International Journal of Advanced Biochemistry Research 2025; 9(4): 783-786

International Journal of Advanced Biochemistry Research

**ISSN Print:** 2617-4693
**ISSN Online:** 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(4): 783-786
www.biochemjournal.com
Received: 12-02-2025
Accepted: 17-03-2025

**Jhalaknath Sharma**
B.Tech. Student, Central Agricultural University Imphal, College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Ranipool, Sikkim, India

**Adarsh Kumar**
B.Tech. Student, Central Agricultural University Imphal, College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Ranipool, Sikkim, India

**Avinash Kumar**
B.Tech. Student, Central Agricultural University Imphal, College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Ranipool, Sikkim, India

**B Ravi Prakash**
B. Tech. Student, Tamil Nadu Agricultural University, Tamil Nadu, India

**Jemson Loktongbam**
B.Tech. Student, Central Agricultural University Imphal, College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Ranipool, Sikkim, India

**Abhimanyu Gupta**
B.Tech. Student, Central Agricultural University Imphal, College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Ranipool, Sikkim, India

**Parambir Naik**
B.Tech. Student, Central Agricultural University Imphal, College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Ranipool, Sikkim, India

**Iutran Passah**
B.Sc Horticulture, Central Agricultural University Imphal, College of Horticulture, Bermiok, Sikkim, India

**Satish Kumar Gaharwariya**
B.Tech Student, IGKV, Raipur, Chhattisgarh, India

**Corresponding Author:**
**Jhalaknath Sharma**
B.Tech. Student, Central Agricultural University Imphal, College of Agricultural Engineering and Post Harvest Technology (CAEPHT), Ranipool, Sikkim, India

# Impact of refrigerated storage on the physicochemical and sensory properties of soy paneer (TOFU)

**Jhalaknath Sharma, Adarsh Kumar, Avinash Kumar, B Ravi Prakash, Jemson Loktongbam, Abhimanyu Gupta, Parambir Naik, Iutran Passah and Satish Kumar Gaharwariya**

**DOI:** https://www.doi.org/10.33545/26174693.2025.v9.i4i.4188

## Abstract
Soy paneer, commonly known as tofu, is a popular plant-based protein source, derived from soybeans. This study aimed to evaluate the physicochemical properties and sensory attributes of soy paneer produced using a standard procedure. The soybeans were processed to extract soy milk, which was coagulated using citric acid to obtain tofu. Various physicochemical parameters such as pH, fat content, acidity, and Solid Not Fat (SNF) were analyzed, revealing that the tofu had a pH of 5.25, fat content of 5%, and SNF content consistent with standard tofu preparation practices. The sensory evaluation, conducted using a 9-point hedonic scale, revealed average scores of 6 for colour, texture, and overall acceptability of the raw paneer, with cooked paneer showing improved sensory scores, particularly in taste (7.5) and texture (7). A five-day storage study under refrigeration indicated that while sensory properties were maintained for up to 3 days, the tofu exhibited undesirable odour after 5 days, indicating a decline in quality and unfit for consumption beyond this period. The findings suggest that soy paneer (tofu) is a nutritious and acceptable alternative to dairy paneer, with satisfactory sensory attributes and reasonable shelf stability when properly stored.

**Keywords:** Soy Paneer, Tofu, sensory profiling, solid not fat (SNF), Fat content, acidity and pH

## Introduction
Soy Paneer, also known as "Tofu," is a soft cheese made by curdling soy milk. With its subtle flavor, it can be used in both savory and sweet dishes. Due to its spongy texture, it absorbs seasonings and marinades well, making it a versatile ingredient (Dahlquist, 2013) [5]. Tofu is considered a healthier alternative to traditional paneer, as it is lower in calories and contains higher iron content. While 100 grams of paneer contains around 260 calories, the same amount of Soy Paneer provides only 60-65 calories, making it an ideal choice for calorie-conscious individuals. In addition to being low in calories, Soy Paneer offers a high protein content, with 13.80 grams per 100 grams (Singh *et al.,* 2016) [6]. It is a great plant-based protein source, making it an excellent option for vegetarians and vegans. The product is also free from sugar and cholesterol, with 0.00 grams of each, making it suitable for individuals with dietary restrictions. Furthermore, it contains dietary fiber (2.30 g) and a significant amount of calcium (310 mg), which supports bone health (Vijayalakshmi & Vaidehi, 1982) [7].
Soy Paneer is rich in several essential nutrients, including magnesium (58 mg), iron (10 mg), and potassium (237 mg), which contribute to muscle function, red blood cell formation, and maintaining fluid balance (Campbell *et al*., 2004) [4]. Its low fat content, with only 5.00 grams of fat (including healthy polyunsaturated fats), further enhances its appeal as a nutritious, heart-healthy food option. These attributes make Soy Paneer a valuable addition to a balanced diet, providing a versatile, nutrient-rich alternative to traditional dairy products (Chauhan *et al*., 1998) [3]
This study aims to explore the physicochemical properties (such as fat content, protein composition, Solid Not Fat (SNF), pH, and acidity) of soy paneer, as well as evaluate its sensory characteristics, including texture, flavor, color, and overall acceptability. Understanding these parameters is crucial for optimizing the production process and enhancing the quality of soy paneer, ultimately ensuring it meets consumer preferences and

standards. By providing a detailed analysis of these aspects, this research contributes valuable insights into the development and commercialization of soy paneer as a sustainable and nutritious food product (Maurya *et al*., 2018) [8].

## Materials and Methods

The study on the Impact of Refrigerated Storage on the Physicochemical and Sensory Properties of Soy Paneer (Tofu) was conducted in 2022 at the Department of Processing and Food Engineering, College of Agricultural Engineering and Post-Harvest Technology, Ranipool, East Sikkim. Fully matured soybeans were purchased from the local market in Ranipool. The soybeans were thoroughly washed with clean water to remove dirt and impurities before processing. The detailed procedure for preparing Soy Paneer is outlined below:

### Preparation of Soy Milk

**Soaking:** 2.5 to 3 kg of clean soybeans were soaked in normal water overnight.

**Steam Generation:** Water was filled in the steam generation unit through the inlet valve, keeping the air vent open. Once the water reached the desired level, it began to overflow from the air vent.

**Sterilization:** Flame was supplied to the steam generation unit to produce steam, while keeping the grinder-cum-cooker inlet valve open. Once steam pressure reached 15 to 20 psi, sterilization was done by closing the air vent and safety valve of the hopper for 2-3 minutes, followed by flushing the water through the air vent.

**Grinding and Cooking:** After sterilization, the soaked soybeans were fed into the grinder-cum-cooker. Clean water (in the ratio of 5:1 with soybeans) was slowly added, and the machine was run for 20-30 minutes at temperatures ranging from 90 °C to 100 °C. The temperature was increased to 110 °C, or until the soy milk started overflowing from the air vent.

**Soy Milk Collection:** The soy-water solution was collected from the outlet of the grinder-cum-cooker, and suspended particles (okra) were separated using a soy milk filtration unit.

### Preparation of Soy Paneer (Tofu)

**Filtration:** The hot soy milk was filtered through a clean white cloth (muslin cloth) to remove any remaining solids.

**Coagulation:** Food-grade citric acid (0.2% or 2g per liter of milk) was added by mixing it in 30 ml of soy milk. After 5 minutes, the soy milk coagulated.

**Pressing:** The coagulated soy milk was transferred to a paneer pressing device and left for 15-20 minutes to form the desired texture.

**Cooling:** Once the desired product was achieved, it was placed in chilled water and kept in the freezer for 30 minutes to firm up.

### Equipment Specifications

- **Grinder-Cum-Cooker:** A steam-powered device capable of grinding and cooking soybeans. It was equipped with an inlet valve to allow controlled steam flow as shown in Plate 1.
- **Soy Milk Filtration Unit:** A manual or automatic filtration system consisting of a fine mesh or cloth for separating the soy milk from solid particles.
- **Paneer Pressing Device:** A traditional or hydraulic pressing device used to remove excess whey from the coagulated soy milk, forming a compact block of soy paneer.

**Plate 1:** Soya grinder cum cooker machine

### Sensory Evaluation of Soy Paneer (Tofu)

The sensory evaluation of the soy paneer was conducted by a trained panel of evaluators. The panel members were selected based on their familiarity with tofu or paneer products and their ability to discern subtle differences in texture, flavor, and overall quality. A group of 10-15 trained panelists was selected for the sensory evaluation. The panel consisted of individuals with prior experience in evaluating food products based on sensory attributes. Panelists were trained to recognize and rate sensory attributes such as appearance, flavor, texture, and overall acceptability. The soy paneer samples were served in identical portions and were kept at room temperature prior to evaluation to avoid any temperature bias.

### Chemical Analysis

#### pH

The sample was determined using a pH meter (Unilab, RH-135M), an electronic instrument designed to measure the hydrogen-ion concentration, indicating the acidity or alkalinity of a solution. To ensure accuracy, the pH meter's glass electrode was calibrated using buffer solutions with pH values of 4, 7, and 10. Once calibration was complete, the electrode was immersed in 15-20 ml of the sample solution to obtain the pH reading.

### Solid Not Fat (SNF) Analysis

The Solid Not Fat (SNF) content of tofu was determined by first weighing a known amount of sample. The tofu was then dried to constant weight in an oven at 105°C for 24 hours to remove moisture. The dried sample was weighed again, and the SNF content was calculated by subtracting the moisture content from the total weight of the sample. The SNF was expressed as a percentage of the original weight (Asminaya *et al*., 2017) [1].

### Fat
The fat content of tofu was analyzed using the Soxhlet extraction method. A known weight of the tofu sample was first dried to remove any moisture. The dried sample was then placed in a thimble and subjected to solvent extraction using petroleum ether in a Soxhlet apparatus. The solvent was allowed to circulate through the sample for a predetermined number of cycles, extracting the fat. After the extraction was complete, the solvent was evaporated, and the remaining fat was weighed. The fat content was then calculated as a percentage of the sample initial weight (Asminaya *et al*., 2017) [1].

### Acidity determination
The acidity of tofu was determined by titration with a standard sodium hydroxide (NaOH) solution. A known volume of tofu sample was diluted with distilled water and mixed thoroughly. The pH of the solution was adjusted to a neutral range (around pH 7), after which a few drops of phenolphthalein indicator were added. The sample was titrated with NaOH until a permanent pink color appeared, indicating the endpoint. The acidity, expressed as the percentage of lactic acid, was calculated from the volume of titrant used (Arief *et al*., 2020) [2].

### Statistical Analysis
Data Analysis: The data obtained from the sensory evaluation were analyzed using descriptive statistics (mean scores) for each attribute were analyzed using Analysis of Variance (ANOVA) to determine significant differences.

### Storage study:
The storage study was conducted for 5 days under refrigeration, both before and after cooking, to evaluate various parameters and perform sensory assessments.

## Results and Discussion

**Table 1:** Physicochemical Properties of Soy Paneer

| Parameter | Result |
|---|---|
| Solid Not Fat (SNF) | 8.10% |
| Fat (%) | 5.00% |
| pH | 5.25 |
| Acidity | 0.18% |
| Protein | 13.80 g/100 g |
| Carbohydrate | 4.20 g/100 g |
| Colour | Yellowish White |
| Texture | Coarse |
| Smell | Soy Smell |
| Taste | Bean |

The physicochemical properties of soy paneer Table 1. highlight its nutritional and quality attributes. With a Solid Not Fat (SNF) content of 8.10% and fat content of 5.00%, soy paneer is a nutrient-dense, low-fat alternative to traditional paneer, making it suitable for health-conscious consumers. The pH value of 5.25 and acidity level of 0.18% ensure optimal texture, flavor, and shelf stability. Its high protein content (13.80 g/100 g) emphasizes its role as an excellent plant-based protein source, while the low carbohydrate (4.20 g/100 g) and dietary fiber content (2.30 g/100 g) add to its suitability for low-calorie and high-fiber diets. These characteristics make soy paneer a functional food with significant nutritional benefits, particularly for vegetarians, vegans, and individuals seeking healthier alternatives to dairy products.

**Table 2**: Sensory Evaluation Results of Soy Paneer

| Sensory attribute | Average score of raw paneer | Average score of cooked paneer |
|---|---|---|
| Colour and Appearance | 6 | 8 |
| Flavour/Taste | 6 | 7.5 |
| Texture/Mouthfeel | 5 | 7 |
| Texture/Consistency | 6 | 7 |
| Smell/Odour | 6 | 6.5 |
| After Taste | 5 | 6 |
| Overall Acceptability | 6 | 7.5 |

The sensory evaluation of soy paneer from Table 2. we can see that a notable improvement in attributes when transitioning from raw to cooked form. The colour and appearance score increased from 6 to 8, reflecting enhanced visual appeal after cooking. Similarly, the flavour/taste improved significantly from 6 to 7.5, indicating better palatability and taste development post-cooking. The texture/mouthfeel and texture/consistency both increased from 5 and 6 to 7, respectively, suggesting an improved structural integrity and sensory satisfaction. The smell/odour showed a slight enhancement from 6 to 6.5, while the after taste increased from 5 to 6, pointing to a more pleasing finish after consumption. Overall, the acceptability rose from 6 to 7.5, highlighting the superior sensory profile of cooked soy paneer compared to its raw counterpart. This data underscores the importance of cooking in enhancing the sensory appeal of soy paneer, making it more desirable to consumers.

### Storage Study of Soy Paneer
The storage study was conducted over five days at refrigerated conditions (4 °C) to evaluate the physicochemical and sensory changes in soy paneer. The samples were stored in airtight containers to prevent contamination. Observations were recorded daily for key quality parameters.

**Table 3:** Storage Study of Soy Paneer

| Day | pH | Moisture (%) | Acidity (%) | Fat (%) | Overall acceptability (Cooked) | Overall acceptability (Raw) |
|---|---|---|---|---|---|---|
| Day 0 | 5.25 | 70.5 | 0.10 | 5.0 | 7.5 | 6 |
| Day 1 | 5.22 | 70.3 | 0.11 | 5.0 | 7.4 | 5.5 |
| Day 2 | 5.18 | 70.0 | 0.12 | 4.9 | 7.2 | 5 |
| Day 3 | 5.15 | 69.8 | 0.14 | 4.8 | 6.8 | 4.5 |
| Day 4 | 5.10 | 69.5 | 0.16 | 4.7 | 6.5 | 4 |
| Day 5 | 5.05 | 69.2 | 0.18 | 4.6 | 6.2 | 4 |

After a 5-day storage period, the soy paneer exhibited noticeable changes in its physicochemical and sensory properties. The pH gradually decreased from 5.25 on Day 0 to 5.05 on Day 5, while the moisture content remained relatively stable, showing a slight decline. Acidity increased slightly over the storage period, and the fat content showed a gradual decrease. Sensory evaluation scores also declined over the 5 days. Initially, the product was fresh and acceptable with an overall sensory score of 7.5 on Day 0. However, by Day 5, the product's sensory attributes, particularly the smell, deteriorated significantly. The smell became unpleasant, and the overall acceptability dropped to

6.2, indicating that the soy paneer was no longer fit for consumption.

## Conclusion
The study on the physicochemical and sensory profiling of soy paneer (tofu) demonstrated that the product possesses valuable nutritional properties, including a good protein content, carbohydrate. The physicochemical analysis showed that the soy paneer maintained relatively stable moisture content and fat percentage during the storage period. However, sensory evaluation revealed a decline in overall quality over the course of 5 days, particularly in terms of flavor, texture, and smell. The product's pH and acidity levels also changed, with a decrease in pH and a slight increase in acidity. Notably, after 5 days, the unpleasant smell made the soy paneer unfit for consumption. These findings highlight the need for appropriate storage conditions to maintain the sensory and nutritional quality of soy paneer for extended periods. Further research could explore alternative preservation methods to prolong the shelf life and improve the stability of this plant-based product.

## References
1. Asminaya NS, Purwanto BP, Ridwan WA, Atabany A. Milk yield and nutrient adequacy of lactating dairy cow fed based on tofu waste, soybean hulls and straw. International Journal of Science and Research. 2017;6:951-956.
2. Arief A, Rusdimansyah R, Sowmen S, Pazla R, Rizqan R. Milk production and quality of Etawa crossbreed dairy goat that given Tithonia diversifolia, corn waste and concentrate based palm kernel cake. Biodiversitas Journal of Biological Diversity. 2020;21(9):4217-4222.
3. Chauhan GS, Singh JD, Tomar NS. Nutritional changes in soymilk subjected to different physical and chemical treatments. Journal of Food Science. 1998;63(6):1084-1088.
4. Campbell BL, Nelson RG, Ebel CE, Dozier WA, Adrian JL, Hockema BR. Fruit quality characteristics that affect consumer preferences for satsuma mandarins. HortScience. 2004;39(7):1664-1666.
5. Dahlquist E. Biomass as Energy Source: Resources, Systems and Applications. Boca Raton: CRC Press; 2013. p. 300-310.
6. Singh M, Verma DK, Kumar D. Techno-economic feasibility of soy-Tofu a health food in Indian context. Asian Journal of Dairy and Food Research. 2016;35(1):23-27.
7. Vijayalakshmi K, Vaidehi MP. Evaluation of tofu and its products prepared from soymilk and combination with sunflower seed milk and skim milk. Journal of Food Science and Technology. 1982;19:139-142.
8. Maurya SB, Shukla SS, Gour L. Nutritional quality of tofu (Soy paneer) as affecting by gamma irradiation during storage. International Journal of Chemical Studies. 2018;6(1):879-883.