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ORIGINAL ARTICLE

Effect of Different Storage Conditions on The Sensory Attributes of Soymilk

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ABSTRACT

Background: Soymilk is a plant-based protein-rich beverage that is produced from soybeans. It is a steady emulsion of water, oil, and protein. Along with similar vegetable-based milk, soymilk can be utilized as an alternative for dairy milk by individuals who are lactose intolerant or vegan. It can also be a decent swap for cow's milk where cow milk is not accessible in adequate amounts.

Objectives: To evaluate the sensory characteristics of soymilk under different storage conditions i.e., refrigerator, chiller, and room temperature.

Methodology: Examined soybean seeds were rinsed and soaked in the water multiple times the volume of the beans, for around 10hrs. The soaked beans were parboiled (partial cooking) in boiling water for a few moments with steady fomentation. The boiled beans were cooled, de-husked, washed, and after that, the seeds were homogenized with clean water into a stable paste. After that obtained paste was drawn out, (sieved) by utilizing a perfect muslin cloth to isolate the filtrate from the paste. Then the obtained milk was boiled to eliminate the beany flavor and was packed in sterilized glass bottles, stored, and coded as T_1 (refrigerator temperature, 7°C ±1°C), T_2 (chiller temperature, 4°C ±1°C), and T_3 (room temperature, 25°C ±2°C).

Results: The results of the study showed that the maximum score of color, flavor, taste, aroma, and overall acceptability of soymilk recorded as 8.06, 8.22, 8.45, 8.54, and 8.57, respectively on chiller temperature (4°C ±1°C). While the lowest score of color, flavor, taste, aroma, and overall acceptability of soymilk was recorded 7.36, 7.55, 7.78, 7.65, and 7.65, respectively at room temperature (25°C ±2°C).

Conclusion: It was observed from the present study that in between the stored samples, sensory attributes such as color, flavor, taste, aroma, and overall acceptability perceived better scoring for T_2, T_1, and T_3, respectively. Also, during storage, a little decrease in sensory attributes was observed among all treatments mostly from treatments stored at room temperature.

Keywords	*Address of Correspondence	Article info.
Soybean, Soymilk, Sensory attributes, Storage conditions, Temperature, aroma.	*asifirshadbaloch@gmail.com*	*Received: March 21, 2021* *Accepted: October 23, 2021*

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INTRODUCTION

From the last few decades, increased consumption of plant-based protein as the substitution from animal sources has been seen from all over the world. Soybean (*Glycine* max) which contains a high protein content (up to 40%) is an excellent plant protein source. From this, several soybean-based items have been acquainted with the business sectors of western nations, out of which soy drink is considered as an appropriate substitute of milk, with high significance for the individuals who are milk protein hypersensitive, lactose intolerant and vegan persons[1].

Soybeans are known to have beneficial effects on human wellbeing which contain a substantial quantity of dietary fiber (both soluble and insoluble fiber) and Polyunsaturated Fatty Acids (PUFA) and have a small amount of cholesterol, saturated fatty acid, and sodium[2,3]. Soybeans contain various nutrients, proteins, carbohydrates, lipids, vitamins, and minerals. Among foods grown from the ground, soybeans abundantly comprise bioactive constituents of phenolic nature and non-steroidal with chemical structure like 17β-estradiol[4].

Soymilk is obtained from the extracted water of soaked soybeans from the time it is being prepared by crushing water-soaked soybeans. It is known to have a mixture of balanced nutrients as cow milk, but it is deficient in lactose, gluten, and cholesterol, and rich in great phytochemical compounds related to human wellbeing. Soymilk is known to emphatically influence Bone Mineral Density (BMD) and bone strength by upgrading intestinal retention of calcium[2]. In comparison to cow milk, soymilk contains a larger number of proteins, carbohydrates, polyunsaturated fatty acids, and fibers. It is additionally a decent source of potassium, iron, and manganese. Furthermore, it has slighter fat, calories, and sugar as compared to cow milk[5]. It is considered lactose-free milk so, it can be alternative milk for those people who are associated with lactose intolerance disease[6].

The eating habits of individuals in many developing countries involve starch, cereals, and some legumes. Unfortunately, protein derived from animal sources especially milk, that is utilized to supplement the starch-based diets are costly and far off for poor families[7]. The shortage of milk supply in non-industrial nations may be prompted by the improvement of elective milk from vegetable sources[8], and soymilk is one such vegetable extracted milk that can be available to people at a low cost to fulfill their nutrients requirements especially protein. In such situations, soymilk can be the ideal product to meet the nutrition requirements of people.

Plain soymilk is packed in 200/500ml polythene-made bags, glass containers, and tetra packs. It has the ease of use of a half year when stuffed in tetra packs or likely for a few weeks under refrigerated conditions. It should be put away and dispersed at ordinary temperatures[9]. The shelf life of soymilk is of great consideration to make the product acceptable and safe for human consumption. Shelf life is influenced by mean factors, such as heating and preparation method, its packaging, and how the milk alternatives are being stored to lengthen the storability factor and to reach the final consumers with utmost quality[10].

Soybean is one of the main and important legumes concerning the world's total grain production and is most frequently consumed due to its high protein content and moderately low cost. Soymilk in rural households has stayed a problem if not consumed soon after its production and lose its appealing quality. Hence, there is a need to efficiently evaluate the impact of storage techniques on the sensory quality of soymilk. Although several studies have been reported on soy however very little information is available on the changes in sensory properties during the storage of soymilk. Considering the above, the present investigation is proposed to study the sensory evaluation at different storage techniques.

MATERIALS AND METHODS

Procurement of the Sample

The soybean seeds were bought from the neighborhood market of Hyderabad and an experiment was conducted in the research laboratories of the Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam. Later the soybeans were soaked in water to prepare soymilk.

Preparation of Soymilk

Soymilk was extracted from soybean according to the method described by Shurtleff and Aoyagi[11] as described in Fig. **1**. First, soybeans were cleaned and arranged (to eliminate broken, harmed, and stained seeds), furthermore, winnowed soybean seeds were rinsed and soaked in the water around multiple times the volume of the beans for around 10-12hrs. The soaked beans were parboiled in water for a few moments with steady fomentation. After that, the boiled beans were cooled and de-husked, altogether washed, and after that, the seeds were homogenized with clean water into a stable paste. After that, the obtained paste was drawn out (sieved) by utilizing a perfect muslin cloth to isolate the filtrate (milk) from the paste. Then the obtained milk (soymilk) was boiled to eliminate the beany flavor which is normal for soymilk. After that, the milk was packed in sterilized glass bottles,

stored, and coded as T_1 (refrigerator temperature, 7°C ±1°C), T_2 (chiller temperature, 4°C ±1°C), and T_3 (room temperature, 25°C ±2°C).

Sensory Evaluation

The sensory evaluation of soymilk was performed by the panel of twenty judges including Professors and senior students of the Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam to measure the degree of preference among the different treatments for various sensory attributes i.e. color, flavor, taste, aroma, and overall acceptability. This was conducted by using a nine-point hedonic scale as described by Iwe[12] representing as, (9=Like Extremely, 8=Like Very Much, 7=Like Moderately, 6=Like Slightly, 5=Neither Like nor Dislike, 4=Dislike Slightly, 3=Dislike Moderately, 2=Dislike Very Much, 1=Dislike Extremely). All three treatments (T_1 to T_3) were presented to the panel of judges to assess the sensorial attributes.

Statistical Analysis

The recovered data from the present findings were tabulated and analyzed according to the statistical procedure, and significant differences of the mean were further computed using the Least Significant Difference (LSD) at 0.05% level of probability. The final data was analyzed using Statistix 8.1 computer software[13].

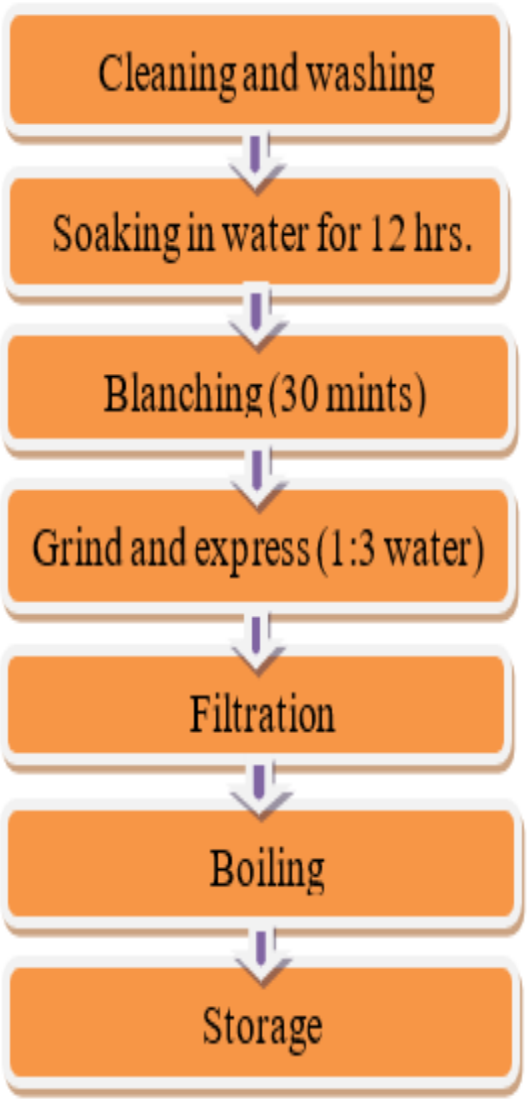

Figure 1. Flow diagram for processing of soybeans to soymilk.

RESULTS AND DISCUSSION

The results showed that the impact of different temperatures on the score of sensory attributes was statistically significant ($p < 0.05$) affected by distinct temperatures, storage periods, and interactions of different temperatures.

Color

The color of any food is vital because it gives customers an early introduction and thusly, it can impact acceptance and rejection of the product. Generally, the color of fresh soymilk is slightly yellow or creamy[14]. The color of soymilk stored under different storage conditions varied significantly among different treatments and during storage (Fig. **2**). The maximum score of color was recorded in T_2 (8.06) followed by T_1 (7.81), while the lowest score of color was noticed in T_3 (6.36). However, during the storage period, a decrease in the color of all treatments was observed and the maximum score of color 7.98 was recorded on 0 day, followed by 20th day 7.32, 10th day 7.26, and 30th day 6.01, respectively. Present results correlate with the findings of Al-Nabulsi[15] who reported that the values of color enzymatic and non-enzymatic reaction in the soybeans are accelerated when soybeans are stored under high temperature, thus brown pigment are formed which are carried over into the soymilk.

Flavor

Soymilk contains a beany flavor and researchers are trying to eliminate the beany flavor in soymilk utilizing different flavors and enzymes[16]. The results for the score of the flavor of soymilk stored under different storage conditions are given in Fig. **3**. The maximum score for flavor was recorded in T_2 (8.22) followed by T_1 (8.21) while the lowest score for flavor was observed in T_3 (7.55). However, during the storage period, the flavor of soymilk changed slightly among all the treatments, and the highest score for flavor 7.78 was observed on the 20th day followed by 30th day 7.75, 10th day 7.33, and 0 days 7.15, respectively. Similar findings were also recorded by Ugochi[17] who recorded results in the range of 7.4 to 6.30 and observed a decrease in flavor at a higher temperature that may be due to the Maillard reaction and enzymatic activities.

Taste

Taste consists of those properties of a product that is judged visually or by touch. The results for the score of the taste of soymilk stored under different storage conditions varied significantly among different treatments and during storage (Fig. **4**). The maximum score of taste was recorded in T_2 (8.45) followed by T_1 (8.05), while the lowest score of taste was recorded in T_3 (6.55). However, during the storage period, the taste of soymilk varied among all treatments, and maximum results of 7.73 were observed on the 30th day followed by 20th day 7.66, 0 days 7.60, and 10th day 7.20, respectively. The present findings are in accord with the observed values of Vanga[18] who also observed relevant results in their study. A similar study of Lawrence[19] observed meaty/breathy flavor and better taste in shelf-stable soymilk. This could be because of higher heat treatment got by shelf-stable soymilks contrasted with refrigerated soymilks.

Aroma

Fresh soymilk is known to have a mild smell, so if a difference in smell is noticed, then milk is probably off. Significantly different scores for the aroma of soymilk stored under different storage conditions were observed and are given in (Fig. **5**). The highest score of aroma was recorded in T_2 (8.54), followed by T_1 (8.25), while the lowest score of aroma was recorded in T_3 (6.65). Whereas during the storage period changes occurred among all treatments and the maximum score of aroma 8.80 was recorded on 0 days followed by 10th day 8.33, 30th day 7.86, and 20th day 7.53, respectively. The data observed from the present study correlates with the observations of Odu[20] who also observed changes in aroma with the storage period and obtained better results for refrigerated soymilk as compared to the soymilk stored at room temperature.

Overall Acceptability

Acceptability is a subjective measure dependent on hedonics or pleasures, which thusly is impacted by the sensory properties of the food. The significantly different scores of overall acceptability of soymilk stored under different storage conditions are given in Fig. **6**. The maximum score of overall acceptability was observed in T_2 (8.52), followed by T_1 (8.30), while the lowest score of overall acceptability was recorded in T_3 (6.65). In the case of the storage duration, the highest score of overall

acceptability 8.80 was observed on 0 days followed by 10th day 8.26, 20th day 8.06, and 30th day 7.46, respectively. These obtained results are in close agreement with the findings of Niyibituronsa[21] who also examined similar results of decreasing trends (8.00 to 6.20) in overall acceptability in soymilk.

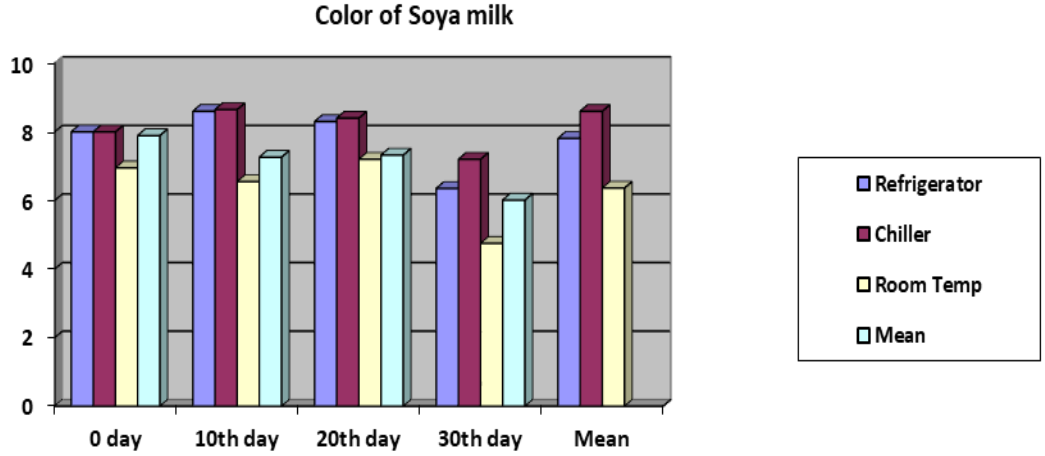

Figure 2. Average score of color of soya milk as affected by various storage temperature.

	Treatments	Storage	T x S
SE±	0.0705	0.819	0.1415
LSD 0.05	0.1467	0.1696	0.2935

T_1 = Refrigeration (7 ±1°C)

T_2 = Chiller (4 ±1°C)

T_3 = Room temperature (20 ±2°C)

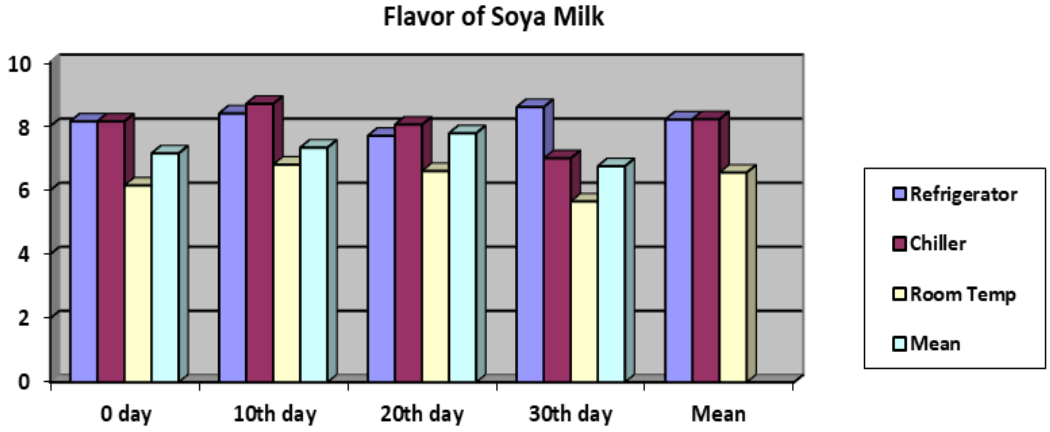

Figure 3. Average score of flavor of soya milk as affected by various storage temperature.

	Temperature	Days	T x D
SE±	0.2137	0.2756	0.4767
LSD 0.05	0.4272	0.5512	0.9539

T_1 = Refrigeration (7 ±1°C)

T_2 = Chiller (4 ±1°C)

T_3 = Room temperature (20 ±2°C)

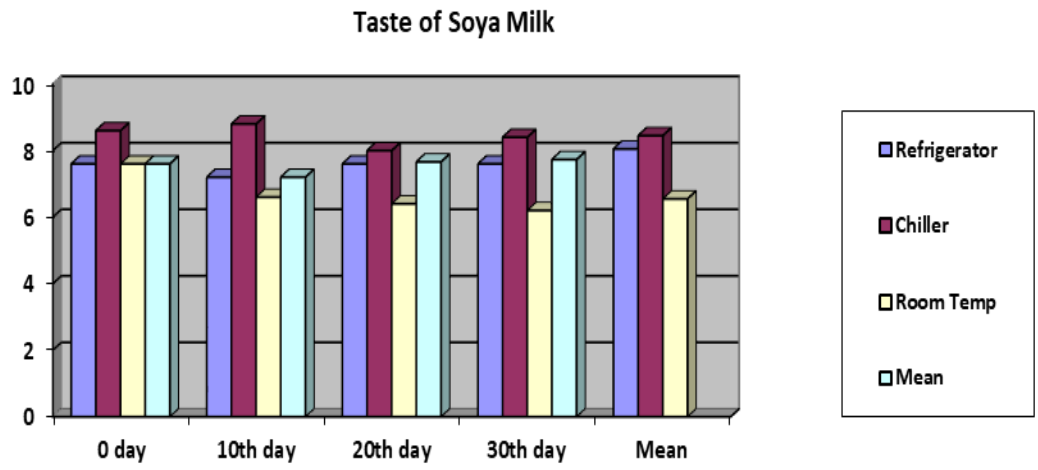

Figure 4. Average score of taste of soya milk as affected by various storage temperature.

	Temperature	Days	T x D
SE±	0.2049	0.2645	0.4582
LSD 0.05	0.4104	0.5299	0.9178

T_1 = Refrigeration (7 ±1°C)

T_2 = Chiller (4 ±1°C)

T_3 = Room temperature (20 ±2°C)

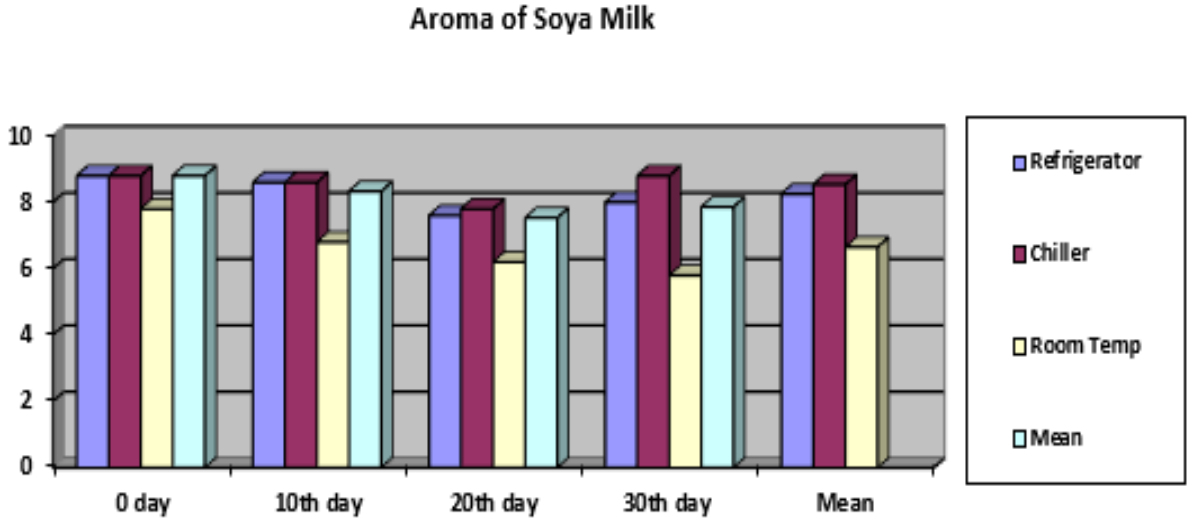

Figure 5. Average score of aroma of soya milk as affected by various storage temperature.

	Temperature	Days	T x D
SE±	0.2240	0.2888	0.4996
LSD 0.05	0.4477	0.5776	0.9998

T_1 = Refrigeration (7 ±1°C)

T_2 = Chiller (4 ±1°C)

T_3 = Room temperature (20 ±2°C)

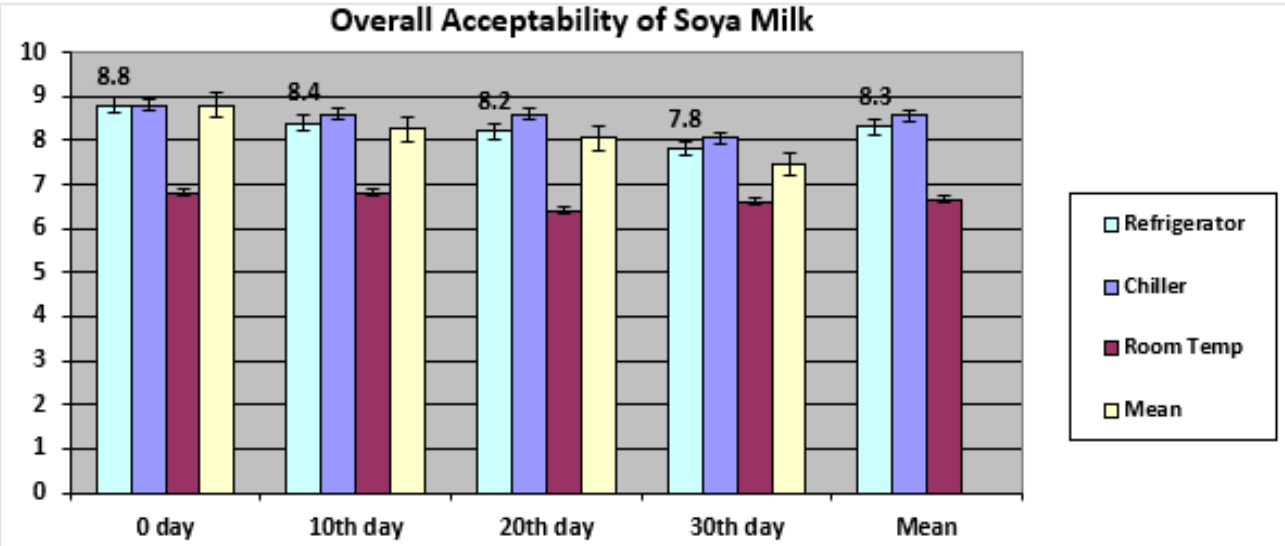

Figure 6. Average score of overall acceptability of soya milk as affected by various storage temperature.

	Temperature	Days	T x D
SE±	0.1848	0.2385	0.4129
LSD 0.05	0.3698	0.4776	0.8268

T_1 = Refrigeration (7 ±1°C)

T_2 = Chiller (4 ±1°C)

T_3 = Room temperature (20 ±2°C)

CONCLUSION

The increasing demand for proteins in the developing countries opened new ways to develop an elective source of protein particularly from plant origin which would be cheaper than animal protein, and still provide protein content close to the animal protein. Production of soymilk from soybean is being practiced for the last few decades as it contains a high protein content and has close characters to animal milk. It can be concluded from the present study that in between the stored samples, sensory attributes such as color, flavor, taste, aroma, and overall acceptability perceived better scoring for T_2, T_1, and T_3, respectively. Also, during storage, a little decrease in sensory attributes was observed among all treatments mostly from treatments stored at room temperature. Based on conclusions, it is suggested that the different flavoring agents and fruits can be used in soy products to finish their beany smell and taste. Different methods for the preparation of soymilk can also be tried for the better quality of soymilk.

CONFLICTS OF INTEREST

None.

FUNDING SOURCE

None.

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LIST OF ABBREVIATIONS

BMD	Bone Mineral Density
LSD	Least Significant Difference
PUFA	Polyunsaturated Fatty Acids

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germination and effect of fermentation on lupin aroma. LWT-Food Sci Technol. 2018; 87:225-33.
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