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The Nutritional Analysis, Sensory Evaluation, Physico-Chemical Changes depending on the Packaging Material, and Bactericidal Potential of Camel Milk Peda

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Abstract: ***This research paper investigates the microbiological changes in camel milk peda during storage and the impact of different packaging techniques on its quality and safety. Initial total viable counts and the presence of yeast and mould in fresh camel milk peda samples are assessed, and their evolution during storage is monitored. The study reveals that the choice of packaging technique significantly influences bacterial growth, with vacuum packaging being the most effective in retarding microbial proliferation. However, mould growth remains a challenge in dairy products like peda, limiting their shelf life and quality. The findings underscore the importance of appropriate packaging methods and storage conditions in extending the shelf life and ensuring the microbiological safety of dairy-based sweets. This research contributes valuable insights into the preservation of dairy products and emphasizes the variability of microbial behavior in different food products and storage conditions.***

Keywords: camel milk, peda, sensory evaluation, bactericidal potential, packaging material

1. Introduction

The Indian economy is predominantly agrarian, with a significant portion of the population residing in rural areas and relying on agriculture and related activities. Among these, the dairy sub-sector plays a vital role, contributing substantially to the Gross National Product (GNP). Despite its importance, investment in animal husbandry and dairying remains limited, emphasizing the need for further development in this sector. The National Dairy Development Board has played a crucial role in establishing cooperative societies across the country, contributing to consistent and sustainable growth (WHO).

Dairying has emerged as a significant branch of agriculture, offering numerous socio-economic benefits, including employment generation [1]. The history of dairy development in India reflects its recent growth, with government initiatives like Operation Flood driving the increase in milk production. India is now the world's largest producer of milk, largely due to the successful implementation of these programs [2].

Camel milk has garnered attention for its unique composition and potential health benefits, particularly its digestibility and nutrient profile [3]. It is known to have immune-boosting and anti-inflammatory properties. Despite its numerous advantages, more research is needed to fully understand its health benefits [4].

The proposed research aims to evaluate the sensory attributes of camel milk, its antimicrobial properties, and the preparation and nutritional analysis of camel milk peda. This study seeks to provide valuable insights into the sensory and nutritional aspects of camel milk products.

2. Materials and Methods

2.1 Collection of milk

Good quality pooled camel milk was obtained from the Experimental Dairy of the National Dairy Research Institute, Karnal (India). Milk was standardized to 5.9 g/100 g fat and 9.0 g/100 g milk solids-not-fat (MSNF). Milk was clarified before use to remove dirt and other extraneous matter.

2.2 Antimicrobial activity

The used bacterial clinical isolate, Staphylococcus aureus Bacteria (MRSA) strain and Enterohaemorrhagic strain of *E. coli* were kindly provided from the Department of microbiology, Kuvempu University. The bacterial culture of Staphylococcus aureus was grown in tryptic broth and incubated overnight. The bacterial culture was then centrifuged at 15,000 x g for 15 min and the pellet was re-suspended and washed with sterile phosphate buffer saline (PBS). The viable bacterial count was adjusted to approximately 2 X 109 colony forming units (CFU)/mL. *E. coli* (Enterohaemorrhagic) strain was grown in brain heart infusion broth (This broth is a general- purpose medium used for the isolation, cultivation, and maintenance of a variety of fastidious and non- fastidious microorganisms). When bacteria were in the log phase of growth, the suspension was centrifuged at 15,000 x g for 15 min, the supernatant was discarded, and the bacteria were re-suspended and diluted into sterile saline. The viable bacterial count was adjusted to approximately 5 X 1010 CFU/mL.

2.3 Evaluation of in vitro Synergistic Action of Camel Milk and Antibiotics

Standard well agar diffusion method was carried out to detect the antibacterial activity of camel milk and the synergistic action of camel milk and antibiotics againstPathogenic organisms (*S. aureus* and *E. coli*). Based on protocol stated by [5], pure cultures of organism were swabbed uniformly on the individual plates using sterile cotton swab. Wells of size 6 mm have been made in Muller–Hinton agar plates using gel puncture. Using micropipette, 100 µl of the camel milk were poured into wells on all plates. Antibiotic ciprofloxacin (5mcg) discs were placed on the well of camel milk and alone in Muller–Hinton a gar. After incubation at 37˚ C f or 24 h, the different levels of zone of inhibition were measured.

2.4 Preparation of Peda:

2.4.1. Ingredients:

- 2 cups camel milk
- 1 cup sugar
- 1/2 tsp cardamom powder
- 2 tbsp. ghee (clarified butter)
- 1/4 cup chopped nuts (cashews, almonds, pistachios)
- A pinch of saffron strands (optional)
- Edible silver foil (varak) for garnish (optional)

2.4.2 Hygiene Precautions

- **Wash Hands:** Begin by washing your hands thoroughly with soap and water. Use an apron to cover your clothes to prevent any contamination.
- **Clean Cooking Area:** Make sure your cooking area is clean and sanitized. Use a clean, dry, and non-porous cutting board and utensils. Wash and sanitize your kitchen equipment and countertops before starting.
- **Use Fresh Ingredients:** Ensure the camel milk is fresh and pasteurized. Check the expiration date of all ingredients.
- **Personal Hygiene:** Ensure you are in good health and avoid cooking if you have any contagious illnesses. Tie your hair back if it's long, and avoid touching your face or hair during cooking.

2.4.3 Instructions

1) In a heavy-bottomed pan, heat the ghee over low to medium heat. Once it melts, add the camel milk and bring it to a boil. Continue to stir to prevent the milk from sticking to the pan.
2) Once the milk comes to a boil, reduce the heat and let it simmer for about 45 minutes to 1 hour. Stir frequently to avoid sticking. The milk will thicken as it simmers.
3) When the milk has reduced to about half its original quantity and thickened considerably, add sugar and cardamom powder. Stir continuously until the mixture thickens and starts to leave the sides of the pan. This will take another 15-20 minutes.
4) Add the saffron strands if using and mix well.
5) Remove the mixture from heat and let it cool for a few minutes.
6) While it's still warm, take small portions of the mixture and roll them into pedha shapes. You can also flatten them slightly and garnish with chopped nuts.
7) Optionally, you can add edible silver foil (varak) on top of the pedhas for an elegant touch.
8) Allow the pedhas to cool completely before storing them in an airtight container.

And finally round peda forming (20 g each with an approximate 3 cm diameter) was done manually using palms. The proximate composition of the peda in terms of moisture (IS: 2785, 1964), fat (IS: SP (Part XI), 1981), protein (Meneffee & Overman, 1940), lactose, sucrose (IS: SP (Part XI), 1981) ash (AOAC, 1975) and free fat (Hall & Hedrick, 1971) is given in Table 1. For estimation of free fat, about 10 g of peda was accurately weighed into a 250 mL glass stoppered conical flask and to it was added 100 mL of petroleum ether (40-600C). The flask was shaken vertically 10 times, then allowed to settle for 15 min and then filtered through Whatman No. 42 filter paper into a previously weighed Mojonnier fat dish. The procedure was repeated twice for extraction. Ether was evaporated and the free fat (residue) was weighed. The results were expressed as g/100 g of total fat. About 500 g of the prepared peda were packed in two different packaging systems viz. vacuum packaging and modified atmosphere packaging (MAP). A 5-layer nylon (LLD/BA/Nylon-6/BA/LDPE) (thickness: 110 m; WVTR: 3.96 g/m2 -24 h; OTR:36 mL/m2-24 h) procured from M/s Jain Chemicals Ltd., Shivamogga (India) was used for MAP by flushing nitrogen and carbon dioxide gases both at 1 bar pressure for 3 s (P2) and vacuum packaging (M/s REEPACK SRI, Italy) under a vacuum of 37.33 k Pa for 7.5 s (P3) while peda packaged in cardboard boxes lined with butter paper was treated as control (P1). Prior to filling, the packaging materials were sterilized by exposing to ultraviolet (UV) light in a UV chamber for 30 min. All the three treated peda samples (P1, P2 and P3) were stored at 30±10C and analyzed at an interval of 10 days for 40 days. All the trials were carried out in triplicate.

Table 1

Proximate composition of the Peda.	
Component	Content (g/100 g)
Moisture	13.26 ± 0.23
Fat	16.15 ± 0.13
Protein	12.56 ± 0.11
Lactose	15.73 ± 0.23
Sucrose	39.42 ± 0.13
Ash	2.56 ± 0.26
Free fat (on total fat basis)	67.50 ± 1.28

Mean ±SD; n=3.

2.5 Sensory evaluation

Sensory evaluation of fresh and stored samples of peda was carried out by hedonic scale a panel of 2nd year students of Food technology department of Kuvempu University. And the Faculties of the same department. The panelists have not been trained for the present study but they are dairy professionals having adequate knowledge about the sensory evaluation methods and the product attributes. All the samples were evaluated for sensory attributes such as flavour, body and texture, colour and appearance overall acceptability using a 50-point score card developed for this

delicious sweet. Based on the overall perception of the samples, the overall acceptability scores of peda were given by the panelists. A minimum score of 65% of total score for each attribute i.e. 6.5 for flavour and body and texture, 3.3 for colour and appearance and 16 for overall acceptability was considered acceptable.

Figure 1: Evaluate Food Like a Professional with the 9-Point Hedonic Scale

2.6 Determination of moisture

Mojonnier method as described in Indian Standards for determination of moisture in hard cheese (IS: 2785, 1964) was used for peda with slight modifications. About 20 g of previously washed and dried sand was weighed into an aluminum dish, allowed to dry further in an oven at 1000C and weighed to the nearest of 1 mg constant weight. Five gram of peda was transferred into the dish and 5 mL of distilled water was added to it. The contents were mixed thoroughly into a paste with the help of glass rod. The dishes were then transferred to thermostatically controlled water bath at 1000C±10C for 30 min and later transferred to a hot air oven maintained at 1000C±10C. Drying was continued till the solid mass of the dishes turned to be light and difference between the two successive weighing was not more than 1 mg. The results were expressed as percent moisture.

2.7 Titratable acidity and pH:

The titratable acidity in terms of percent lactic acid was determined following the method as described by AOAC for cheese (AOAC, 1975) which was adopted for misti dahi (caramel coloured sweetened set-type yoghurt) [6][7]. Two grams of sample was taken in a porcelain dish and mixed homogenously by adding 20 mL hot distilled water (650C). This was followed by addition of 10 mL of 0.1 mol eq/L sodium hydroxide and 1 mL of 0.5 g/100 mL phenolphthalein indicator. The mixture was titrated against 0.1 mol eq/L hydrochloric acid with continuous stirring till the pink colour disappeared completely. The pH of the fresh and stored samples was determined using a digital pH metre (Model: Lab India).

2.8 Water activity:

Water activity was measured using water activity metre "Aqua Lab" (Model Series 3 TE) supplied by Decagon Devices, WA, USA. Prior to the measurement the samples were tempered to 250C.

2.9 Microbiological analysis:

Microbiological analysis of peda samples during storage was examined for total viable count, yeast and mould counts and coliform count as per the standard methods described in Manual of Dairy Bacteriology (ICAR, 1982). The data on microbiological quality is presented in log10 values.

2.10 Nutritional analysis of peda:

The prepared peda was sent to IADFAC Laboratories Pvt. Ltd. Bangalore. To evaluate nutritional analysis like Carbohydrates, Proteins, Iron, Calcium, Potassium, Magnesium, Energy, Dietary fibers, Total fat, Phosphorous, Cholesterol, Monounsaturated fat, Polyunsaturated fat, Lactose and Total sugar. FSSAI and AOAC manual procedure was followed for the analysis.

3. Results

3.1 Antibacterial activity:

The antibacterial activity of camel milk was assayed in vitro by agar well diffusion method against *E. coli* and *S. aureus*.**Table.2** summarizes the maximum synergistic antibacterial activity of camel milk and ciprofloxacin (45 mm, 47 mm respectively) more than ciprofloxacin only (37 mm, 19 mm respectively).

Table 2: *In vitro* antimicrobial activity of camel milk:

	Zone of inhibition (mm)	
	Camel milk and Ciprofloxacin	Ciprofloxacin
E. coli	45	37
S. aureus	47	19

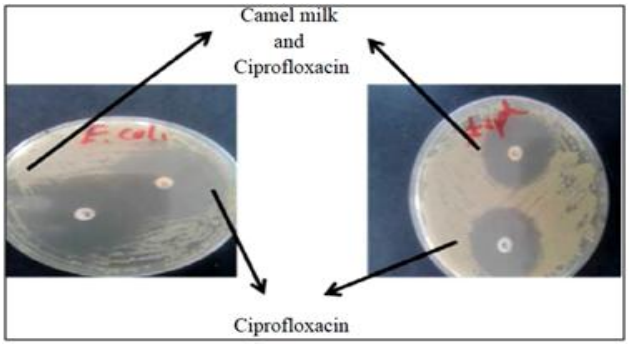

Figure 1: Culture of camel milk with or without ciprofloxacin together for bacterial strain *S. aureus* and *E. coli*

3.2 Preparation of peda:

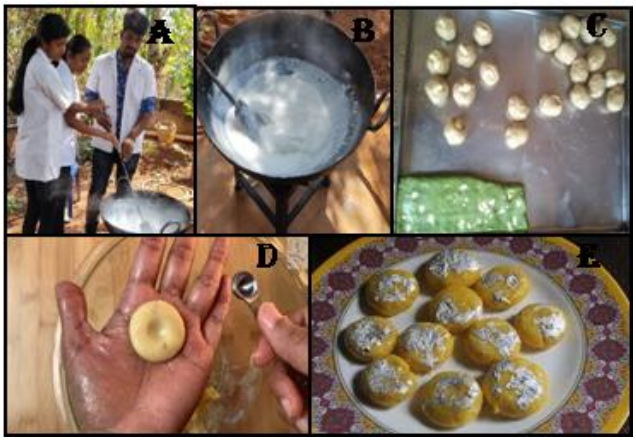

Figure 2: A - Preparation of peda by students, **B** - Boiling of camel milk, **C** &**D** - Giving shape for peda, **E** – Final product of peda from the milk of camel.

3.3 Sensory evaluation

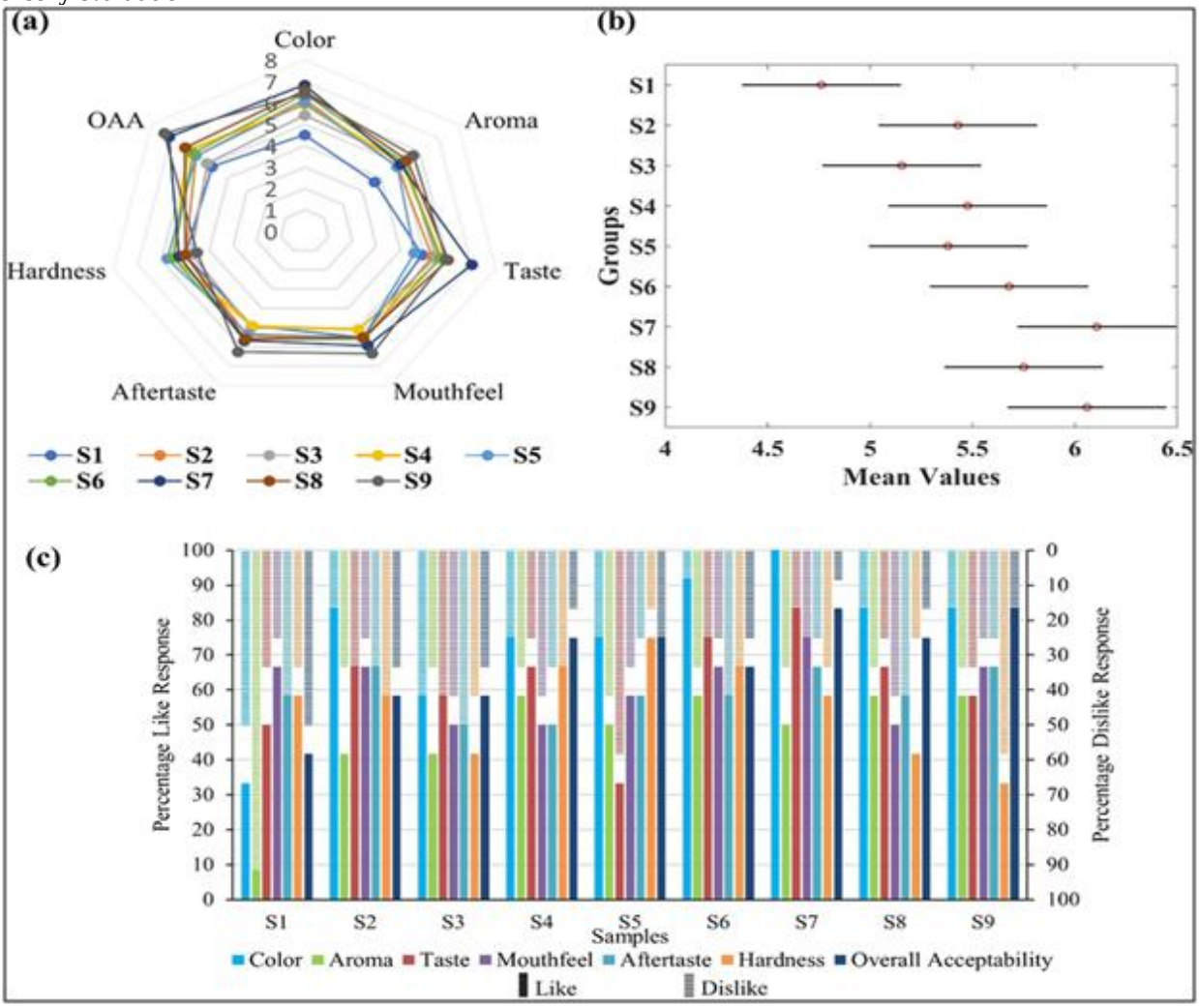

Figure 3: (a) Graph showing the 9-point Hedonic scale for sensory evaluation of peda. (b) Graph showing the mean value of the 9-point Hedonic scale for sensory evaluation of peda. (C) Graph the percentage of like/dislike response for sensory evaluation of peda.

Sensory evaluation of camel milk peda reveals highly positive attributes. The peda's color is appealing with rich, creamy tones, and its aroma evokes comfort and nostalgia. Testers express satisfaction with its smooth and creamy mouthfeel. The taste is well-balanced, allowing the unique camel milk flavor to shine, and the aftertaste is pleasant. The peda's hardness offers a satisfying bite. Overall acceptability is high due to its attractive appearance, enticing aroma, pleasing mouthfeel, balanced taste, pleasant aftertaste, and appropriate hardness. Camel milk peda is widely enjoyed, making it a promising dessert option. **Fig. 3 (a) (b) (c)**

3.4. Determination of moisture, Titratable acidity, pH and Water activity of peda:

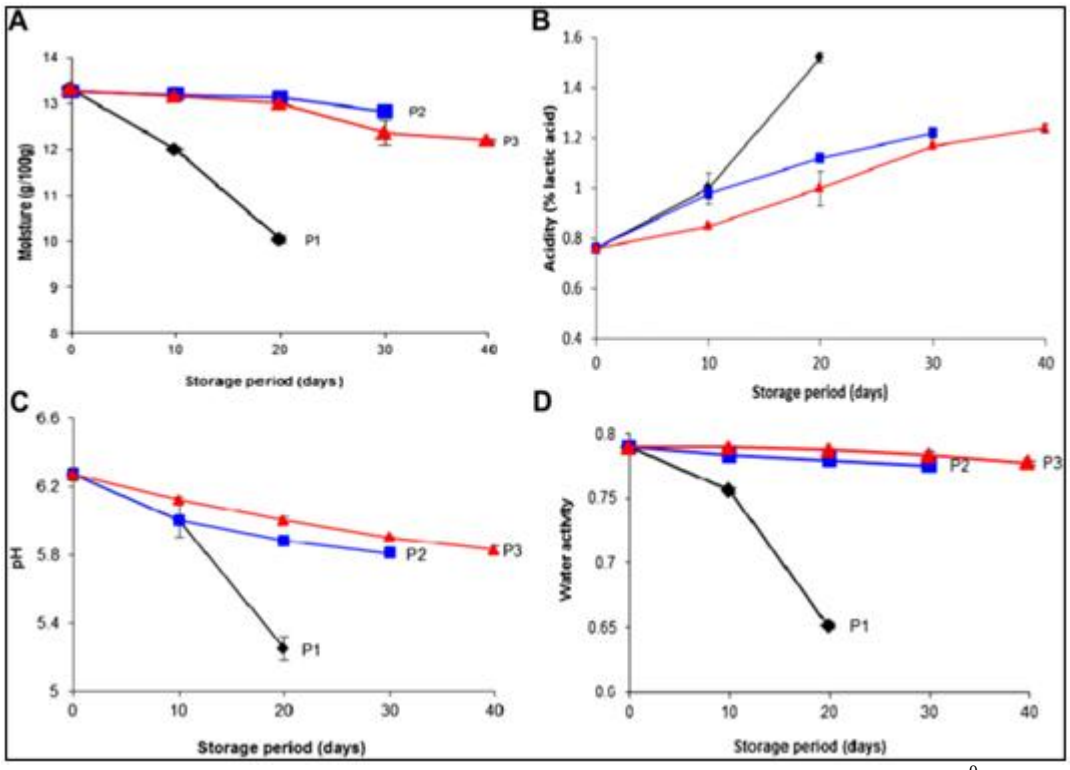

Figure 4: Effect of packaging techniques on physico-chemical attributes of peda during storage at 30^{0}C (A: Moisture; B: Acidity; C: pH; and D: Water activity) (♦=cardboard box lined with butter paper (P1); ■ modified atmosphere packaging in 5-layer nylon (P2); ▲ vacuum packaging in 5-layer nylon (P3)).

Fig. 4 illustrates the physico-chemical changes in peda during storage. Moisture loss during storage affects quality, bacterial activity, and more. Different packaging materials influence moisture loss. A decrease in moisture, pH, and water activity is observed, with the highest loss in cardboard packaging. Acidity increases during storage, especially in cardboard packaging. The results align with sensory changes, impacting body and texture scores. Changes in color (L*, a*, b*) are also noted, with varying trends in different packaging techniques. Cardboard-packaged peda becomes lighter, while vacuum-packaged peda becomes darker. Overall, packaging techniques significantly affect these attributes.

Table 2: Effect of packaging treatments on the instrumental colour and textural attributes of peda during storage at 30^{0}C

Parameter		Storage Interval				
		0	10	20	30	40
Colour parameters						
Lightness (L*)	P_1	45.54 ± 0.04	48.42 ± 0.08	50.01 ± 0.01		
	P_2	45.28 ± 0.03	45.72 ± 0.25	46.92 ± 0.05	48.31 ± 0.04	
	P_3	45.14 ± 0.03	44.40 ± 0.02	43.86 ± 0.06	43.54 ± 0.07	42.98 ± 0.16
Redness (a*)	P_1	14.02 ± 0.02	12.68 ± 0.02	10.57 ± 0.01		
	P_2	14.08 ± 0.08	13.88 ± 0.09	13.26 ± 0.11	12.29 ± 0.02	
	P_3	14.15 ± 0.04	14.00 ± 0.09	14.20 ± 0.10	14.64 ± 0.05	15.34 ± 0.04
Yellowness (b*)	P_1	30.84 ± 0.04	34.74 ± 0.06	35.17 ± 0.02		
	P_2	31.80 ± 0.02	31.56 ± 0.12	32.81 ± 0.09	34.20 ± 0.10	
	P_3	34.28 ± 0.03	34.09 ± 0.09	33.88 ± 0.09	33.60 ± 0.07	33.48 ± 0.08
Textural attributes						
Hardness (N)	P_1	86.14 ± 0.51	142.10 ± 0.45	203.67 ± 11.47		
	P_2	85.12 ± 0.87	83.98 ± 1.91	86.81 ± 0.27	95.66 ± 6.92	
	P_3	87.06 ± 0.08	86.81 ± 0.18	96.12 ± 1.24	107.92 ± 1.87	110.51 ± 0.09
Cohesiveness	P_1	0.153 ± 0.004	0.225 ± 0.014	0.256 ± 0.005		
	P_2	0.150 ± 0.002	0.149 ± 0.001	0.151 ± 0.002	0.155 ± 0.012	
	P_3	0.142 ± 0.003	0.140 ± 0.001	0.158 ± 0.005	0.167 ± 0.002	0.185 ± 0.005
Adhesiveness (N.m)	P_1	52.43 ± 1.12	44.09 ± 0.15	39.46 ± 0.40		
	P_2	50.72 ± 0.50	48.09 ± 0.30	51.43 ± 0.60	52.52 ± 7.98	
	P_3	57.19 ± 0.11	55.54 ± 0.05	60.57 ± 0.65	64.71 ± 1.74	71.26 ± 0.07
Springiness	P_1	0.162 ± 0.003	0.218 ± 0.007	0.233 ± 0.008		
	P_2	0.151 ± 0.003	0.155 ± 0.005	0.163 ± 0.003	0.178 ± 0.005	
	P_3	0.161 ± 0.002	0.167 ± 0.002	0.174 ± 0.003	0.180 ± 0.003	0.198 ± 0.002
Gumminess (N)	P_1	13.17 ± 0.41	32.03 ± 2.07	52.29 ± 4.06		
	P_2	12.58 ± 0.44	12.64 ± 0.31	13.15 ± 0.17	14.92 ± 2.20	
	P_3	12.56 ± 0.26	12.61 ± 0.19	15.10 ± 0.29	17.35 ± 1.02	20.51 ± 0.57
Chewiness (N)	P_1	2.13 ± 0.10	7.00 ± 0.64	12.23 ± 1.30		
	P_2	1.99 ± 0.26	1.60 ± 0.07	2.07 ± 0.07	2.64 ± 0.47	
	P_3	2.15 ± 0.08	2.18 ± 0.02	2.57 ± 0.20	3.23 ± 0.12	4.41 ± 0.16

Mean ± SD; n ¼ 3. **P1** ¼ cardboard box lined with butter paper; **P2** ¼ modified atmosphere packaging in 5-layer nylon; **P3** ¼ vacuum packaging in 5-layer nylon.

3.5 Microbiological changes in peda during storage:

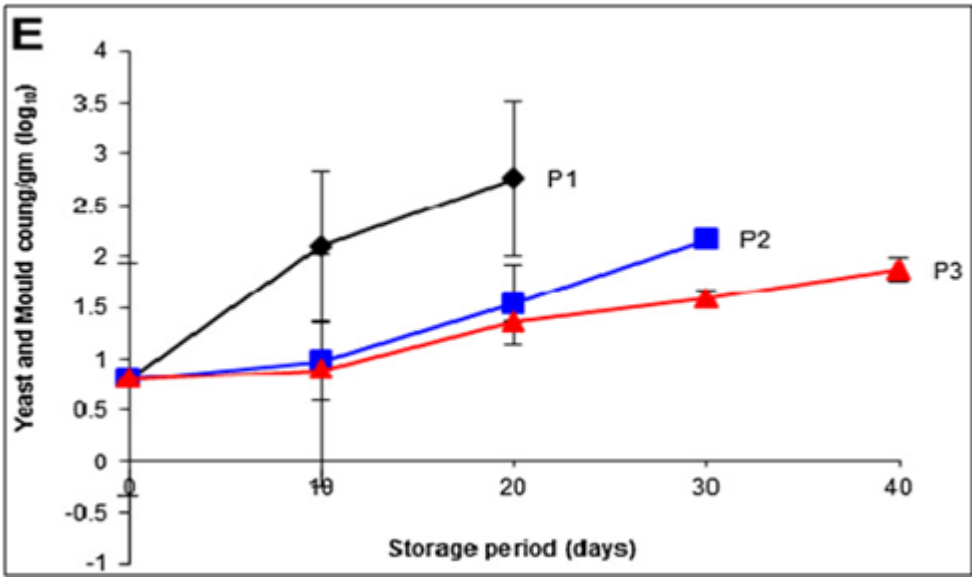

Figure 5: (♦=cardboard box lined with butter paper (P1); ■= modified atmosphere packaging in 5-layer nylon (P2); ▲= vacuum packaging in 5-layer nylon (P3))

The microbiological changes in peda packaged under different packaging conditions during storage are given in Fig. 5. Initial total viable count in all the samples ranged from 2.40 to 2.56 per gram ($\log_{10}$). During storage all the samples showed an increasing trend in total viable count. The rate of increase was higher in case of P1 samples compared P2 and P3. This trend demonstrates that vacuum packaging followed by MAP retarded the overall bacterial growth during storage ($P < 0.01$). Earlier workers also reported increasing standard plate counts of burfi during storage [8][9] [10] [11]But in his study on the extension of shelf life of peda did not observe increase in the microbial growth during storage in the product packaged under MAP with oxygen scavengers. Palit and Pal (2005) [12] reported that the rate of increase of total viable counts in control sample of burfi was higher than that of vacuum packaged burfi. For most of the intermediate Indian dairy foods such as peda, burfi, kalakand etc. mould growth tends to be a major problem and often most important single factor limiting their shelf life. In the present study, yeast and mould counts were not detected in fresh peda samples packaged in cardboard box (P1). During storage all the samples of peda showed the presence of yeast and mould count which increased with the progress of storage period (**Fig. 5**). Among all the samples, P1 spoilt after 20 days of storage due to surface mould growth and were withdrawn from further storage. Due to same reason, P2 samples packaged in MAP spoilt after 30 days of storage whereas, vacuum packaged samples (P3) spoilt mainly due to the growth of gas producing organisms after 40 days of storage. Highly significant ($P < 0.01$) effect of different packaging techniques and intervals of storage on total viable count and yeast and mould counts were revealed.

3.6 Nutritional analysis of peda:

Figure 6: Report of nutritional analysis of peda from IADFAC Laboratories Pvt. Ltd. Bangalore.

The crafted peda was dispatched to IADFAC Laboratories Pvt. Ltd. in Bangalore for a comprehensive nutritional analysis. This evaluation encompassed critical parameters including Carbohydrates, Proteins, Iron, Calcium, Potassium, Magnesium, Energy content, Dietary fibers, Total fat, Phosphorous, Cholesterol, Monounsaturated fat, Polyunsaturated fat, Lactose, and Total sugar. The assessment strictly adhered to the procedural guidelines outlined by both FSSAI and the AOAC manual.

As per the obtained results the carbohydrate is 58.39 g /100 g, Protein is 12.92 g /100 g, Calcium is 574.30 mg / 100 g, Iron is 36.30 mg / 100 g, Potassium is 1019.06 mg / 100g, Magnesium is 772.49 mg / 100 g, Energy is 457.86 kcal / 100 g, Dietary fiber <0.5 g / 100 g, Total fat 19.18 g / 100g, Phosphorus 0.32 g / 100 g, Cholesterol 93.72 mg / 100 g, Monounsaturated fat (MUFA) 5.74 g / 100 g, Polyunsaturated fat (PUFA) 0.91 g / 100 g, Lactose 13.93 g / 100 g, Total sugar 58.36 g / 100 g.

4. Discussion

The *in vitro* experiment assessed the antibacterial activity of camel milk against *E. coli* and *S. aureus*, two significant bacterial strains. The results demonstrated that camel milk, when used alone, exhibited antibacterial properties with substantial inhibition zones against both bacterial strains. Notably, combining camel milk with ciprofloxacin enhanced the antibacterial activity, resulting in larger inhibition zones than ciprofloxacin alone. This synergy suggests that camel milk could serve as a potential natural source of antibacterial agents or complement conventional antibiotic treatments. The findings highlight the possibility of integrating traditional remedies, such as camel milk, with antibiotics to improve the efficacy of bacterial infection treatments. While these results are promising, further research and clinical trials are essential to fully explore and validate the potential of camel milk in human bacterial infection treatment strategies.

The sensory evaluation of camel milk peda highlighted several favorable attributes that set it apart from the more conventional cow milk peda. Camel milk peda was found to be visually appealing with its warm and exotic color, which conveys a sense of richness and natural ingredients. Its sweet and milky aroma evoked nostalgia and comfort, making it intriguing and inviting. The smooth and creamy mouthfeel of camel milk peda added to its overall appeal, providing a unique texture that distinguishes it from regular cow milk peda.

In terms of taste, camel milk peda received positive comments for its well-balanced sweetness and the distinctive flavor of camel milk. The pleasant and lingering aftertaste further enhanced its appeal. The appropriate hardness of camel milk peda contributed to a satisfying eating experience. Overall, camel milk peda's attractive appearance, enticing aroma, pleasing mouthfeel, balanced taste, pleasant aftertaste, and suitable hardness resulted in high scores for its overall acceptability.

While traditional cow milk peda is undoubtedly beloved, camel milk peda's unique sensory characteristics make it a standout dessert option. These distinct attributes cater to those seeking a novel and enjoyable dessert experience. Camel milk peda's positive reception in sensory evaluation suggests its potential to become a preferred choice among dessert enthusiasts.

The storage of peda is associated with the common occurrence of moisture loss, a critical factor affecting its quality. The study underscores the significance of moisture content, as it can influence bacterial activity, yeast and mold growth, browning reactions, and the overall acceptability of peda. Proper selection of packaging materials and techniques is crucial, particularly in high-temperature storage conditions, to mitigate moisture loss.

The research findings reveal that different packaging techniques have varying effects on peda quality during storage. Cardboard packaging (P1) results in the highest moisture loss due to its inadequate water vapor barrier properties. In contrast, Modified Atmosphere Packaging (MAP) (P2) and vacuum packaging (P3) offer superior moisture barrier capabilities, leading to lower rates of moisture loss.

The increase in acidity during storage, with the highest increase observed in cardboard-box-stored samples (P1), is an essential aspect to consider. This acidity shift occurs at a slower rate in MAP (P2) and vacuum-packaged samples (P3). These acidity changes have implications for the sensory attributes and overall acceptability of peda.

Furthermore, the study delves into the color changes of peda during storage, focusing on parameters like lightness (L*), redness (a*), and yellowness (b*). Distinct packaging techniques lead to unique trends in color alterations. Cardboard-box-stored peda becomes lighter, while vacuum-packaged samples become darker. Possible explanations for these color variations, such as oxygen permeation and the presence of a vacuum, are discussed.

The statistical significance of these findings underscores the importance of choosing the right packaging technique and considering the duration of storage when managing the physico-chemical attributes of peda. These insights provide valuable information for optimizing peda storage conditions and maintaining its quality.

The research sheds light on the dynamic microbiological changes that occur during the storage of peda, emphasizing the pivotal role of packaging techniques in safeguarding the product's quality and safety. The findings underscore the effectiveness of vacuum packaging (P3) in retarding bacterial growth, which is paramount for extending the shelf life of dairy products.

Furthermore, the study highlights a common challenge faced by dairy products like peda: the presence of yeast and mould. This issue can compromise both the shelf life and overall quality of these products, as indicated by the spoilage of samples in P1, P2, and P3 over time.

The highly significant ($P < 0.01$) effect of different packaging techniques and storage durations on the total

viable count and yeast and mould counts reinforces the critical influence of these factors on the microbiological quality of peda.

These research findings not only offer practical insights for the preservation of dairy-based sweets but also accentuate the need for the meticulous selection of packaging methods and storage conditions. They play a pivotal role in prolonging the shelf life and upholding the microbiological safety of these delectable treats. Additionally, the variations observed in this study compared to prior research, such as the study by Kumar et al. in 1997[13], underscore the intricate and diverse nature of microbial behavior in different food products and storage environments.

5. Conclusion

The study highlights the antibacterial properties of camel milk, especially against *E. coli* and *S. aureus*, and its synergistic effect with ciprofloxacin. Camel milk peda stands out for its unique sensory qualities. Packaging methods impact its color over time. Vacuum packaging is effective in preserving quality and safety. The study emphasizes the need for ongoing research to understand microbial behavior in different food products and storage conditions. This supports the potential medicinal and nutritional uses of camel milk, but further molecular research and clinical trials are crucial to confirm its therapeutic benefits.

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