Section: Research Paper

FORMULATION AND EVALUATION OF MIXED MILLET PANEER

Nithya Bala Sundari S*, Samrin M, Deepak D, Ramanji Reddy E, Menaha R, Harini S J, Chandara Meenu A, Sneka S

Bannari Amman Institute of Technology, Sathyamangalam, Erode, Tamil Nadu, India, 638401, Department of Food Technology.

***E-mail:** dr.nithi05@gmail.com, **Mobile:** 9566360985

ABSTRACT

A dairy product called mixed millet paneer is made with mixed millet milk as its main component. The goals of this study were to identify the components of paneer and investigate how the quality of paneer was impacted by mixing of millet milk and cow's milk in appropriate ratio. A, B, C, and D are four different compositions of mixed millet paneer, where the ratio of cow's milk to millet milk was 7:3, 5:3, 1:1, and 11:9. Formulation was performed by adjusting the proportion of millet milk and cow's milk. The formulations were all then subjected to sensory analysis. In order to determine the shelf life of the finished product, a microbial analysis of the best mixed millet paneer was done. Then Chemical analysis of the paneer sample was carried out. After all of this research, the best ($p < 0.05$) composition was determined to be blended millet milk at 62.5% and 37.5% respectively. In other compositions, the difference between millet milk and cow's milk had a substantial (p 0.05) impact on the final product's body, colour, taste, texture, and acceptance. The millet paneer was then tested for moisture, fat, protein (% N 6.25), ash content, pH, and acidity. According to the findings, the millet paneer has values of 56.68%, 1.57%, 19.04%, 0.06%, 52.83%, 0.52%, 0.39%, 0.05%, 6.82%, and 0.070%, compared to a control paneer of 55.97%, 18.98%, 19.93%,1.45%, respectively.

Keywords: Foxtail Millet, Pearl Millet, Paneer, Functional Foods

1. INTRODUCTION:

Popular South Asian cuisine item paneer resembles several kinds of soft, raw cheese. This kind of cheese does not ferment, it does not melt, it does not mature. One distinctive quality of paneer is that it contains both casein and the majority of the whey protein recovered during manufacture, whereas other cheeses lose the majority of the whey *(Khan et al., 2011).* All lipids, casein combined with denatured whey protein, and half of salt and lactose are used to create it through heat and acid coagulation. Only 6 days at 10°C were possible for paneer storage without substantial quality degradation, while the freshness is lost after 3 days. In order to extend the shelf life of paneer by inhibiting the development of microbes on its surface, initiatives have been made. The longevity of paneer may be extended by dipping it in a brine solution from 7 days to 20 days at 6- 8ºC *(Kanawjia and Khurana, 2006).* Milk fat plays a crucial part in the rising incidence of cardiovascular problems. Therefore, there is numerous interest in lowering the milk fat content of paneer. This necessitates the generation of paneer-like goods using low-fat millets like ragi, foxtail, and pearl millet, which, in

addition to being inexpensive, may be processed into a product with qualities that are extremely similar to the nutritional and textural characteristics of paneer. *(Mathare et al., 2009).* Millets are high in vitamins and minerals and include 60–70% carbs, 7–11% proteins, 1.5–5% fat, and 2–7% crude fibre. They are a great source of antioxidants, magnesium, and vitamin B. Other dietary minerals including manganese, phosphorus, and iron are also abundant in millet.

MATERIALS AND METHODS

2.1 Materials

The materials collected for the formulation of mixed millet paneer were as follows: Fresh cow milk (fat = 3.8% and SNF = 8.7%) and millet such as Ragi, Pearl millet, fox tail millet was obtained from the local market of Coimbatore.

2.2 Characterization of millet mil**k**

The method outlined by Ghadivel et al. (2007) and Yadav et al. (2011) was used to characterise the millet milk under standard circumstances, including Proximate Analysis, Moisture Analysis, and pH. Proximate analysis provides very informative results, particularly from the nutritional and biochemical points of views. Both millet milk and regular milk had their proximate characteristics, such as mineral content, protein content, crude fibre content, and carbohydrate content, examined.

2.3. Extraction of millet milk

The whole Millets (Ragi, pearl millet, foxtail millet) (100g, 200g, 100g) were soaked in water for 6 hours. Millets that had been wet were cleaned with distilled water. This was done at least three times. Then it was crushed and extraction of mixed millet milk is completed. Milk was filtered using a muslin cloth. To make mixed millet milk, the residue was again ground and filtered.

2.4 Preparation of Mixed Millet Paneer

The standard paneer from cow milk (3%) was prepared as per methodology of Sanyal and Yadav (2000). Four distinct preparations of the mixed millet paneer are displayed in table 1. Variously prepared milk was heated for five minutes at 80–85°C prior to cooling to 70°C. It was coagulated by gently adding acetic acid (3% solution) to the milk while stirring continuously. Following milk coagulation, coagulum (curd) is produced, and clear whey is separated. After 10 minutes of mixture resting, the whey was drained from the mixture using a muslin cloth. The curd was then gathered and put into a hoop (10 x 10 x 5 cm) that was lined with a sturdy, clean muslin fabric. The hoop featured an open top and bottom and a rectangular frame. The frame was then placed on a wooden plank, filled with the curd, and covered with another plank. A weight of 250g was then placed on top of the hoop for 15 to 20 minutes. The crushed block of curd is taken out of the hoop, divided into six to eight pieces, and submerged in cold water (4-6oC) for two to three hours. The cold paneer chunks are then taken out and left on a wooden board for 10 to 15 minutes to allow any trapped water to drain. Then, these pieces were covered with parchment paper and stored at a low temperature (4–1°C).

Table 1: Sample Formulations

Samples	Cow milk(ml)	Ragi milk (ml)	Pearl millet milk(ml)	Foxtail millet milk(ml)
A	70	10	10	10
B	125	25	25	25
C	100	33	33	33
D	110	30	30	30

2.5 Characterization of mixed millet paneer

2.5.1 Proximate analysis

The fat, acidity, protein, and total solids of the cow milk and mixed millet milk were examined. Additionally, SNF for cow milk was established. The moisture, fat, protein, total solids, acidity, and ash contents of the finished mixed millet paneer were tested.

2.5.2 Color and Texture analysis

Using a Hunter Lab colour spectrophotometer (Ultra scan VIS, Hunter Lab, Reston, Virginia, USA) and the hunter colour scale, the colour index of the mixed millet paneer was ascertained. The chromaticity parameters [a* (red-green)] and [b* (blue/yellow-blue)] as well as the brightness [L* 0 (black)-100 (white)] were measured. The figures with white tile serving as the control (L* = 98.76, a* = 0.04, b* = 2.01) in temperature of 25 °C in reflectance mode. All of the samples were placed in the sample container, and the reflectance was automatically calculated.

Using a TA. XT plus Texture Analyzer (Stable Microsystems, Godalming, Surrey GU7 1 YL, UK), the specimen's and the standard's texture characteristics were studied. A 36 mm cylinder radius probe was applied to evaluate the force applied to the sample's center and its hardness.

2.5.3 Microbiological study

Total plate count, number of yeast and mould, Staphylococcus, and coliform count of paneer samples was computed using the accepted techniques recommended by APHA, 1992,et.al. Samples were inoculated in duplicate plates of suitable media and incubated at the recommended temperature. Following the completion of incubation period, the total quantity of colonies on the plates was counted.

Table 2 Media and incubation condition for microbial examination

Method	Medium	Incubation
Total plate count	Plate count agar	37ºC for 24-48 h
Yeast and mold count	Potato dextrose agar	22ºC for 72 h

2.6 Sensory analysis

For the sensory assessment, a panel of 10 people was chosen. Panelists composed of faculty members and students were given samples of blended mixed millet paneer. The

panelists were asked to judge the samples for color, taste, flavor and overall acceptability using a 9-point hedonic scale rating.

2.7 Statistical analysis

In order to assess the probability that the differences were statistically significant at the 5% level of relevance, the data were statistically analyzed using the analysis of variance technique (ANOVA).

3 RESULTS AND DISCUSSIONS

3.1 Characterization of millet milk

The outcome demonstrated in Table 3 revealed that millet milk had a higher moisture content than regular cow milk and significantly enhanced textural characters of paneer, the protein content of millet milk was almost five-fold higher than standard cow milk that enhanced paneer production. The fat content of millet milk was comparatively lower than to cow milk which makes millet paneer as diet food. The finished result is quite healthy since millet milk has a little higher crude fiber content than regular cow milk. A similar result for millet milk was reported by *Ghadivel et al. (2007), Yadav et al. (2011)* and for standard cow milk was reported by *Posati and Orr (1976) and Han et al. (2012)*.

Table 3 Proximate analysis of millet milk and cow milk

Sample (100 ml)	**Moisture (%)**	**Ash (%)**	**Protein (%)**	**Fat (%)**	**Crude Fiber (%)**	**Carbohydrate (%)**
Mixed Millet Milk	90.96±0.15	0.35±0.16	8.5±0.16	0.74±0.15	0.9±0.15	7.8±0.15
Cow Milk	87.1±1.89	0.7±0.3	3.3±0.2	3.8±0.15	0.73±0.3	5.1±1.42

Mean ± Standard Deviation (SD) values of triplicates. All the obtained data were subjected to univariate with Duncan's multiple range test.

3.2 Mixed Millet Paneer

The characterization of three millet mixed milk (Ragi, Foxtail millet, Pearl millet) was shown in Table 3 highlighted the substantial protein level of this three-milk mixture in comparison to regular cow's milk. So, using this three-millet composition, paneer had been produced using four distinct formulations (A, B, C, and D), as shown in Table 1. Based on overall acceptance in sensory analysis of these four samples, sample B was preferred for further analysis.

3.3 Proximate analysis of mixed millet paneer

Sensory optimized paneer sample B and control sample was subjected to chemical analysis and the data obtained are as shown in Table 4. The addition of mixed millet milk was shown to have improved the protein content of sample B (52.83%) relative to conventional paneer (19.93%).Additionally, a modest rise in moisture and fat content was discovered. Due to the millet component, it was discovered that the mixed millet paneer was a little acidic than the control sample. Due to the inclusion of millet milk, mixed millet paneer has a bit higher moisture content than cow milk paneer. The mixed millet paneer sample proves to have a lower total ash concentration than the control sample, which is within allowable limits. The findings concurred with those made by Shivakumar et al. (2014).

Table 4 Proximate analysis of Mixed Millet Paneer (Sample B) and Standard Paneer

Sample	**Moisture (%)**	**Ash (%)**	**Protein (%)**	**Fat (%)**	**pH**	**Acidity (%)**
Mixed Millet Paneer	56.68±1.57	0.39±0.05	52.83±0.52	19.04±0.06	6.82	6.52
Standard Paneer	55.97±1.43	1.45 ±0.05	19.93±0.34	18.98 ±0.03	0.507 ±0.01	0.41±0.005

3.4 Color and Texture Analysis:

Color value for mixed millet paneer with a sensorily accepted formulation (5:3) and standard paneer was given in the Table 5. When contrasted with standard paneer, mixed millet paneer has a quite distinct color value, this is because of the phenolic compound present in millet, especially finger millet. there is an increase in Δa* and Δb* value compared to the standard paneer, paneer has slight yellowish red color

The texture analysis value for mixed millet paneer sample with formulation 5:3 and standard paneer sample was given in the below Fig 1. Blending of cow milk: mixed millet milk in the ratio (5:3) was known to be optimum because it gives ideal smooth viscous texture and consistency to the paneer. *A. Jha et al. (2011)* reported on aroma-sweetness interactions on dairy desserts that were reorganized as soft in texture. According to D. Wadikar et al. (2007), resistant starch is responsible finger millet-based goods their improved body and consistency. Mixed millet paneer is identified to be softer than the standard cow milk paneer.

Table 5 Color analysis of Mixed Millet Paneer (Sample B) and Standard Paneer

Sample	**ΔL***	**Δa***	**Δb***
Mixed Millet Paneer	58.34	3.21	13.51
Standard Paneer	87.55	1.35	8.36

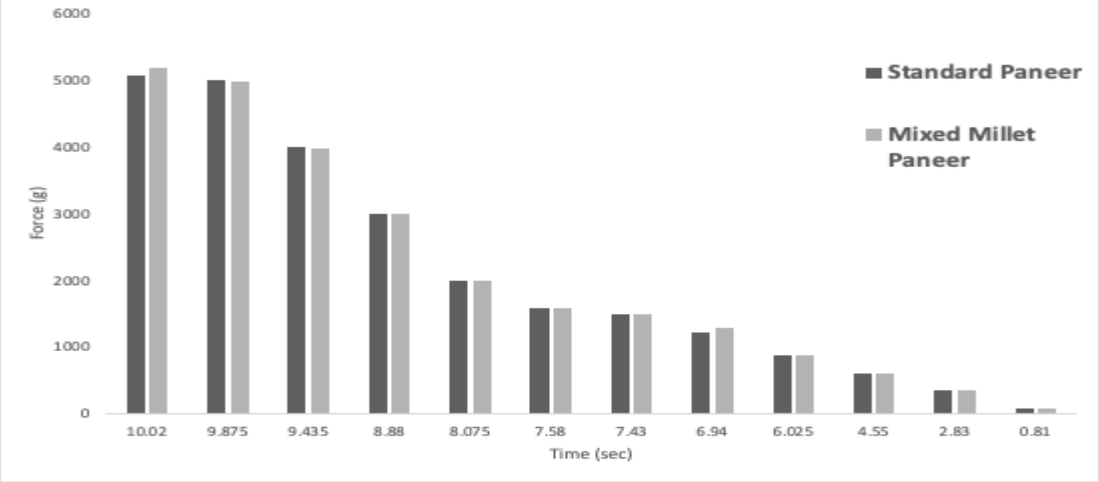

Fig 1: *Texture chart for standard Paneer and Mixed Millet Paneer. Mean ± Standard Deviation (SD) values of triplicates.*

3.5 Microbiological analysis

The milk's biological quality, the way paneer is made, how it is packaged, and how it is stored all affect the paneer's microbial quality. Aggarwal and Srinivasan et al. (1980) found that raw milk can become contaminated by people handling the product because it contains organisms such coliforms, yeasts, moulds, and other microbes from sources like air, water, equipment, and muslin fabric. According to Thakral et al. (1986), these bacteria can alter the product's lipolytic and proteolytic composition, induce discoloration, and produce other flaws. During storage at 5±1ºC., the total plate count (TPC), mould and yeast counts, and coliform counts of sensory optimized paneer sample B with formulation 5:3 and the standard paneer sample were measured.

Aseptic conditions were used to prepare the samples for microbiological examination. For macerating the sample, a sterile pestle and mortar were used. A sterile 100 ml glass beaker was used to weigh about 11 grams of paneer, which was then transferred aseptically to the sterilized mortar using a sterile stainless-steel spatula. The material was then extensively macerated by forming a paste with a little amount of previously warmed (45 ºC) 99 ml of 2% sterile diluents and transferring the contents to the same conical flask to obtain initial dilution (1: 10). The guidelines required that 9 ml of citrate buffer from the initial dilution be used to create further dilutions. The dilutions were immediately employed for plating.

Table 6. CFU/ml of bacterial colonies using Nutrient Agar (NA) and Potato Dextrose Agar (PDA)

Sample	**Dilution Factor**	**Nutrient Agar**		**PDA**	
		No.of colonies	**CFU/ml**	**No.of colonies**	**CFU/ml**
Mixed millet paneer	$_{10}-4$	670	6700000	529	529000
Standard paneer	$_{10}-4$	151	1510000000	230	23000000

3.6 Sensory analysis

Sensory analysis of mixed millet paneer samples with four different formulations (7:3,5:3,1:1,11:9) was performed with the aid of ten semi- trained panelists evaluating color, flavor, body, texture and overall acceptance of prepared mixed millet paneer. The sensory score with different attributes for the four different samples was given in Fig 2. Among the four different sample, sample B with formulation ratio 5:3 resulted in overall acceptance was chosen for further analysis.

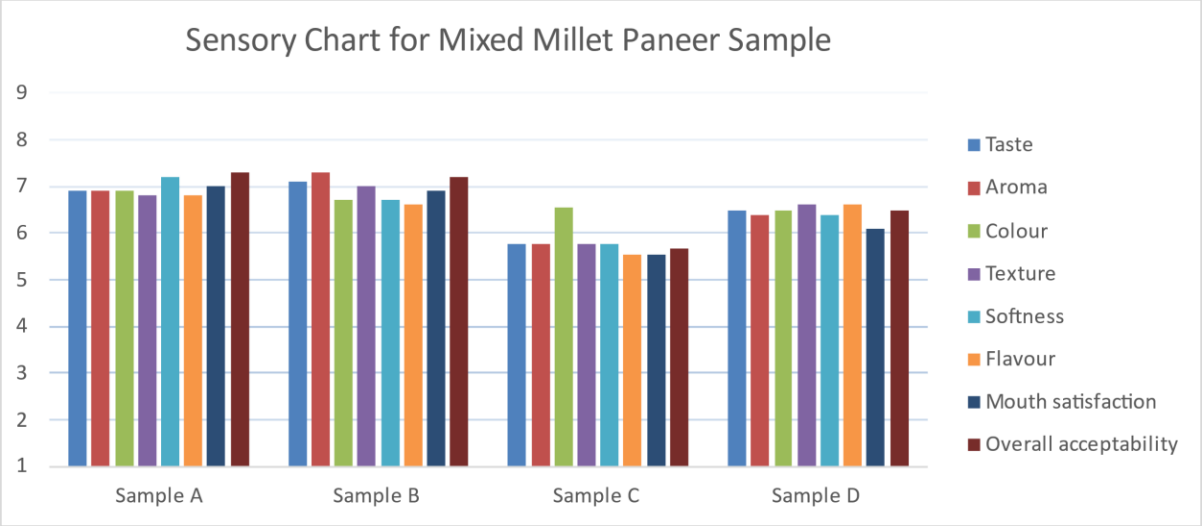

Fig. 2 *Mean sensory score for four different mixed millet paneer samples with different formulation ratio. Sample A (7:3), Sample B (5:3), Sample C (1:1), Sample D (11:9)*

4. CONCLUSION:

The outcomes of the current research indicate that use of mixed millet milk along with cow milk improves the nutritional quality when compared to standard milk paneer. When compared to commercially available milk paneer, including mixed millet results in a threefold increase in protein content. Millet milk mixed with cow and buffalo milk will be blended. Lower the product's cost while improving its nutritional qualities Milk from mixed millet (ragi, pearl millet, and foxtail millet) is high in vitamin C and iron, which will help to complement the cow's diet. Due to its low vitamin C and iron levels, buffalo milk is not recommended. The product can be kept frozen (below –18oC) for a long time. Without any decrease in quality for more than a year. Including foxtail millet, finger millet, and pearl millet will increase your intake of dietary fibre, proteins, energy, antioxidants, minerals, and addition to that paneer the food is improved by dietary fibre, proteins, energy, minerals, vitamins, and antioxidants that are crucial for human health. In light of the continual Consumer awareness of functional and healthful diets, alongside as technology for cereal-based foods. Products provide options to meet customer acceptance requirements.

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