International Journal of Veterinary Sciences and Animal Husbandry 2025; SP-10(8): 168-173

ISSN: 2456-2912
NAAS Rating (2025): 4.61
VET 2025; SP-10(8): 168-173

www.veterinarypaper.com
Received: 08-07-2025
Accepted: 09-08-2025

Poorani A
Department of Livestock Products Technology, Veterinary College and Research Institute, Udumalpet, Tamil Nadu, India

Elango A
Veterinary College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Salem, Tamil Nadu, India

Pugazhenthi TR
Department of Livestock Products Technology, Veterinary College and Research Institute, Theni, Tamil Nadu, India

Manivannan C
Veterinary College and Research Institute, Tamil Nadu Veterinary and Animal Sciences University, Udumalpet, Tamil Nadu, India

Corresponding Author:
Poorani A
Department of Livestock Products Technology, Veterinary College and Research Institute, Udumalpet, Tamil Nadu, India

Descriptive sensory analysis of cow milk curd incubated at moderately higher temperatures and stored under refrigerated conditions using a variety of lactic starter cultures

Poorani A, Elango A, Pugazhenthi TR and Manivannan C

Abstract
Highly renowned traditionally fermented milk product, Curd, is well known for its unique physicochemical, nutritional and organoleptic properties, underpinned by complex and largely unexplored microbial ecosystem. This study employed descriptive sensory analysis of cow milk curd incubated at moderately higher temperature and stored under refrigerated conditions using a variety of lactic starter cultures and approaches to investigate sensory attributes of cow milk curd. Sensory evaluation linked microbial diversity to attributes such as creamy texture, fruity aroma, and sour taste, furthermore cow milk curd prepared by combination of starter culture *Lactococcus lactis* subsp. *lactis* + *Lactococcus lactis* subsp. *cremoris* + *Lactococcus lactis* subsp. *lactis biovar diacetylactis* inoculation was also positively correlated with desirable traits. The sensory scores for curd samples prepared using Cow milk curd prepared by *Lactococcus lactis*s UBSP. *lactis* + *Lactococcus lactis* subsp. *cremoris* + *Lactococcus lactis* subsp. *lactis biovar diacetylactis* inoculation and incubated at 40 °C (C2Ll+Lc+Ld combination of starter cultures) were higher than the control and other treatments interms of flavour, body and texture, colour and appearance, overall acceptability (8.87±0.01, 8.72±0.01, 8.80±0.01, 8.79±0.01) on day 0.
Sensory analysis highlighted the correlation between microbial diversity and sensory attributes underscoring cow milk curd microbial uniqueness. The findings provide a framework for refining cow milk curd formulations to address diverse market demands, achieving a balance between sensory excellence and practical starter culture collection strategies. This research reinforces the significance of cow milk curd as a culturally adaptable, health-promoting dietary component and a promising market segment for ongoing innovation.

Keywords: Starter cultures, 40°C incubation temperature, Cow milk curd, refrigeration, sensory analysis

Introduction
Curd is a fermented milk product widely consumed in India ad also in other parts of South-Asian countries. Curd is endowed with many therapeutic ingredients that fit into the current consumer demand for health-based foods. Hence, it is necessary to study the effect of sensory analysis of cow milk curd incubated at higher temperature and stored under refrigerated conditions using a variety of lactic starter cultures. To make good quality curd, selection of starter cultures makes a major role. These bacteria work symbiotically to produce lactic acid, which coagulates the milk and develops the characteristic flavor and texture of curd.
Lactic acid bacteria are the primary microorganisms used in curd production. They convert lactose (milk sugar) into lactic acid, which is responsible for the sour taste and thickening of the curd. Symbiotic relationship exists between lactic acid bacteria. The specific strains of LAB used can influence the final flavor of the curd. Different strains produce different amounts of flavor compounds, such as acetaldehyde and diacetyl. Similarly the texture of the curd is also affected by the starter culture. The interplay between lactic acid bacteria contributes to the smooth, firm texture characteristic of good quality curd. In this connection investigation related to explore the best lactic starter culture suitable for the preparation of cow milk curd incubated at moderately higher temperature and stored under refrigerated conditions through sensory analysis.

Materials and Methods

Experiment trials using the starter culture combination listed in table 1. Dairy starter cultures were obtained from the National Collection of Dairy Cultures, Division of Dairy Microbiology, National Dairy Research Institute, Karnal (Haryana) were used in this research. Cow milk curd were prepared and incubated at 37 °C using five per cent fat and nine per cent solids not fat combination in cow milk.

By using Pearson square method (Pearson and Freeman, 1972) [12] the cow milk standardized to 5 per cent fat and 9 per cent SNF combination and the following starter cultures were used:-

Table 1: Starter culture strains and their combinations used for Dahi preparation, each replicated six times.

S. No.	Treatment	Combinations	Replication
1	T_1	*Lactococcus lactis* subsp. *lactis*	6
2	T_2	*Lactococcus lactis* subsp. *cremoris*	6
3	T_3	*Lactococcus lactis* subsp. *lactis biovar diacetylactis*	6
4	T_4	*Lactococcus lactis* subsp. *lactis* + *Lactococcus lactis* subsp. *lacti sbiovar diacetylactis*	6
5	T_5	*Lactococcus lactis*subsp. *cremoris* + *Lactococcus lactis* subsp. *lactis biovar diacetylactis*	6
6	T_6	*Lactococcus lactis*subsp. *lactis* + *Lactococcus lactis*subsp. *cremoris* + *Lactococcus lactis* subsp. *lactisbiovardiacetylactis*	6
7	T_7	*Leuconostoclactis*	6
8	T_8	*Leuconostocmesenteroides* subsp.*cremoris*	6
9	T_9	*Leucuconostoclactis* + *Leuconostoc mesenteroides* subsp. *cremoris*	6
10	T_{10}	*Lactobacillus plantarum*	6
11	T_{12}	*Lactobacillus paraplantarum*	6
12	T_{13}	*Streptococcus salivarius* subsp. *thermophilus*	6

Sensory analysis of curd

Sensory evaluation of cow milk curd samples was carried out using 9-point Hedonic scale. The Sensory evaluation panel consisted of twelve judges having adequate knowledge about the sensory evaluation methods and product characteristics were chosen. Cow milk curd samples were evaluated for sensory attributes such as colour and appearance, body and texture, flavour, and overall acceptability on a nine-point hedonic scale (9 for liking extremely and 1 for disliking extremely) by a panel of six discriminative and communicative judges. Randomly, one cup (100 ml) of each treatment was drawn from the refrigerator just before serving and was served to each panel list for judging.

Results and Discussion

The sensory scores of the cow milk curd samples prepared with various combinations of starter cultures and with incubation temperature of 37 °C is given in Tables 2, 3, 4 and 5, Figure 1-4.

The sensory scores for curd samples prepared using C2Ll+Lc+Ld combination of starter cultures incubated at 40 ºC were higher than the control and other treatments interms of flavour, body and texture, colour and appearance, overall acceptability (8.87±0.01, 8.72±0.01, 8.80±0.01, 8.79±0.01) on day 0 and lowest flavour, body and texture, colour and appearance, overall acceptability scores (7.14±0.01, 6.99±0.01, 8.02±0.01, 7.46±0.01) were observed for the curd sample prepared using C2Lc starter culture on day 0.

The flavour, body and texture, colour and appearance and overall acceptability scores (6.68±0.01, 6.53±0.01, 7.03±0.01, 7.01±0.01) were higher than the control and other treatments for the curd samples prepared using C2Ll+Lc+Ld (Table 18-21) starter culture combinations and incubated at 40ºC on day 6 of storage at 5.00±0.5 ºC and whereas flavour, body and texture, colour and appearance and overall acceptability scores were lower than the control and other treatments for the curd sample prepared using C2St starter culture (3.66±0.01, 3.51±0.01, 6.14±0.01, 4.00±0.01) day 6 of storage at 5.00±0.5 ºC.

Cow milk curd samples prepared with various combinations of starter culture and with incubation temperature of 40 ºC is evaluated by the sensory panel and the overall acceptability scores are presented in Tables 2, 3, 4 and 5 and there was a significant difference (p<0.01) between the treatment and control samples.

Cow curd sample with *Lactococcus lactis subsp. lactis, Lactococcus lactis subsp. cremoris and Lactococcus lactis subsp. lactis biovar diacetylactis* starter culture received a higher sensory scores than the other curd samples incubated at 40 °C.

Chaudhary *et al.* (2018) [3] studied the influence of exo-polysachharides and non-exo polysaccharides producing cultures on the quality attributes of dahi prepared with incubation temperature of 39 °C and recorded overall acceptability score ranged from 8.23 to 8.07. The present overall acceptability score of the cow milk curd samples prepared with different starter cultures are in agreement with the scores of Chaudhary *et al.* (2018) [3]. During storage at room temperature, *Lactococcus lactis* subsp. *lactis, Lactococcus lactis* subsp. *cremoris and Lactococcus lactis* subsp. *lactis* biovar *diacetylactis* curd samples were acceptable with higher sensory scores for up to 1 day.

In this experiment, cow milk curd sample prepared with *Lactococcus lactis* subsp. *lactis, Lactococcus lactis* subsp. *cremoris and Lactococcus lactis* subsp. *lactis* biovar *diacetylactis* starter culture combination received higher sensory scores than the other curd samples incubated at 40 °C. (Table 2-5; Figure 1-4). This could be due to fact that these combined cultures produced exo ploy saccharides resulting in higher cohesiveness, springiness, adhesiveness, chewiness resulted in higher sensory score. These observations are in accordance to findings of Chaudhary *et al.* (2018) [3] who concluded that dahi made using exo polysaccharides producing cultures gave a rich mouth-feel compared to dahi made using with other cultures. They had documented that non-exo polysaccharides producing cultures tend to produce dahi with higher fracturability, hardness, and gumminess. They had also concluded that sensory evaluation often reveals that dahi made with exo polysaccharides-producing cultures is perceived as smoother, creamier, and more viscous, while also displaying reduced whey separation.

A low sensory score for a *Streptococcus salivarius* subsp. *Thermophilus* (now known as *Streptococcus thermophilus*) culture indicates that the fermented product made using this culture (like yogurt) may have undesirable sensory characteristics, such as poor texture, flavor, or aroma. This could be due to various factors affecting the bacteria's ability to produce desirable compounds during fermentation. *S. thermophilus* is a Gram-positive coccus, occurring in chains with a desirable growth temperature of 42-45 °C for rapid

growth in milk. The proteolytic system of *S. thermophilus* is more limited than other dairy starters, hence it is often paired with *Lactobacillus* sp. But in this experiment trial *Streptococcus salivarius* subsp. *thermophilus* at alone used for milk fermentation hence resulting in poor sensory score. The fermentation process might not have been carried out under optimal conditions, leading to insufficient acid production or other desirable flavor compounds.

Table 2: Flavour scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

Storage period in Days	Starter culture							
	C2C	C2Ll	C2Lc	C2Ld	C2Ll+Ld	C2Lc+Ld	C2Ll+Lc+Ld	C2St
0	8.61^{bA}±0.2	8.76^{bA}±0.10	7.14^{dA}±0.10	8.36^{cA}±0.10	8.47^{cA}±0.10	7.16^{dA}±0.10	8.87^{aA}±0.10	7.16^{dA}±0.10
2	7.64^{dB}±0.10	7.63^{dB}±0.10	6.64^{eB}±0.10	7.97^{bA}±0.10	7.87^{cB}±0.10	6.66^{eB}±0.10	8.06^{aB}±0.10	6.65^{eB}±0.10
4	6.14^{cC}±0.10	5.65^{dC}±0.10	5.66^{dC}±0.10	6.67^{bB}±0.10	6.68^{bC}±0.10	5.67^{dC}±0.10	7.17^{aC}±0.10	6.16^{cC}±0.10
6	4.65^{bD}±0.10	4.64^{bD}±0.10	4.66^{bD}±0.10	4.66^{bC}±0.10	4.67^{bD}±0.10	4.66^{bD}±0.10	6.68^{aD}±0.10	3.66^{cD}±0.10
8	3.64^{bE}±0.10	3.64^{bE}±0.10	3.66^{bE}±0.13	3.67^{bD}±0.10	3.68^{bE}±0.13	3.67^{bE}±0.13	4.88^{aE}±0.13	2.67^{cE}±0.10
10	2.66^{cF}±0.10	2.70^{aF}±0.10	2.66^{cF}±0.10	2.65^{cE}±0.10	2.69^{aF}±0.10	2.67^{bF}±0.10	2.70^{aF}±0.10	2.68^{bE}±0.10

Mean ± Standard error values from six trials.
Mean values bearing different superscripts in a column differed significantly (p<0.01)

Table 3: Body and texture scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

Storage period in Days	Starter cultures							
	C2C	C2Ll	C2Lc	C2Ld	C2Ll+Ld	C2Lc+Ld	C2Ll+Lc+Ld	C2St
0	8.66^{aA}±.03	8.15^{bA}±0.10	6.99^{cA}±0.10	8.21^{bA}±0.10	8.32^{aA}±0.10	7.01^{cA}±0.10	8.72^{aA}±0.10	7.01^{cA}±0.10
2	7.29^{dB}±0.10	7.49^{cB}±0.10	6.51^{eA}±0.10	7.82^{bA}±0.10	7.72^{bB}±0.10	6.51^{eB}±0.10	7.91^{aB}±0.10	6.50^{eB}±0.10
4	5.99^{cC}±0.10	5.40^{dC}±0.10	5.41^{dB}±0.10	6.52^{bB}±0.10	6.53^{bC}±0.10	5.56^{dC}±0.10	7.02^{aC}±0.10	6.01^{cC}±0.10
6	4.40^{cD}±0.10	4.49^{bD}±0.10	4.51^{bC}±0.10	4.52^{bC}±0.10	4.51^{bD}±0.10	4.52^{bD}±0.10	6.53^{aD}±0.10	3.51^{dD}±0.10
8	3.49^{bE}±0.10	3.49^{bE}±0.10	3.51^{bD}±0.13	3.52^{bD}±0.10	3.53^{bE}±0.13	3.53^{bE}±0.13	4.73^{aE}±0.13	2.52^{cE}±0.10
10	2.51^{bF}±0.10	2.55^{aF}±0.10	2.51^{bE}±0.10	2.52^{bE}±0.10	2.54^{aF}±0.10	2.52^{bF}±0.10	2.55^{aF}±0.10	2.54^{aF}±0.10

Table 4: Colour and appearance scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

Storage period in Days	Starter culture							
	C2C	C2Ll	C2Lc	C2Ld	C2Ll+Ld	C2Lc+Ld	C2Ll+Lc+Ld	C2St
0	8.75^{abA}±0.03	8.69^{bA}±0.10	8.02^{dA}±0.10	8.71^{bA}±0.10	8.81^{aA}±0.10	8.12^{cA}±0.10	8.80^{aA}±0.10	8.06^{cA}±0.10
2	7.55^{eB}±0.10	8.66^{bA}±0.10	7.97^{dA}±0.10	8.63^{bA}±0.10	8.75^{aA}±0.10	8.06^{cA}±0.10	8.74^{aA}±0.10	8.00^{cA}±0.10
4	7.50^{aB}±0.10	7.01^{cB}±0.10	7.03^{cB}±0.10	7.01^{cB}±0.10	7.02^{cB}±0.10	7.01^{dB}±0.10	7.50^{aB}±0.10	7.19^{bB}±0.10
6	6.84^{bC}±0.10	5.72^{eC}±0.10	5.79^{dC}±0.10	5.78^{dC}±0.10	5.77^{dC}±0.10	5.83^{dC}±0.10	7.03^{aB}±0.10	6.14^{cC}±0.10
8	5.26^{cD}±0.10	5.23^{cD}±0.10	5.29^{cD}±0.13	5.21^{dD}±0.10	5.24^{cD}±0.13	5.23^{cD}±0.13	6.81^{aC}±0.13	5.81^{bD}±0.10
10	5.13^{cD}±0.10	3.15^{eE}±0.10	5.19^{cD}±0.10	5.13^{cD}±0.10	5.05^{dD}±0.10	5.09^{dD}±0.10	6.04^{aD}±0.10	5.51^{bD}±0.10

Mean ± Standard error values from six trials.
Mean values bearing different superscripts in a column differed significantly (p<0.01)

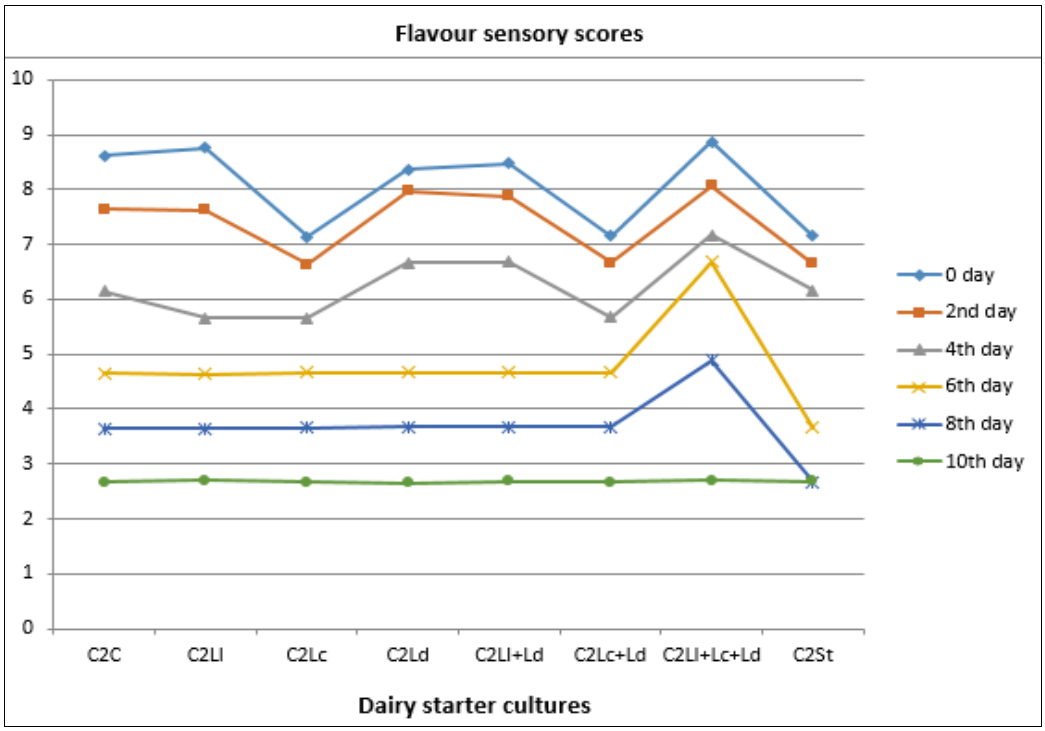

Fig 1: Flavour scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

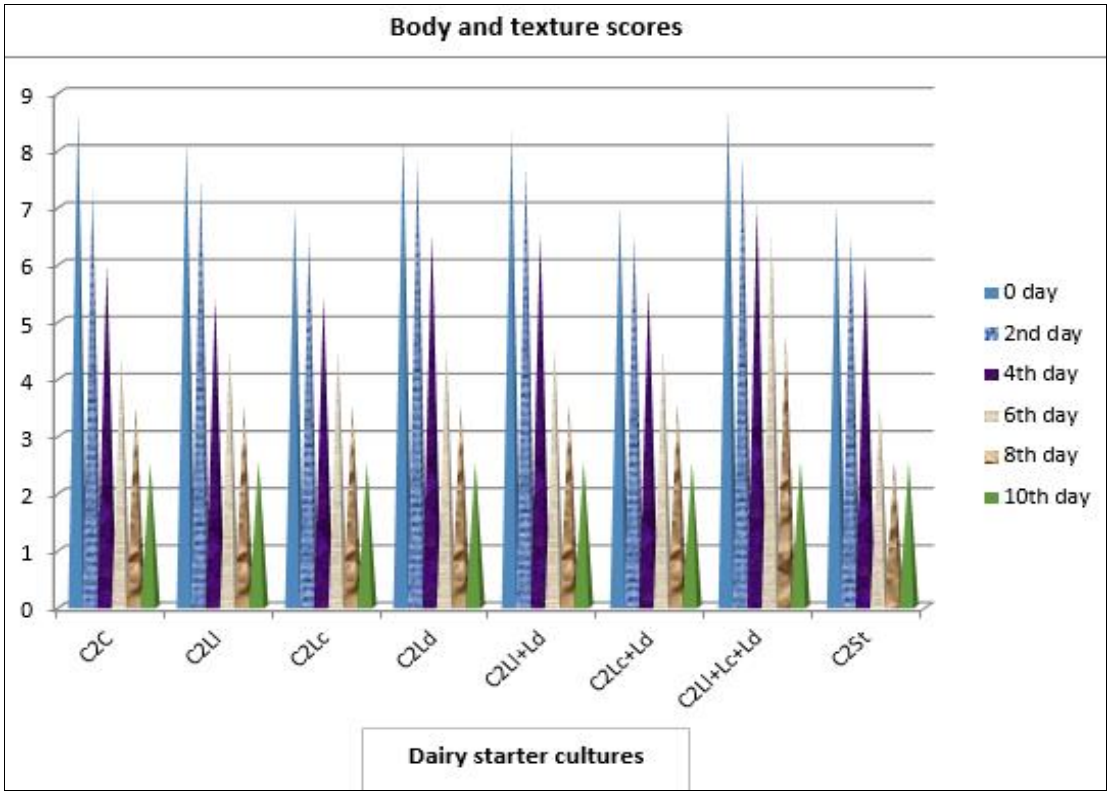

Fig 2: Body and texture scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

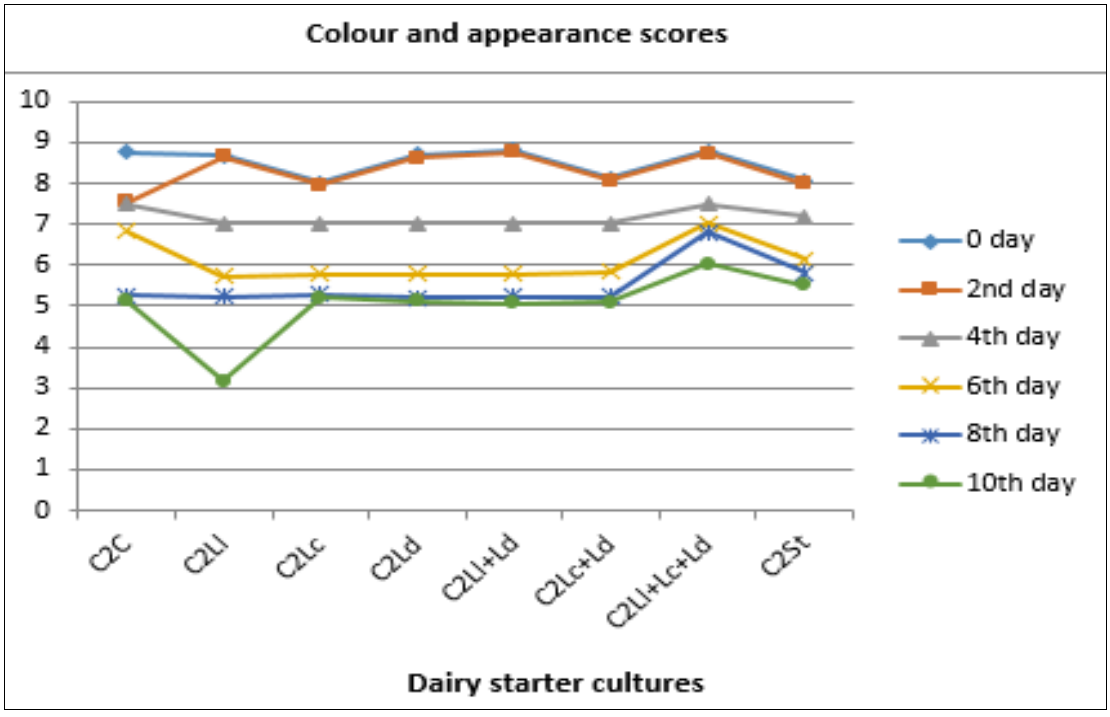

Fig 3: Colour and appearance scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

Table 4: Overall acceptability scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

Storage period in Days	Starter cultures							
	C2C	C2Ll	C2Lc	C2Ld	C2Ll+Ld	C2Lc+Ld	C2Ll+Lc+Ld	C2St
0	8.73^{aA}±0.13	8.68^{bA}±0.10	7.46^{dA}±0.10	8.68^{bA}±0.10	8.79^{aA}±0.10	7.48^{eA}±0.10	8.79^{aA}±0.10	7.54^{cA}±0.10
2	8.00^{dB} ±0.10	8.00^{dB}±0.10	7.00^{eA}±0.10	8.21^{bA}±0.10	8.19^{cB}±0.10	7.00^{eAB}±0.10	8.29^{aAB}±0.10	6.98^{fB}±0.10
4	6.48^{cC}±0.10	6.00^{dC}±0.10	6.00^{dB}±0.10	7.00^{bB}±0.10	7.00^{bC}±0.10	6.00^{dC}±0.10	7.49^{aB}±0.10	6.48^{cC}±0.10
6	6.00^{bC}±0.10	5.00^{cD}±0.10	5.01^{cC}±0.10	5.00^{cC}±0.10	5.00^{cD}±0.10	5.00^{cD}±0.10	7.01^{aB}±0.10	4.00^{dD}±0.10
8	4.00^{bD}±0.10	4.01^{bE}±0.10	4.01^{bD}±0.13	4.01^{bD}±0.10	4.02^{bE}±0.13	4.02^{bE}±0.13	5.19^{aC}±0.13	3.01^{cE}±0.10
10	3.05^{eE}±0.10	3.03^{eF}±0.10	3.07^{eE}±0.10	3.12^{dE}±0.10	3.22^{cF}±0.10	3.61^{bF}±0.10	3.77^{aD}±0.10	3.01^{eE}±0.10

Mean ± Standard error values from six trials.
Mean values bearing different superscripts in a column differed significantly (p<0.01)

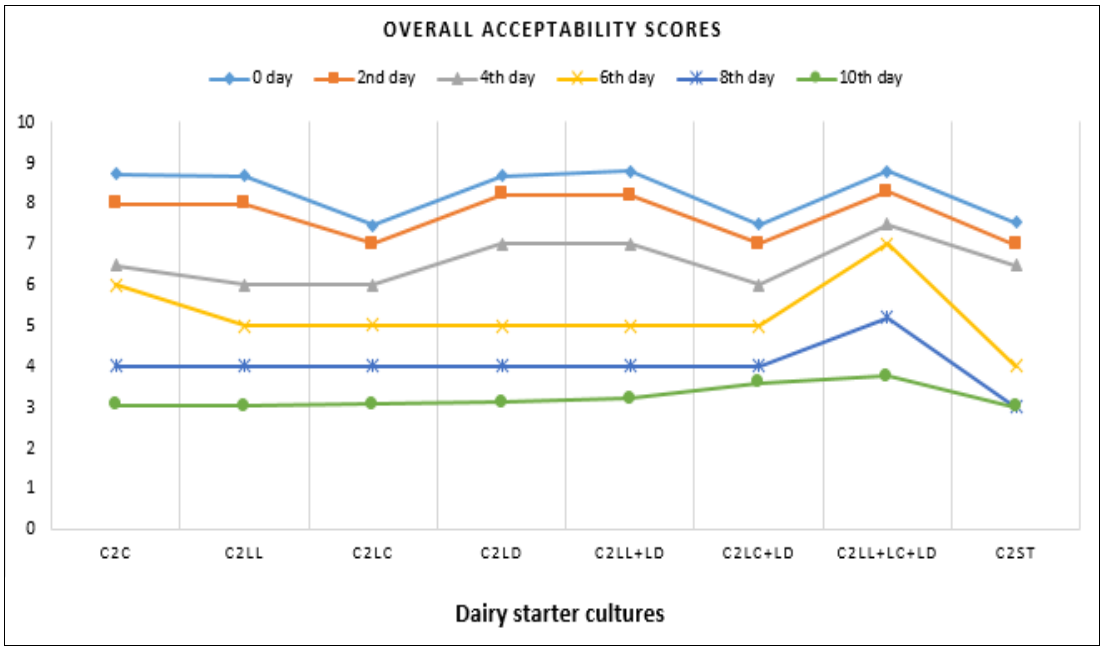

Fig 4: Overall acceptability scores of cow milk curd with various starter cultures incubated at 40 °C during refrigerated storage

Conclusion

The results obtained provide valuable insights into the drivers of preference for production of cow milk curds. Samples of cow milk curd prepared by using culture *Lactococcus lactis* subsp. *lactis* + *Lactococcus lactis* subsp. *cremoris* + *Lactococcus lactis* subsp. *lactis* biovar *diacetylactis* consistently exhibited higher acceptance levels, characterized by attributes such as high texture in the creaminess, mouth, surface uniformity, mouth-filling, grip in the mouth, apparent homogeneity ease of pick-up with a spoon, milk cream flavor, sweetness, and dairy flavor. Higher hedonic ratings for sensory attributes showed strong correlations with consumer preferences, emphasizing their relevance in product optimization.

Additionally, hedonic score ratings are validated as the importance of specific sensory properties as key determinants of consumer liking. Understanding sensory attributes enables targeted adjustments related to selection of suitable starter culture at 40 °C incubation temperature used for fermentation, enables in ensuring optimal sensory appeal while respecting ingredient constraints and production practicality.

This study highlights the critical role of aligning sensory attributes with consumer expectations to improve product acceptance. By exploring sensory characteristics alongside consumer segmentation, the results pave the way for further refinement of selection of suitable starter culture to address diverse market demands. These findings offer a robust framework for designing successful cow milk curd products that achieve a balance between sensory excellence and practical formulation strategies.

Conflict of Interest

Not available

Financial support

Authors sincerely thank Tamil Nadu Veterinary and Animal Sciences University for providing necessary facilities to carry out this research work.

Reference

1. Behare P, Singh R, Singh RP. Exopolysaccharide-producing mesophilic lactic cultures for preparation of fat-free Dahi-an Indian fermented milk. J Dairy Res. 2009;76(1):90-7.
2. Bolini HMA, Cardello F, Medeiros DAC, Moskowitz H. Unlocking consumer preferences: Sensory descriptors driving Greek yogurt acceptance and innovation. Foods. 2025;14(1):130.
3. Chaudhary GV, Sreeja V, Prajapati JB. Textural, sensory and physico-chemical changes in Dahi made using EPS and non-EPS producing cultures during storage. Int J Fermented Foods. 2018;7(1):1-10.
4. Chowdhury NA, Paramanik K, Zaman W. Study on the quality assessment of curd (Dahi), locally available in Bangladeshi market. Int J Biol Res. 2011;2(1):15-20.
5. El-Bakry M, Sanchez A, Mehta BM, editors. Microstructure of dairy products. Hoboken: John Wiley & Sons; 2018.
6. Geeta C. Evaluation of EPS and non-EPS producing strains of lactic acid bacteria on quality of Dahi [Dissertation]. Anand: Anand Agricultural University; 2016.
7. Kumari V, Kumar N, Mandal S. Evaluation of technological attributes of Lactococcus lactis cultures for preparation of Dahi and Misti Dahi (Sweetened Dahi). Asian J Dairy Food Res. 2021;40(4):358-364.
8. Majumder R, Salini SV, Basavaprabhu HN, Kumari M, Behare PV. Development and evaluation of thermophilic direct-vat-set liquid starter culture blends for Dahi production. J Food Sci. Technol. 2025;62(4):1-9.
9. Meshram BD. Sensory evaluation of commercial Dahi. Asian J Dairy Food Res. 2014;33(3):175-178.
10. Nawaz F, Barkaat M, Khan MN, Kanwal H, Tabassum M, Rauf N, *et al*. Impact of microbial composition on nutritional and organoleptic quality of an indigenous fermented milk product (Dahi). J Food Sci. Technol. 2025;62(3):1-12.
11. Nawaz F, Barkaat M, Khan MN, Kanwal H, Tabassum M, Rauf N, Imran M. Impact of microbial composition on nutritional and organoleptic quality of an indigenous fermented milk product (Dahi). J Food Sci Technol. 2025;62(3):1-12.
12. Pearson RE, Freeman AE. Standardization of part and complete milk and milk fat production records. J Dairy

Sci. 1972;55(5):581-588.
13. Qureshi TM, Nadeem M, Muhammad G, Abbas W, Akram K, Hussain M, *et al*. Physico-chemical characteristics, antioxidant activities, and ACE inhibitory potential of Pakistani Dahi supplemented with date fruit paste. Food Sci Nutr. 2025;13(2):e4588.
14. Ray A, Sinha C, Minz PS, Dabas JK, John H, Kumari K. Automatic pH-controlled thermal modulation unit for yoghurt production. J Food Process Eng. 2025;48(1):e70050.

How to Cite This Article
Poorani A, Elango A, Pugazhenthi TR, Manivannan C. Descriptive sensory analysis of cow milk curd incubated at moderately higher temperatures and stored under refrigerated conditions using a variety of lactic starter cultures. International Journal of Veterinary Sciences and Animal Husbandry. 2025;SP-10(8):168-173.