fermented soymilk. Different types of bacteria are used in the fermentation of soymilk such as Lactic acid bacteria, *Bifidobacteria strains*, *Lactococcus lactis*, *Lactobacillus Plantarum*, *Lactobacillus rhamnosus*, *Lactobacillus paracasei*, *Streptococcus thermophilus*, and *Lactobacillus casei.*

Unfermented soymilk has more nutritional values as compared to fermented soymilk. Soymilk contains 43.1 % proteins and fermented soymilk contains 41.6% proteins. A carbohydrate of soymilk contains 5.3% and fermented soymilk contains 5.8 % whereas soymilk contains 32.7% fat and fermented soymilk contains 32.4% of fats [11]. Probiotic LAB strains such as *Lactobacillus paracasei* (L. paracasei), *Lactobacillus casei* (L. casei), *Lactobacillus mali*, and *Bifidobacterium breve* reported as a powerful starter for the fermentation of soy milk to improve pleasantly fermented soy milk products is done. Isoflavones contained in lactic fermented soymilk were mainly aglycones. Fermented soymilk enhanced antioxidant activity, ant mutagenic activity, and antitumor activity. Although the fermented food content has increased aglycones levels after fermentation, changes in their isoflavones content during storage [12]. Antioxidants are compounds that prevent oxidation. The antioxidant activity of soymilk is 41.6%. Soymilk shows more phenolic antioxidants content in comparison to the usual milk. Other than that, fermented soymilk also has antioxidant activity because of lactic acid bacteria which ferments it [13].

Nutritional significance

Milk is averagely composed by 87% water, 4-5% lactose, 3% protein, 3-4% fat, 0.8% 62 minerals and 0.1% vitamins [14]. A balanced diet should contain both micro-nutrients and macro-nutrients. According to the USDA Nutrient Database, the nutritional value of soymilk per 100g is ash (0.27g). Soymilk has 2.8 g of protein, 2.0 g of fat (total lipids), 0.214 g of fatty acids (saturated), 0.326 g of fatty acids (mono-saturated), and 0.833 g of fatty acids (poly-saturated), 1.8 g of carbohydrates. Macronutrients also consist 93.3 g of water and 1.3g of fiber. Micronutrients consist of vitamins and minerals. Vitamins profile of soymilk is 0.161 mg vitamin B1 (thiamine), 0.070 mg vitamin B2 (riboflavin), 0.147 mg vitamin B3 (niacin), 0.048 mg vitamin B5 (pantothenic acid), 0.041 mg vitamin B6, 1.5 µg vitamin B9 (folic acid), 0.0 µ vitamin B12, 0.0 mg vitamin C (ascorbic acid), 3.0 µg vitamin A and 0.010 µg vitamin E (Tocopherols). Minerals present in soymilk are 4.0 mg calcium, 0.58 mg iron, 19.0 mg magnesium, 49.0 mg phosphorus, 141.0 mg potassium, 12.0 mg sodium, 0.23 mg zinc, 0.12 mg copper, 0.17 mg manganese, and 1.3µg selenium [16]. Kranz (2017) reported that Soy milk contains carbohydrates (2%), proteins (3%), fats (1%), moisture content (94%), and 0% of the lactose in it and a good substitute for milk).

Each 225g of soybeans contains between 80 and 100 calories, 4g of carbon, 1g of sugar, 4g of fat and 7g of protein. The drink on the plant-based has a very low saturated fat and null lactose Fermented soy milk is suitable for those suffering from hypertension. It has advisable that patients suffering from coronary heart disease should drink soymilk regularly. Products of soymilk are rich in mono or polyunsaturated fatty acid which helps to control cholesterol from incoming into the bloodstream which results in a decrease in LDL level in the blood [6]. The eight ounces of plain soymilk has a nutrient content of 140 grams of calories, 10 grams of protein, 4 grams of fat, 14 grams of carbohydrates, 120 grams of sodium, 1.8mg of iron, 0.1mg of riboflavin, and 80mg of calcium. Soymilk sugar is free of lactose and for this reason; there is no possibility of having lactose intolerance syndrome [17].

Various bioactive compounds are present in soymilk. Some of these compounds could be very important for example, phytosterols which lowers the total LDL level in the blood, and hence it has a significant role in controlling serum

cholesterol levels in patients with hypertension [18]. Bioactive compounds such as polyamines have been considered as antioxidants and have an important role in the regulation of normal cell growth and differentiation by keeping check on oxidative stress [19]. Tocopherols are also known for their antioxidant activities. Soybean and its products have some compounds classified as Isoflavones which are not steroidal compounds which has some functional molecules, responsible for phytoestrogenic and antioxidative properties in them. The main isoflavones identified are which include compounds like aglycone compounds such as daidzein, genistein, and glycitin. It has also respective conjugates of glucoside, malonyl glucoside, and acetyl glucosidal groups. In soymilk, isoflavones are present in form of glycoside, acetylglycoside, malonyl glucoside, and rarely as aglycones [20]. Isoflavones occur in 8.8 mg. Isoflavones are well known to lower the risk of heart failure, postmenopausal syndrome, cancer and osteoporosis in women.

As Milk is not complete food because milk does not contain certain nutrients such as vitamin B complex, vitamin C, and iron. Milk also does not contain several amino acids such as leucine, lysine, isoleucine, and methionine. Moreover, lactose only occurs in bovine milk. Milk cannot consider as complete food for adults but can be for children because in children iron and several amino acids are required in fewer amounts. Also, it is a better option for those who are allergic to cow's milk [17]. However, soymilk also has some drawbacks such as off-flavor, poor stability, anti-nutritional factors, and shelf life. Fig. I. shows the comparative study of nutritional properties bovine milk and soymilk and by graph it is clear that soybeans are more nutritive as compared to bovine milk.

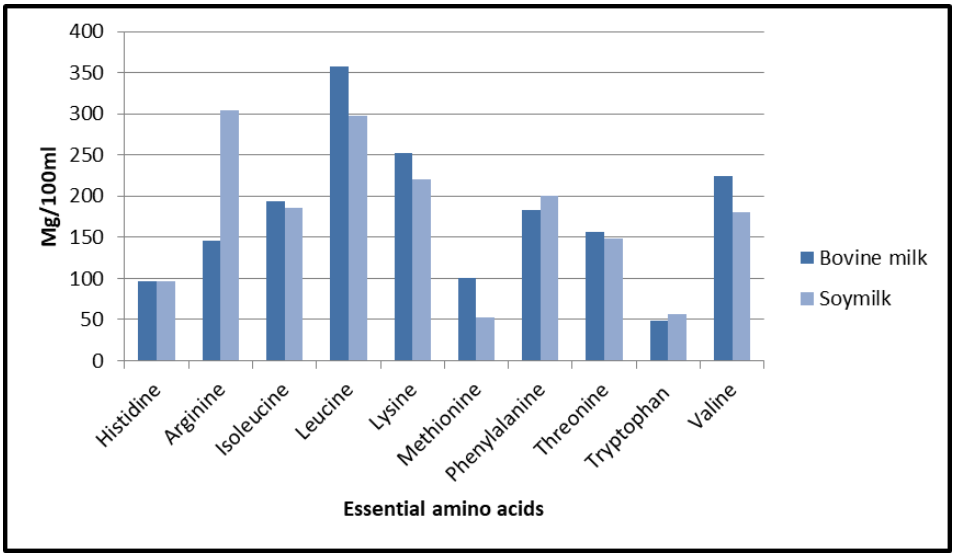

Fig 1: Comparative overview of the nutritional composition of bovine milk and soymilk

Confrontations in production technology

As it has been discussed above that soymilk have several drawbacks such as anti-nutritional factors, beany flavor or off- flavor, shelf life and last poor stability. During conventional soy milk, the process of heating destroys most of the anti-nutritional factors in soymilk. Compounds like phytic acid that affects the availability of calcium which does not decrease more during heat processing. At the same time, over-heating can damage amino acids too substantially and eliminate trypsin inhibitor activity along with the loss in overall nutritional value of soy milk [21]. Anti-nutritional factors that are present in soymilk are Kunitz Trypsin Inhibitor (KTI) and Bowman-Birk Inhibitor (BBI). KTI mainly consists of trypsin inhibitor activity (TIA) and a small chymotrypsin inhibitory activity (CIA). BBI has two separate inhibitory sites: trypsin and chymotrypsin, both of which binds into a single 1:1 complex. Protein digestibility decreases the high level of TIA and it may cause pancreatic disease. Temperature-dependent heating time required to kill 90% soymilk TIA 100 C, 40 min; 125 C, 5 min; 143 C, 60 s. For household soymilk, 40 min is long for boiling which is not suitable for a modern lifestyle [22]. Kunitz trypsin inhibitor (KTI) mainly consists of trypsin inhibitor activity (TIA) and a small chymotrypsin inhibitory activity (CIA). TIA mainly occurs as a result of two proteins of KTI and BBI. The molecular weight (MW) of KTI is 20 kDa which has two intrachain disulfide bonds although the molecular weight of BBI is 8 kDa which has seven intrachain disulfide bonds. KTI is termed as a "heat-labile" protein, but BBI is named a "heat-stable" protein. Even after the disulfide bond (SS) is broken then also BBI has a stable conformation [23]. KTI and BBI pure solution has been heated at the temperature of 10º C it has been observed that KTI lost its TIA after 180 min although BBI maintained 75% of its TIA even after 360 minutes. TIA of soymilk has been reduced up to 13% of original raw soymilk by traditions treatment of TIA at 100˚ C for 20 min. Heating of soymilk at 143˚ C for 60 sec can deactivate 10% of TIA. Formerly the original of TIA was about 85%. KTI can be disabled very easily 60% of soymilk TIA was from KTI. TIA inactivation protein was not disclosed [24].

Off-flavor or beany flavor of soymilk is the result of an action of an enzyme known as *lipoxygenase*. The enzyme is complex of oxidized lipids, results in beany flavor [25]. Inactivation of *lipoxygenase* in soymilk preparations can effectively eliminate the taste of the beany flavors. Beany flavor and lipoxygenase enzyme has been remarkably reduced the process of blanching soybean in sodium carbonate solution at 8º C [26]. The most effective and simple method to remove the beany flavor is grinding and hot water blanching. It is very effective to eliminate beany flavor by blanching with hot water because hot water has been seen to inactivate lipoxygenase and it is an enzyme important to generate soymilk off-flavor. In soymilk, beany flavor compounds are

extremely difficult and complex to understand. Total 8 beany flavor compounds are such as n-hexanal, trans-2-hexenal, 1-often-3-ol, n-hexanol, 1-pentanol, acetic acid, benzaldehyde, and trans-2, 4-decadienal [26]. Lipoxygenase (LOX) is neutralized by pH, pressure treatments, and heating; therefore, heat treatment is the best option to eliminate the off-flavor in soymilk. Lipoxygenase is definite for lipids with cis that is cis-1, 4- pentadienne system. These chemical compounds are liable for unacceptable soymilk flavor. However, boiling for three to five minutes makes lipoxygenase enzymes easily inactive. The blanching process prevents the manufacture of the characteristics of beany flavor, making soymilk more or less acceptable. Use of sodium bicarbonate and hot water to blanch before grinding is also known to reduce off-flavors [27].

Fresh soymilk has very short shelf life. It is as a result of milk pH that is 7.0 – 7.5 but the pH of soymilk is about 6.7. Soymilk has the biggest problem which is the short shelf life of soymilk which is due to microbial activity. Microorganisms that are responsible for the spoilage of soymilk are coliforms, fungi, and mesophilic aerobic bacteria. In today's lifestyle, consumers demand a long-shelf-like product that is safe and stable during the storage time. The UHT technique has potential in the production of such soy milk. Depending on the composition of the product, a shelf-life of up to several months and a year can be achieved. Besides, the correct choice of emulsifiers and stabilizers is essential to ensure a product of homogeneous without blending and sedimentation during the entire shelf life [28]. Refrigeration of soymilk helps to enhance the shelf life [29]. The most common practice is thermal processing which has been used to improve microbial safety. The use of ultra-high temperature (UHT) is relatively new to Soymilk production. Heat is usually applied soymilk during the preparation process mostly to ensure and expand food security product shelf life. Usually, the fresh and plain soymilk is packed in 200/500 mL glass bottles or tetra packs, or polythene bags. In tetra packs, the shelf life of soymilk is six months after packing or maybe a few weeks in refrigerator conditions. It must be stored and distributed at ambient temperature. The shelf life of sterilized soymilk in refrigerated condition was found 170 days and at ambient conditions was reported 90 days [30].

Soymilk has poor stability. Stability is affected by size of fat globules, phase of emulsion, pH, temperature of storage, microbial activity. Improvements in soymilk stability, especially pH, total titratable acidity (TTA), emulsion stability (ES), and rheology in the case of fresh soymilk, and in storage at room temperature (25–30 °C) for a period of 7 days, and in refrigeration (4 °C) for a period of 7, 14, or 21 days [31].

Size of fat globules: In soymilk, chalkiness is a defect in which the feeling of chalk powder occurs in the mouth after consuming the soymilk. In this defect, the presence of fine and grainy particles in the mouth occurs. Lack of stable suspension occurs in which two layers appear top layer of serum (clear separation) and another opaque layer of solids particles at bottom settle down. But it can be prevented by centrifugation or filtration by adding a stabilizer. Pasteurized of soymilk by heating up to 85℃ after two simultaneous homogenization at 24.13 MPa (3500 psi). Third homogenization is done to break the clumps formed by heating and by reducing the heat chalkiness is also reduced [32].

Emulsion stability (ES): ES values increase with increasing roasting over times of soybean (at 110 °C for 20–100 min and 120 °C for 20 min) which is extra homogenous soymilk which was developed than roasted soybeans as distinct control [33].

pH: pH parameter may differ during the production of soymilk which ranges from 7.34 to 6.40 and during storage decreases. Temperature of storage: Storage of soymilk is only done in a refrigerator (21 days) not at room temperature because it causes spoilage [33].

Viscosity: Viscosity is a significantly useful property of soymilk and is of critical importance when the commercialization of pressure soymilk is considered.

The choice of soybean used for making soymilk has a significant effect on the composition of soymilk. Processing methods and their parameters also affect the composition and nutrient value. The change in the solid content of soymilk also affects the viscosity of soymilk proportionally. Table I shows the production technology of last ten years with challenges and innovations in production technology with reported health benefit.

Table 1: Production Technology of soymilk in last decades

Production technology	Challenges of production technology	Significance	References
Whole soybean - Washed and soaked overnight in distilled water - Decanting the water - Soaked soybeans were mixed with distilled water - Mixed in a blender for 3 min - Filtrated the slurry using muslin cloth – Soymilk - Autoclave at 145° C for 10 seconds - Fermented with *S. thermopilus* BCRC 14085 at 37° C for 32 hrs - Fermented soymilk	Fermentation of soymilk using *Lactobacillus bulgaricus* and *Streptococcus thermophilus* reduced the beany and soapy flavour.	Prevention of osteoporosis Reduce the risk of certain cancer Easing of menopause symptoms	Liao *et al.*, 2010 [56]
Washing of dried soybeans - Soaking in 5% NaHCO3 and NaCO3 for 17-19 hours - Scrubbing and Hot treatment at 99°C, for 45-50 min - Grinding with boiled water at 99ºC - Cooking at 90ºC for 15-20 min - Homogenization 4000 psi - Clarification of soluble and insoluble portion - Soymilk + sugar (2%) + salt (0.2%)	Boiled for 14 minutes inactivates about 80% inhibitor at 85-88°C. Nutty flavour was removed by heat treatment and alkali treatment.	Enhance hair growth Strengthen blood vessel integrity Improve immunity	Kale *et al.*, 2012 [54]
Soybean, clean and de-hulled - Soaking in water(with 1%NaHCO3) - Wet grinding with hot water and volume make-up - Boiling for 15-20 min.- Filtration through Muslin Cloth - Residue (Okara) - Soymilk	Cooking is done at 80-150°C for inactivation of enzymes lipoxygenase (LO) and trypsin inhibitors. Ultra-filtration is done at 20,000 molecular weight used in filtration to remove ANF i.e., phytic acid.	Enhance the level of isoflavones It lowers down the level of cholesterol It contains very low saturated fat	Giri and Mangaraj, 2012 [52]
60g of germinated soybeans - Washing and soaking - Mixed	Soaking beans in sodium carbonate	Good source of	Jiang *et al.*,

with 540 ml tap water (9:1) - Blended for 5 min at low temp - Filter the slurry through a mesh screen - Soymilk	helps in reduced the beany flavour. Increased shelf life up to 14 days in refrigerator storage is done by high hydrostatic pressure at 300-700 MPa.	calcium, potassium, and protein. Boost riboflavin and vitamin B12. Improved lipid profile.	2013 [21]
Soybean - Soaked in de-ionized water at 4°C overnight - Blender for 3-4 min - Slurry minced by high-speed blender at 2000 rpm for 10 min - Soymilk	Blanching is done to inactivate trypsin inhibitors and lipoxygenase that would produce off-flavours in soy milk.	Aids in weight loss Nourishes hair follicles Repairs damage and split ends	Chen *et al.*, 2014 [22]
Dry whole soybean - Blanching 30 min in (0.25% sodium bicarbonate) at 100°C - Soaking at 20±5°C overnight - De-hulling and grinding in hot water at 50-60°C - Filtration and centrifuge 3000 rpm/ 3 min - Homogenization at 4000 psi - Sterilization 121°C / 15 min - Cooling to 5°C - Soymilk	ANF Phytic acid was removed by germination at 25° C. Beany flavour was removed by heat treatment combined with sodium bicarbonate.	Lower the risk of cardiovascular diseases. Promote weight loss. Improves mental health.	Salem *et al.*, 2015 [58]
Soybean - Soaked in distilled water 10-12 hr at 4°C – Drain - Hydrated beans + 3% NaHCO3 - Blanching T±2°C for 5 min – Drain - Grinding with distilled water for 2 min - Filtration using defatted cotton sheet - Raw soymilk	Soymilk blanching with NaHCO3 solution at 80°C for 3 min is an effective method for the inactivation of lipoxygenase and inhibiting the formation of beany flavour.	Keep heart healthy Cures skin-related issues Instant energy booster	Peng and Guo 2015 [57]
Soybeans - Sorting to remove dirt - Soaking the beans for about 16 hours with 1 % NaHCO3 - Boil in the solution for 20 min - Blend in boiled water at 30°C to obtain the fine slurry - Homogenize slurry, sieve, and pasteurize for 10 minutes - Soymilk	Removal of 'beany flavour' includes heat inactivation of the lipoxygenase enzyme during the grinding process.	Prevents kidney disease and diabetes Restore energy Treat anaemia	Bollegala and Rajapakse 2015 [25]
Soybean seeds cleaned - Soaked in 0.5% NaHCO3 solution for 12 hr – Drained - De-coated and rinse twice with tap water - Blanched for 10 min at 100°C in 0.5% NaHCO3 solution - Ground and cooked at 27-30°C - Soymilk extracted and filtered - Pasteurized at 68°C for 30 min - Soymilk	NA	Prevents damage to blood vessel Reduces cholesterol level Strengthen blood vessels	Abagoshu *et al.*, 2017 [51]
Soybeans - Soaked in NaHCO3 at 25-30°C for overnight - Draining off the water - Blanched in 0.5% NaHCO3 for 30 min - Drained off the water and cooled in tap water - Separate the cotyledons from the hulls - Grind the cotyledons and then filtered the slurry - Soymilk	NA	Prevents from diabetics Decrease the risk of psychological disorders Improves the immunity	Hati *et al.*, 2017 [20]
Soybeans - Soaked for overnight - Blanched and then grinded - Filter through double muslin cloth - Add distilled water and then Fermentation at 42° C for 7 hours - Sterilized by autoclaving at 121°C for 15 min - Soymilk - milk + 1% inoculated with LP C2 in a110fermentation vessel for 24 hr at 37° C with 100 rpm with agitation - After 6 hr fermented soymilk is formed	NA	Restore post-workout energy Lactose-free Fight obesity	Singh and Vij 2017 [59]
Soybeans washed and cleaned - Soaked in distilled water for 18hr at 25°C - Wet grinding of soybean with water for 3 min - Filtered the slurry through a muslin cloth - Raw soymilk	Autoclaving, batch boiling, and Ultra-High Temperature (UHT), High Temperature and Pressure combination, and High-Pressure Processing (HPP) are processing methods used for inactivation of trypsin inhibitor in soymilk.	Improve lipid profile Excellent weight loss supplement Best drink for pregnant women.	Vagadia *et al.*, 2018 [36]
Soybean - Soaked at 25°C for 18 hours (1:3) - Hydrated soybean were drained – Ground in the blender for 3 min – Filtered the slurry through muslin cloth – Soymilk – Heat the milk at 100º C for 20 min – Cooled in the water bath at 50ºC for 10 min – Add 2% of sucrose to enhance the taste (sweet)	Roasting on soymilk is done at 160-180° C inactivates anti-nutritional factors especially trypsin inhibitors and improves the shelf life. Roasting of soymilk was found to inactivate soymilk lipoxygenase activities.	Tackles arthritis Instant energy booster Stronger bones	Navicha and Hua 2019 [33]
Soybean sorting and washing - Soaked for 24 hours followed by blanching for 5 min at 60° C - Draining and de-hulling – Grinding/ milling – Diluting with water (1:3) - Filter with muslin cloth - Boiling for 15 min and then Cool it - Milk + 1,2,3,4% of pure yogurt culture incubated 30,35 and 42° h for 18 hrs - Soymilk	NA	Strengthens blood vessel Reduce the risk of breast cancer.	Hati *et al.*, 2020 [53]

Technological Innovations to overcome confrontations

Several technologies are used to observe the deactivation of TIA. These technologies are high pressure; ultrasound, microwave, fermentation, and irradiation are shown the best parts in soymilk processing. However, the widely used methods are thermal treatment including boiling processing (conventional), steam injection batch processing, and ultrahigh-temperature processing (UHT) [34].

Ultra-high temperature (UHT) processing destroys 90% TIA at 100° C for 40 min and at 125° C for 5 min. For household soymilk, 40 min is long for boiling which is not suitable for a modern lifestyle [22]. On large-scale processing, it reduces the heating time is worthwhile to save energy, reduce costs, and increase the quality of soymilk [34].

Microwave processing is a thermal processing technique of dielectric that can accelerate the inactivation rates of several anti-nutrients compared to traditional processing techniques [35]. Microwave processing in soymilk has been reduced up to 70% of TIA and improve digestibility of soymilk protein after 8 min at 100° C as compared to untreated samples [36].

A more advanced thermal processing method is Ohmic heating in which the foodstuff is heated by passing an electric current through it (Joule effect). Soymilk treated with Ohmic heating has been found better for tofu production [34].

Ultra high-pressure homogenization (UHPH) is emerging technology whose objective is to gain a better quality of food product compared to traditional heat treatment [37]. UHPT is a technique which used to combine the effects of high temperature and pressure to recover the quality of soymilk. UHPT treated soymilk has been reduced microorganisms and colloidal stability was high during the time of storage [37]. It is a non-thermal process and helps to deactivate microorganisms and improve the texture, color, taste, and enhances the shelf life [38].By UHPT treatment significant reduction has been found in the size of the particle, results in greater physical stability of soymilk. UHPH treatment has been produced low values hydro-peroxideindex [39].

Pulsed electric field (PEF) is a non-thermal food conservation technique that becomes a substitute for thermal pasteurization. Compared to conventional thermal pasteurization, PEF can also inactivate enzymes and also kill the microorganism. It has been conserves the vitamins, nutrients, texture, taste, color, and heat liable useful constituents of foods [40]. PEF has mostly applying to liquid food with low conductivity of electrical and low viscosity. PEF application has been inactivating the lipoxygenase (LOX), and 54% of LOX inactivated in cold breaking of soymilk [41].

High-pressure processing (HPP) can be applied to the inactivation of microorganisms, enzymes, and protein disclosure. Protein unfolding has been promoted by HPP while sensory and nutrition factors have been found mostly conserved. HPP may occur as an inappropriate technique for deactivating trypsin inhibitor in soymilk. HPP at moderate pressure (500 MPa) and room temperature have been performed to check-in relatively likely to neutralize trypsin inhibitors [42].

Fermentation helps to decrease anti-nutritional factors such as phytic acid, oxalic acid, and protease inhibitor. It enhances the bioavailability as microbes breaking down the complex organic substance into simpler ones. Soymilk fermentation improves the bio functional property as a result of enhance of free is flavones and peptides by the microorganisms [43]. Soymilk drawbacks can be reduced by these technologies as seen in fig. II.

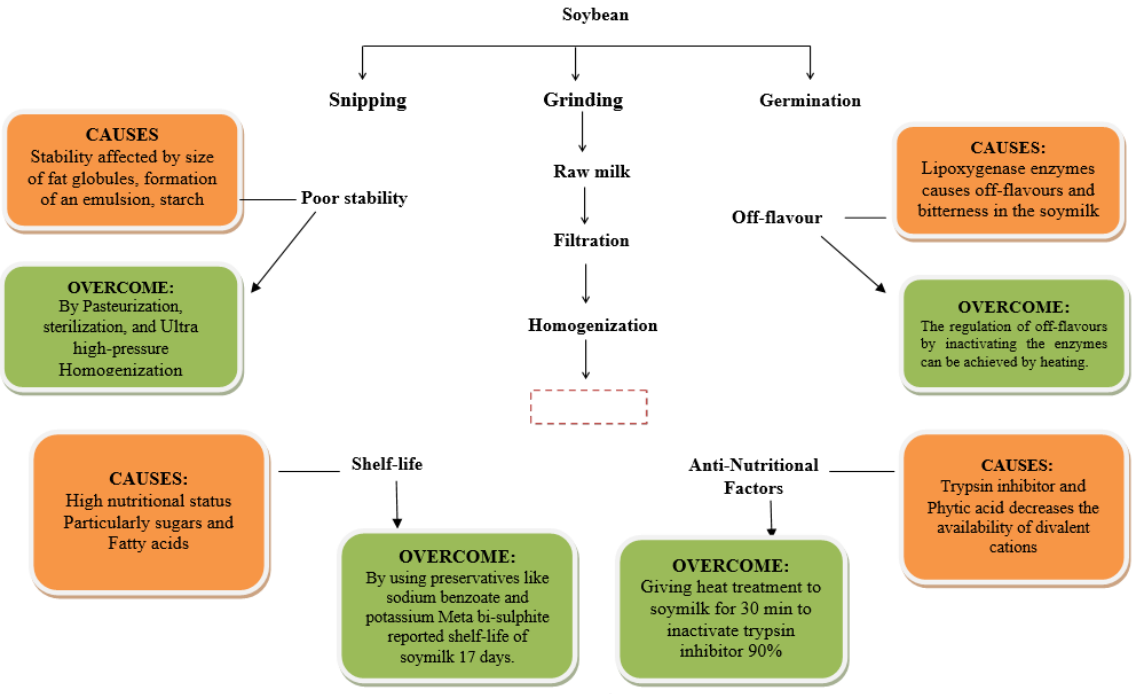

Fig II: Potential constraints and innovation to overcome

Processing consequences over functionalized bioactive compounds

Heterocyclic phenols are isoflavones in which flavonoids are a subclass with similarity of structural to estrogens and are termed as phytoestrogens [44]. Genistein, daidzein and glycitein are the most popular isoflavones found in soya [45]. The concentration of bioactive compounds varies greatly in soybean variety, climatic condition and location, temperature etc. location with high temperature usually reduces the quality of soybean. Usually, the concentration of bioactive

compounds is in the order of genistein> daidzein> and glycitein [46].

In sterilization with soy milk that has to be heated for 5 minutes at 121ºC. It will destroy almost 17 % genistein, 87% daidzein, and 72% of glycitein. On the other hand, for pasteurization, heating at 95° C for 1 hour will reduce glycitein up to 66 %, daidzein up to 77% only rise 33% of genistein [47].

In soymilk soaking at 40° C to 60° C can reduce lipoxygenase activity. Thus, the digestion of soybean protein is improved. But, higher soaking temperatures make better damage to solids such as isoflavones and proteins in liquid medium [46].

Pre-soaking treatment of grains reduces the acidity in thyme, reducing the perception of astringency, which is caused by genistein. Grinding can raise isoflavones extraction. The grinding process had a critical effect on isoflavones and this effect varied with the temperature of grinding. Different heating methods had different effects on different isoflavone forms [48].

Success stories

In many people's diets, cow's milk is considered a staple. However, some people may or may not be consume it due to their personal choice, allergens, and intolerance. In allergens or milk allergy, about 3-5% of children under the age of three years are sensitive to milk. It can cause several symptoms such as vomiting, rashes, and diarrhea. About 80% of children outperform this allergy by the age of 16. In lactose intolerance, about 65% of the world population is intolerant to lactose and lactose is a sugar found in milk. This disorder occurs only when the lactase enzyme is deficient in the body because the lactase enzyme helps to digest the lactose in the body. The best non-dairy substitute for milk is soymilk. Soymilk does not have all these problems that cow's milk has. Soymilk is the most popular non-dairy alternatives for decades because its nutritional profile is very much similar to cow milk. It is a plant-based source that is high in protein. Soymilk is also called complete protein because it contains all essential amino acids. Soymilk is low in saturated fat, indeed free of cholesterol, and has no lactose. Soy milk contains carbohydrates (2%), proteins (3%), fats (1%), and moisture content (94%).

Nowadays, the vegan diet has turn out to be more popular. More and more people have decided to go vegan diet for environmental or health reasons. A vegan diet refers to consuming only those products that are made from plants based, not animal-based [49]. People are preferred to consume a vegan diet for various reasons. There are various advantages to consume a vegan diet are it can reduce body weight, decreased blood sugar level in diabetes patients, can help keep your heart healthy, and other health benefits of vegan diets (cancers risk, arthritis, and Alzheimer's disease) [50].

Conclusions

The demand for milk is increasing so that it cannot be able to fulfill everywhere. Cow's milk is causing lots of problems like lactose intolerance. Lots of people are suffering from lactose intolerance, and then they are not able to consume milk or milk products. There is a lot of problem with pathogens as well. Sometimes with the arrival of a pathogen can cause several diseases in the body. This was a problem like those people who follow a vegan diet are not able to consume milk. Due to this, they cannot get proper nutrition at once. One of the good alternatives maybe is soymilk. Soymilk is rich in protein and free from lactose. Soymilk is easy to process. Soymilk is expensive than normal milk because of milk processing in soymilk. Soymilk can be a better alternative than milk. The problem of lactose intolerance is being solved. The problem of the vegan diet problem is also solved. However, it's not a perfect alternative because it also has some disadvantages such as short shelf life, poor stability, beany flavor, and anti-nutritional factors. All these problems can be solved by food technology. UHT and fermentation technologies have potential to reduce anti-nutritional factors. Pulsed electric field and high-pressure processing can reduce beany flavor. Stability could be improved by the heating method and shelf life could be increase by storing in refrigerator condition. Better technology can be found to deactivate enzymes which are responsible for increasing off-flavour problem in soymilk. All the problems can be resolved by processing and it can be sold as a non-dairy substitute in the market.

Conflict of interest

None

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