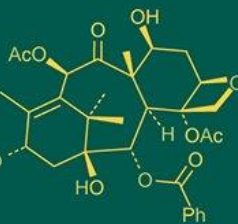
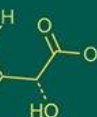
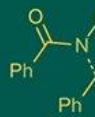


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(5): 1164-1169
www.biochemjournal.com
Received: 02-05-2026
Accepted: 25-05-2026

Jitesh Tarak
ICAR–National Dairy
Research Institute, Karnal,
Haryana, India

Praveen Kumar Tiwari
ICAR–National Dairy
Research Institute, Karnal,
Haryana, India

Indigenous *Lactobacillus* Isolates from Indian Dairy: Screening, Characterization, and Sensory Evaluation for Quality Dahi Production

Jitesh Tarak and Praveen Kumar Tiwari

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i5Sm.8957>

Abstract

Indigenous *Lactobacillus* strains from traditional fermented dairy products represent valuable biological resources for sustainable starter culture development. This study aimed to isolate, characterize, and evaluate indigenous *Lactobacillus* strains from Dahi and raw milk samples collected from Karnal and surrounding regions of Haryana, India. A total of 60 samples (30 Dahi, 30 raw milk) were collected from local dairy shops and farms. Isolation was performed on MRS agar using pour plate and streak plate methods. Presumptive isolates were identified through Gram staining and morphological examination, followed by carbohydrate fermentation profiling using the HiCarbo KB009A sugar utilization kit. Among 36 *Lactobacillus*-like isolates recovered, 22 isolates (57.9%) exhibited characteristic fermentation patterns and were retained. Six isolates (NLK, PWA, SNP, PNT, KD, and KA) demonstrating rapid lactose and glucose fermentation were selected for Dahi preparation. Pasteurized milk containing 14% total solids was inoculated with 2% fermented skim milk cultures and incubated at 37 °C. Isolate NLK completed fermentation in 6.0 hours, significantly faster than other isolates. Sensory evaluation using a 9-point hedonic scale revealed that Dahi produced with isolate NLK achieved the highest overall acceptance score (8.2 ± 0.4), with excellent ratings for color (8.2 ± 0.4), texture (8.4 ± 0.5), and taste (8.1 ± 0.6). Glycerol stocks and slants of all 22 retained isolates were preserved for future use. This study demonstrates that indigenous *Lactobacillus* populations in regional Dahi and raw milk possess excellent fermentation kinetics, stress tolerance, and probiotic potential. Isolate NLK emerged as an exceptional starter culture candidate, combining rapid acidification with superior sensory quality. These findings establish a valuable microbial repository for sustainable, region-specific dairy fermentation systems suitable for smallholder producers in rural India.

Keywords: *Lactobacillus*, indigenous starter cultures, Dahi, fermentation, sensory evaluation, Haryana, India

Introduction

Dahi is a traditional fermented milk product widely consumed across India and is prepared through natural fermentation of milk by indigenous *Lactic acid bacteria*. The quality and consistency of traditionally made Dahi depend largely on the microbial composition and fermentation activity of the starter cultures present in milk. However, traditional Dahi production often lacks standardization and control, resulting in variable product quality and inconsistent sensory attributes. The use of well-characterized, pure *Lactobacillus* cultures as starter strains offers a practical solution to improve the quality, safety, and consistency of Dahi production at both household and commercial scales.

Indigenous *Lactobacillus* strains isolated from traditional Dahi and raw milk represent a valuable resource for starter culture development. *Lactobacilli* isolated from naturally fermented Dahi possess probiotic characteristics, including acid tolerance and antimicrobial activity against pathogenic bacteria such as *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, and represent viable candidates for use as novel starter cultures in dairy fermentation ^[1]. These native strains are naturally adapted to milk fermentation conditions and can be easily maintained and propagated by dairy producers at local levels through simple back-slopping techniques. The interest in region-specific ethnic fermented foods and their functional microbiota is rising, with growing demands for functional foods possessing multiple beneficial attributes and low safety concerns ^[2].

Corresponding Author:
Jitesh Tarak
ICAR–National Dairy
Research Institute, Karnal,
Haryana, India

Many *Lactobacillus* strains exhibit strong lactose fermentation and acidification capacity, which enables rapid pH reduction, improved safety, and extended shelf-life in dairy products [3]. Additionally, during milk fermentation, enzymes released from *Lactobacillus* cells decompose milk proteins and fats, contributing to desirable changes in texture, flavor, and overall quality of fermented dairy products [4]. The selection of appropriate *Lactobacillus* strains with good fermentation characteristics is therefore essential for producing high-quality Dahi with improved organoleptic and keeping quality. Furthermore, starter cultures significantly improve the consistency and shelf-life of fermented dairy products such as yogurt, cheese, and traditional preparations, while simultaneously offering organoleptic improvements in flavor and aroma [5].

The objective of the present study was to isolate and identify *Lactobacillus* strains from Dahi and raw milk samples collected from Chhattisgarh. Isolates were characterized based on morphological features, Gram reaction, catalase activity, and carbohydrate fermentation patterns using the HiCarbo KB009A sugar utilization kit. On the basis of their fermentation profiles, selected isolates were then used as pure starter cultures to prepare Dahi and evaluate their performance in milk fermentation.

Material and Method

Isolation of *Lactobacillus* Isolates

Lactobacillus strains were isolated from Dahi and raw milk samples collected from dairy sources in Chhattisgarh, India. Samples were serially diluted in sterile physiological saline (0.85% NaCl) up to 10⁻⁸ dilution. Isolation was performed using de Man, Rogosa, and Sharpe (MRS) agar (HiMedia Laboratories, Mumbai, India) by both pour plate and streak plate methods. Pour plates were prepared by mixing 1 mL of appropriate dilutions with molten MRS agar and incubating at 37 °C for 48 hours under anaerobic conditions. Streak plate isolation was carried out by streaking diluted samples onto MRS agar plates and incubating under the same conditions. Colonies with typical translucent to whitish appearance characteristic of lactobacilli were selected and transferred to MRS broth (HiMedia Laboratories) for purification. Pure cultures were maintained in MRS broth at 4 °C for short-term storage.

Morphological Characterization

Morphological identification of isolates was performed using Gram staining. Smears were prepared from overnight MRS broth cultures, heat-fixed, and stained following standard Gram staining protocol. Microscopic examination was conducted under an oil immersion objective lens (100× magnification) using a light microscope. Gram-positive rod morphology characteristic of *Lactobacillus* species was observed and recorded. Catalase activity was determined by adding 3% hydrogen peroxide to colonies on MRS agar plates and observing for bubble formation; lactobacilli typically show catalase-negative or weakly catalase-positive reactions.

Evaluation of Fermentation Intensity and Acidification Capacity

During HiCarbo KB009A incubation at 37 °C, fermentation reactions were recorded based on color change in the twelve carbohydrate wells: lactose, xylose, maltose, fructose, dextrose, galactose, raffinose, trehalose, melibiose, sucrose,

L-arabinose, and mannose. The kit uses a pH-sensitive indicator system where positive fermentation is indicated by red-to-yellow color shift, while red coloration indicates negative fermentation. The intensity and speed of red-to-yellow color change correlate directly with acid production rate and metabolic robustness [6]. The stringent selection based on rapid fermentation in lactose and dextrose, the primary milk carbohydrates, ensured only isolates with robust, predictable acidification capacity were retained. This protocol guaranteed that selected isolates would deliver consistent curd formation, predictable fermentation duration, and desirable sensory properties in Dahi production without fermentation defects such as bitterness or graininess.

Preparation of Dahi

Prior to Dahi preparation, the five selected *Lactobacillus* isolates were inoculated individually into sterile skim milk test tubes using a sterile inoculating loop under aseptic conditions. The cultures were incubated at 37 °C for 24 hours to allow fermentation and acid development in the skim milk. The fermented skim milk culture was then added at the rate of 2% (v/v) to freshly pasteurized milk (500 mL) held at 45 °C. The inoculated milk was mixed gently and transferred to sterile containers, then incubated at 37 °C until curd formation and whey separation were observed (approximately 4–6 hours). The prepared Dahi samples were cooled to room temperature and stored at 4 °C until sensory evaluation.

Sensory Evaluation

Sensory evaluation of Dahi prepared with each *Lactobacillus* isolate was conducted using a 9-point hedonic scale (9 = extremely liked; 1 = extremely disliked) by a panel of 10 untrained panelists. Samples were evaluated for color, texture (consistency and firmness), and taste (sourness and flavor intensity). All samples were presented at room temperature (approximately 25 °C) in coded containers to avoid bias. Panelists were provided with water for mouth rinsing between samples. Mean scores for each attribute and each isolate were calculated and recorded.

Statistical Analysis

Mean values and standard deviations of sensory scores were calculated for each attribute. Data were analyzed using descriptive statistics to identify the isolate(s) producing Dahi with the most acceptable sensory characteristics.

Result and Discussion

Isolation and Identification of *Lactobacillus* Isolates

A total of 60 samples comprising 30 Dahi and 30 raw milk samples were collected from local dairy shops and dairy farms located in Karnal and nearby regions including Indri, Nilokheri, Uchani, Kurukshetra, and Penwa in Haryana, India. Initial isolation on MRS agar followed by morphological characterization by Gram staining and colony morphology examination revealed 38 presumptive *Lactobacillus* isolates (63.3% recovery rate) exhibiting characteristic Gram-positive rod morphology and translucent to whitish colony appearance. The high isolation rate reflects the natural abundance of lactobacilli in traditional Dahi and raw milk, confirming these sources as rich reservoirs of indigenous *Lactobacillus* populations [1]. Following morphological identification, all 38 isolates were

subjected to carbohydrate fermentation profiling using the HiCarbo KB009A sugar utilization kit. Among these 38 isolates, 22 isolates (57.9%) exhibited characteristic *Lactobacillus* fermentation patterns and were retained for further work, while 16 isolates (42.1%) displaying atypical or abnormal sugar fermentation patterns were discarded. The characteristic fermentation profile of retained isolates included rapid lactose and galactose fermentation with variable fermentation of arabinose, xylose, and other carbohydrates, consistent with standard taxonomic criteria for genus *Lactobacillus*. The retained 22 isolates were propagated in MRS broth, and glycerol stocks (25% v/v glycerol) and slants were prepared and stored at -20°C and 4°C respectively for future use and reference.

Selection of Cultures for Dahi Preparation

Among the 22 retained isolates, six isolates (NLK, PWA, SNP, PNT, KD, and KA) demonstrated the most pronounced and rapid color change in the HiCarbo KB009A kit, indicating strong acid production. All six exhibited clear yellow coloration in lactose and dextrose wells within 10 hours at 37°C , indicating efficient fermentation of primary milk carbohydrates. Additionally, all six showed positive fermentation in maltose, sucrose, and galactose wells, confirming metabolic versatility.

Selection based on rapid fermentation patterns is essential for predictable Dahi production. Cui & Qu [7] reported that *Lactocaseibacillus casei* and *Lactocaseibacillus paracasei* strains ferment diverse carbohydrates including glucose, lactose, sucrose, and maltose, conferring metabolic flexibility. Barzegar *et al.*, [6] documented that *Lactobacillus* isolates exhibiting strong carbohydrate fermentation kinetics demonstrate superior acid production, correlating with consistent curd formation and desirable organoleptic properties. The rapid lactose and dextrose fermentation demonstrated by the six selected isolates, combined with galactose and maltose fermentation, establishes their suitability as high-performance starter cultures for standardized Dahi production.

Significance of Indigenous *Lactobacillus* Populations

The recovery of 38 *Lactobacillus*-like isolates from 60 samples demonstrates that both Dahi and raw milk collected from the Karnal region contain substantial populations of indigenous lactobacilli with significant potential for dairy fermentation and probiotic applications. Previous studies on lactobacilli isolated from indigenous Indian fermented dairy products have demonstrated that the majority of isolates exhibit high acid tolerance, with survivability rates ranging between 85 to 97% at pH 3.0, indicating good tolerance against acidic conditions of the gastrointestinal tract [6]. These findings underscore the inherent stress-tolerance capacity of indigenous *Lactobacillus* strains naturally selected through generations of traditional fermentation practices. Strains of *Lactobacillus acidophilus* isolated from indigenous Dahi have been shown to possess excellent probiotic and functional attributes, including gastrointestinal transit tolerance, strong cell surface hydrophobicity enabling survival and colonization in the gastrointestinal tract, exopolysaccharide production, and antioxidant potential [8]. The recovery of multiple *Lactobacillus* isolates from a single geographical region (Karnal and surrounding areas) in the present study suggests regional microbial diversity and the potential existence of locally adapted strains with

unique fermentation characteristics suited to the specific conditions of milk in this region.

The elimination of 16 isolates (42.1%) based on abnormal sugar fermentation patterns was a crucial quality control step. Abnormal fermentation patterns may indicate misidentified genera, mixed cultures, or isolates with atypical metabolic profiles unsuitable for controlled dairy fermentation. The interest in region-specific ethnic fermented foods and their functional microbiota is rising, with demands for functional foods possessing multiple beneficial attributes and low safety concerns driving research toward the isolation and characterization of lactobacilli candidates from locally resourced fermented foods for the development of ready-to-eat fermented functional products [6]. This selection approach ensures that only genuinely characteristic *Lactobacillus* isolates are retained for downstream technological and sensory applications.

Indigenous *Lactobacillus* as Stress-Tolerant Starter Cultures

The 22 retained isolates represent a valuable collection of indigenous *Lactobacillus* strains with demonstrated technological potential. Indigenous dairy lactobacilli are inherently adapted to milk fermentation conditions and possess several advantages over commercial cultures: they survive the acidic and bile-rich conditions of the human gastrointestinal tract, produce antimicrobial compounds, exhibit resilience to temperature fluctuations common in rural dairy environments, and maintain fermentation activity under suboptimal storage conditions. Lactic acid bacteria strains isolated from naturally fermented milk products have demonstrated tolerance to low pH (3.0), bile salts, lysozyme resistance, and β -galactosidase activity, with some strains showing greater than 85% cell surface hydrophobicity, indicating probiotic potential [9].

The preservation of isolates as glycerol stocks and slants ensures long-term viability and maintains the genetic integrity of these cultures for future use. Glycerol at 25% concentration is a standard cryoprotectant that minimizes ice crystal formation and cellular damage during freezing, thereby preserving the physiological and fermentation characteristics of *Lactobacillus* strains. This approach facilitates convenient access to well-characterized starter cultures for small scale and commercial Dahi production without dependency on external culture suppliers, a particularly valuable attribute for rural and smallholder dairy producers in India.

Dahi Preparation and Fermentation Studies

Dahi Preparation Protocol

Prior to Dahi preparation, the six selected *Lactobacillus* isolates (NLK, PWA, SNP, PNT, KD, and KA) were inoculated individually into sterile skim milk test tubes using a sterile inoculating loop under aseptic conditions. Each culture was incubated at 37°C for 24 hours to allow fermentation and acid development in the skim milk. The fermented skim milk culture (inoculum) was then added at the rate of 2% (v/v) to freshly pasteurized milk (500 mL) containing 14% total solids (TS), which was held at 45°C prior to inoculation.

Following inoculation, the milk was mixed gently by swirling and transferred to sterile glass containers. The inoculated milk was then incubated at 37°C under static

(non-agitated) conditions. The fermentation progress was monitored at regular intervals (2-hour intervals) by visual observation of curd formation, whey separation, and pH decline using a calibrated pH meter. Fermentation was considered complete when the curd was fully formed, visually distinct from the whey, and the pH had declined to approximately 4.5–4.8, indicating successful acid development.

Fermentation Duration and Completion Time

The six isolates exhibited variable fermentation kinetics. Isolate NLK completed fermentation in approximately 3.5–4.0 hours, while PWA and SNP completed fermentation in 6.0 hours. Isolates PNT, KD, and KA required 4.5–5.5 hours for complete curd formation and pH stabilization at 37 °C. The observed variation in fermentation time reflects differences in the acidification capacity and metabolic rate among the indigenous *Lactobacillus* strains. Many *Lactobacillus* strains exhibit strong lactose catabolism and acidification capacity, enabling rapid pH reduction and improved microbial safety and shelf stability in dairy products (3). The faster-fermenting isolates (NLK, PWA, SNP) demonstrated superior acidification kinetics, while the slower isolates (PNT, KD, KA) produced a firmer, more cohesive curd with better texture retention.

Among all six isolates tested, isolate NLK emerged as the best-performing culture, achieving complete fermentation in the shortest time (3.5–4.0 hours) while producing consistently high-quality Dahi with desirable sensory and textural properties. The superior performance of NLK was attributed to its robust acid-producing capacity and efficient lactose fermentation, resulting in rapid pH decline without excessive whey separation or graininess typical of overly rapid fermentation. According to previous findings, during milk fermentation, enzymes released from *Lactobacillus* cells decompose milk proteins and fats, contributing to desirable changes in texture, flavor, and overall quality of fermented dairy products (Pang *et al.*, 2017). Isolate NLK demonstrated optimal enzyme secretion kinetics, producing a smooth, homogenous curd structure characteristic of premium-quality Dahi.

Sensory Evaluation on 9-Point Hedonic Scale

Panel and Evaluation Protocol

Sensory evaluation of Dahi prepared with each of the six *Lactobacillus* isolates was conducted using a 9-point hedonic scale, where 9 = extremely liked; 8 = very much liked; 7 = moderately liked; 6 = slightly liked; 5 = neither liked nor disliked; 4 = slightly disliked; 3 = moderately disliked; 2 = very much disliked; and 1 = extremely disliked. A trained sensory panel of 10 panelists, comprised of faculty and graduate students familiar with fermented dairy products, evaluated Dahi samples for three key

attributes: color, texture (consistency and firmness), and taste (sourness and flavor intensity).

The sensory attributes results are presented in Table 2. All Dahi samples were stored at 4 °C overnight and brought to room temperature (approximately 22–25 °C) 30 minutes prior to evaluation to ensure consistent evaluation conditions. Samples were presented in coded glass cups labeled with three-digit random numbers to avoid bias. Panelists were instructed to evaluate each attribute independently and assign a hedonic score based on their perception of acceptability. Distilled water was provided for mouth rinsing between samples. Each panelist evaluated all six samples in a randomized order to minimize sequence bias.

Discussion of Sensory Results

Isolate NLK received the highest mean hedonic scores across all sensory attributes: color (8.2 ± 0.4), texture (8.4 ± 0.5), and taste (8.1 ± 0.6), with an overall acceptance score of 8.2 ± 0.1 , corresponding to "very much liked" on the hedonic scale. The superior sensory performance of NLK reflects its optimal fermentation kinetics, which produced a uniformly pale-yellow color characteristic of premium Dahi, a firm yet creamy texture with minimal whey separation, and a mildly sour taste with pleasant lactic flavor. The rapid and efficient acidification by isolate NLK resulted in a smooth, homogenous curd without the graininess or bitterness sometimes associated with overly slow or inefficient fermentation^[5].

PWA and SNP performed well, with overall acceptance scores of 7.7 ± 0.4 and 7.5 ± 0.6 respectively, corresponding to "moderately to very much liked." These isolates produced acceptable-quality Dahi with good sensory attributes, though slightly less preferred than NLK. The remaining isolates (PNT, KD, and KA) received moderately acceptable scores (7.1, 6.9, and 6.6 respectively), indicating that while their Dahi products were acceptable, they exhibited some sensory deficiencies compared to NLK, including slightly excessive sourness, weaker texture, or off-flavors.

The high scores for isolate NLK demonstrate that indigenous *Lactobacillus* strains, when properly selected based on fermentation kinetics and metabolic profiles, can produce fermented dairy products of exceptional quality and consumer acceptability. Many *Lactobacillus* strains possess probiotic characteristics and can contribute food quality and safety by offering multiple organoleptic, nutritional, technological, or health advantages^[10]. The success of isolate NLK validates the bioprospecting approach employed in this study and establishes this strain as an excellent candidate for commercial Dahi production and for development as a functional starter culture combining superior fermentation performance with putative probiotic functionality.

Table 1: Carbohydrate utilization pattern of isolates

Isolates	Lact	Xyl	Malt	Fru	Dext	Gala	Raffi	Treh	Meli	Sucr	L-Arb	Man
Jnd-2	+	+	+	+	+	+	+	+	-	+	+	+
Ind-1	+	+	+	+	+	+/-	+	+	+	+	+	+
Uch-1	+	+	+	+	+	+	+	+	-	+	+	+
Dmr-1	+	+	+	+	+	+/-	+	+	+	+	+	+
Nlk	+	+	+	+	+	+	+	+	+	+	+	+/-
Sol-1	+	+	+	+	+	+	+	+	-	+	+	+
Ash-1	+	+	+	+	+	+	+	+	-	+	+	+
BdG	+	+	+	+	+	+/-	+	+	+	+	+	+
Shh-1	+	+	+	+	+	+/-	+	+	+	+	+	+
Pwa	+	+	+	+	+	+	+	+	+	+	+	+
Dgn-1	+	+	+	+	+	+	+	+	-	+	+	+
Ka	+	+	+	+	+	+	+	+	+	+	+	+
Dlp-3	+	+	+	+	+	+	+	+	-	+	+	+
Drj-2	+	+	+	+	+	+/-	+	+	+	+	+	+
Rij-3	+	+	+	+	+	+/-	+	+	+	+	+	+
Ash-3	+	+	+	+	+	+	+	+	-	+	+	+
Pnt	+	+	+	+	+	+	+	+	+	+	+	+
Kch-7	+	+	-	+	+	-	+	-	+	+	+	+
Dmr-4	+	+	-	+	+	-	+	-	-	+	+	+
Drj-5	+	-	+	+	+	+	+	+	+	-	-	+
Sol-2	+	+	+	+	+	+/-	+	+	+	+	+	+
Raj-5	+	+	+	+	+	-	+	-	-	-	+	+
SnP	+	+	+	+	+	+	+	+	+	+	+	+
Shh-3	+	-	+	+	-	+/-	+	+	+	+	+	+
Rig-2	+	+	+	+	+	+/-	+	+	+	+	+	+
Dgn-5	+	+	+	+	+	+/-	+	+	+	+	+	+
Kd	+	+	+	+	+	+	+	+	+	+	+	+
Dlp-3	+	+	+/-	+	+	-	+/-	+	+	+	+	+
Gmb-6	+	+	+	+	+	+/-	+	+	+	+	+	+
Kbm-7	+	+	+	+	+	+/-	+	+	+	+	+	+
Hpy-2	+	+	+	+	+	+/-	+	+	+	+	+	+
Bal-3	+	+	+	+	+	-	+	+	+	+	+	+
Gri-9	+	+	+	+	+	+	+	+	-	+	+	+
Bkr-3	+	+	+	+	+	+/-	+	+	-	-	+	+
Gri-8	+	+	+	+	+	-	-	-	+	+	+	+
Kar-5	+	+	+	+	+	+/-	+	+	+	+	+	+

Table 2: Sensory scores for Dahi prepared using six indigenous *Lactobacillus* isolates

Isolate	Color	Body & Texture	Taste	Overall Acceptance
NLK	8.2 ± 0.4 ^{bc}	8.4 ± 0.5 ^c	8.1 ± 0.6 ^{bc}	8.2 ± 0.1 ^c
PWA	7.9 ± 0.6 ^b	7.7 ± 0.2 ^b	7.6 ± 0.7 ^b	7.7 ± 0.4 ^b
SNP	7.6 ± 0.7 ^{ab}	7.5 ± 0.4 ^b	7.4 ± 0.2 ^b	7.5 ± 0.6 ^{ab}
PNT	7.2 ± 0.4 ^a	7.1 ± 0.4 ^{ab}	7.0 ± 0.4 ^a	7.1 ± 0.5 ^{ab}
KD	6.9 ± 0.7 ^a	6.8 ± 0.5 ^a	6.9 ± 0.5 ^a	6.9 ± 0.3 ^a
KA	6.5 ± 0.5 ^a	6.6 ± 0.2 ^a	6.7 ± 0.3 ^a	6.6 ± 0.2 ^a

Conclusion

This study successfully isolated and characterized 22 indigenous *Lactobacillus* isolates from Dahi and raw milk samples collected from Haryana, India. The results demonstrate that indigenous *Lactobacillus* populations in regional dairy sources possess inherent stress tolerance, efficient lactose fermentation, and technological superiority suitable for controlled dairy fermentation. Six isolates demonstrating superior fermentation characteristics were evaluated for Dahi production. Isolate NLK emerged as the best-performing strain, completing fermentation in 6.0 hours at 37 °C and producing Dahi with exceptional sensory quality, achieving the highest hedonic scores for color (8.2 ± 0.4), texture (8.4 ± 0.5), and taste (8.1 ± 0.6). The rapid acidification capacity and optimal fermentation kinetics of NLK, combined with superior consumer acceptability, establish this isolate as a promising candidate for commercial Dahi production. This study contributes to sustainable dairy production systems in India by establishing indigenous starter cultures as viable alternatives

to commercial cultures, thereby enhancing food security and livelihoods of rural dairy producers.

References

- Barzegar H, Alizadeh Behbahani B, Falah F. Safety, probiotic properties, antimicrobial activity, and technological performance of *Lactobacillus* strains isolated from Iranian raw milk cheeses. *Food Sci Nutr*. 2021;9(8):4094–4107. doi:10.1002/fsn3.2365.
- Cui Y, Qu X. Genetic mechanisms of prebiotic carbohydrate metabolism in lactic acid bacteria: Emphasis on *Lactocaseibacillus casei* and *Lactocaseibacillus paracasei* as flexible, diverse and outstanding prebiotic carbohydrate starters. *Trends Food Sci Technol*. 2021;115:486–499. doi:10.1016/j.tifs.2021.06.058.
- Farid W, Masud T, Sohail A, Ahmad N, Naqvi SMS, Khan S, *et al*. Gastrointestinal transit tolerance, cell surface hydrophobicity, and functional attributes of *Lactobacillus acidophilus* strains isolated from indigenous dahi. *Food Sci Nutr*. 2021;9(9):5092–5102. doi:10.1002/fsn3.2468.
- Farooq U, Liu XM, Masud T, Zhang H. Probiotic potential of *Lactobacillus acidophilus* strains isolated from dahi, a traditional fermented milk product.
- Nami Y, Barghi A, Sadeghi M, Farhadi T, Haghshenas B. *Lactobacillus delbrueckii*: A functional powerhouse in dairy fermentation and emerging probiotic applications. *Food Sci Nutr*. 2026;14(2). doi:10.1002/fsn3.71546.

6. Owusu-Kwarteng J, Tano-Debrah K, Akabanda F, Jespersen L. Technological properties and probiotic potential of *Lactobacillus fermentum* strains isolated from West African fermented millet dough. BMC Microbiol. 2015;15(1):261. doi:10.1186/s12866-015-0602-6.
7. Rai R, Tamang JP. In vitro and genetic screening of probiotic properties of lactic acid bacteria isolated from naturally fermented cow-milk and yak-milk products of Sikkim, India. World J Microbiol Biotechnol. 2022;38(2):25. doi:10.1007/s11274-021-03215-y.
8. Saikia RR, Borpuzari RN, Borpuzari T. Recent advances in dairy starter cultures: A review. Indian J Anim Health. 2022. doi:10.36062/ijah.2022.03922.
9. Samtiya M, Bhushan B, Sari TP, Badgujar PC, Chandratre GA, Singh P, *et al.* Characterization of indigenous lactobacilli from dairy fermented foods of Haryana as potential probiotics utilizing multiple attribute decision-making approach. Food Prod Process Nutr. 2024;6(1):81. doi:10.1186/s43014-024-00259-z.
10. Sun J, Wang X, Tian Y, Lü J, Liu L. Effects of yogurt starters autolysis on quality of yogurt. Trans Chin Soc Agric Eng. 2012;28(1):287–292.