

SENSORY EVALUATION OF *SHRIKHAND* PREPARED FROM BUFFALO AND CAMEL MILK ENRICHED WITH GINGER AND BLACK PEPPER

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ABSTRACT

Present investigation was carried out to assess the sensory evaluation of herbs enriched *shrikhand*. *Shrikhand* is a popular Indian dessert prepared by fermentation of milk. In present study the *shrikhand* is obtained by buffalo and camel milk (70:30) by incorporating spices. *Shrikhand* was prepared from dahi (70% buffalo + 30% camel milk) with a constant level of sugar (40%) and supplementing with ginger powder (0.5%, 1%, 1.5% - T₁G₁, T₁G₂, T₁G₃), black pepper powder (0.5%, 1%, 1.5% - T₂B₁, T₂B₂, T₂B₃) and ginger + black pepper powder (0.25-0.25%, 0.5+0.5%, 0.75-0.75% - T₃(GB)₁, T₃(GB)₂, T₃(GB)₃). T₀ served as control with no supplementation. The sensory evaluation of the developed *shrikhand* was carried out using an 8-point hedonic scale by semi-trained panellists to assess appearance and colour, flavour, body and texture and overall acceptability. Three treatment groups were prepared based on the spice incorporated (ginger, black pepper and ginger + black pepper) and each group consisted of three concentration levels (0.5%, 1.0%, and 1.5%). The comparison of sensory scores was therefore made within their respective treatment groups. It was observed that the 1% ginger, 1% black pepper and 0.5% + 0.5% ginger + black pepper treatments obtained significantly ($P < 0.01$) higher overall acceptability, scoring 7.44 ± 0.039 , 7.70 ± 0.041 and 7.69 ± 0.031 , respectively. After identifying the best compositions within each group, a subsequent comparison among the three most acceptable treatments-1% ginger (T₁), 1% black pepper (T₂) and 0.5% + 0.5% ginger + black pepper (T₃) was conducted. The pooled data were then used to determine overall acceptability. Sensory analysis showed a significant difference ($P < 0.01$) in various sensory attributes of the T₁ sample compared with the other treatments. *Shrikhand* prepared with 1% ginger powder (T₁) recorded the highest overall acceptability, scoring 7.69 ± 0.032 .

Keywords: Black Pepper, Buffalo Milk, Camel Milk, Ginger, Hedonic Scale

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Shrikhand is one of the leading indigenous fermented milk products in the Indian diet, particularly enjoyed in the states of Maharashtra and Gujarat (Aneja *et al.*, 2002). Fermented milk products become more nutritious due to the increased vitamin content produced by selective starter cultures. Fermented milk products have better keeping quality and are easily digestible because of breaking down of proteins into peptides and free amino acids as a result of microbial action. *Shrikhand* is a popular Indian dessert, it's a creamy, yogurt-based sweet dish that's often flavoured with cardamom, saffron and sometimes fruit like mango and herbs like ginger, black pepper etc. (Aneja *et al.*, 2002). To make it, thick yogurt (usually hung curd or Greek yogurt) is sweetened with sugar and mixed with these flavors. *Shrikhand* is derived from the Sanskrit term '*Shikharani*', a curd produced with additional sugar, flavouring ingredients (saffron), fruits, nuts and almonds (Mane *et al.*, 2017). This chakka is then finely combined with sugar and flavourings to achieve a semisoft texture and sour-sweet flavour. *Shrikhand* is well-known for its excellent nutritional value, distinctive flavour, appetizing nature, and potential therapeutic value. Lactic acid bacteria reduce blood cholesterol levels while raising vitamin B levels in the product (Bhandage *et al.*, 2020).

Camel milk is an excellent source of health-beneficial substances in the human diet. Camel milk has an average of 3.1% protein, 3.5% fat, 4.4% lactose, 0.79% ash and 11.9% total solids. Water content is the most significant component in camel milk (Kaskous, 2016). Camel milk has less lactose than cow's milk, making it potentially more tolerable for people with mild lactose intolerance. Fermented camel milk, which contains more antioxidant peptides due to its higher β -casein level has been proven to be a medicinal substance (Izadi *et al.*, 2019). Buffalo milk has a significant impact on human nutrition.

Buffalo milk contains higher concentrations of fat (6.80%), ash, total solids ($17.0 \pm 0.1\%$), protein (3.91%), SNF (9.61%), lactose ($4.83 \pm 0.01\%$), calcium and vitamins A and C. Because of its vitamins, minerals and bioactive components, buffalo milk exhibits notable antioxidant properties. The greater antioxidant capacity of buffalo milk, as compared with cow milk, has been attributed to its higher monounsaturated fatty acid (MUFA) content (Khan *et al.*, 2017).

Because of the potential toxicity of chemical preservatives in humans, there is a growing market that prefers meals devoid of them. Herbs, spices and seasonings have been familiar to humans for centuries.

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Herb's bioactive components include antioxidant and antibacterial characteristics, preventing degradation and increasing the shelf life of dairy products. Moreover, their ingestion has been linked to several health advantages. (Barak *et al.*, 2023). Black pepper (*Piper nigrum*) is an excellent source of minerals, including manganese, phosphorus, iron, potassium and magnesium. Calcium, dietary fibre, copper, and vitamins B₆, C and K. Along with piperine, it also contains flavonoids, other alkaloids and monoterpenes (camphene, pinene and limonene) that have antibacterial properties against a variety of microbes. (Khawsud *et al.*, 2020). According to Ayurvedic medicine, ginger (*Zingiber officinale*) is a carminative stimulant that provides stimulating treatments. All the elements needed for healthy nutrition are present in ginger. Iron, calcium, vitamins C, E and B₆ and dietary fibre are also present. It contains no cholesterol. Therefore, the aim of this study was to evaluate the sensory parameters of *shrikhand* manufactured with buffalo and camel milk supplemented with different levels of ginger and black pepper powder.

MATERIALS AND METHODS

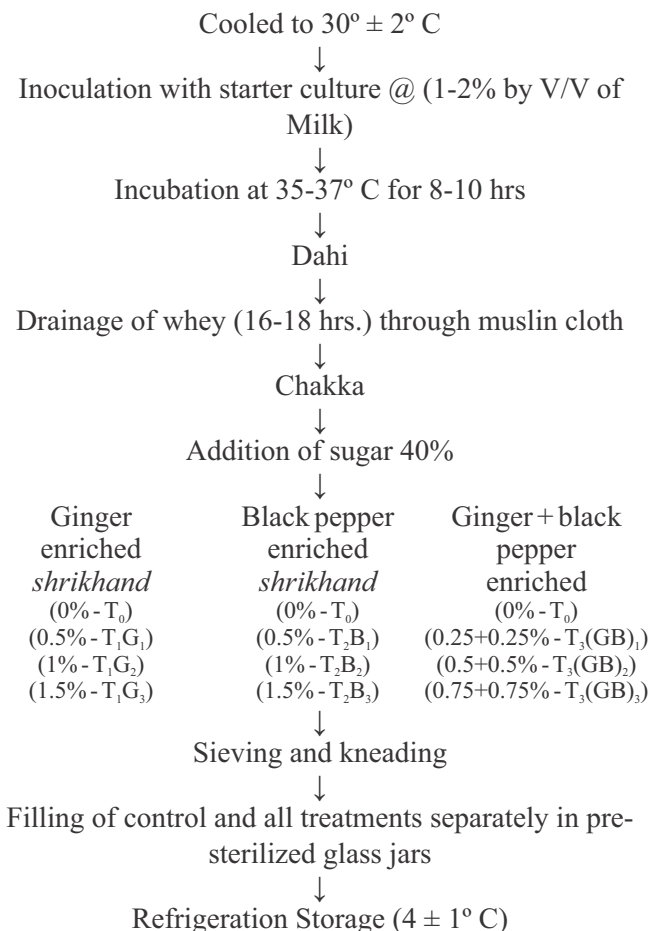
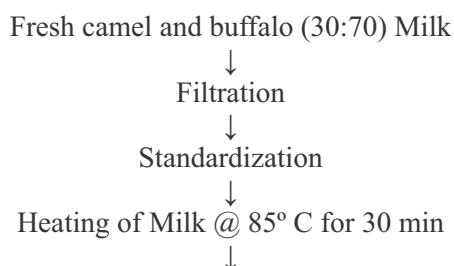
The experiment research work was carried out to prepare *shrikhand* with the addition of black pepper (*Piper nigrum*) and ginger powder (*Zingiber officinale*) which was conducted in the laboratory of the Department of Livestock Products Technology, College of Veterinary and Animal Science, (RAJUVAS) Bikaner during the year 2023-24. The materials used and the methodologies adapted are as under.

MATERIALS

Good quality Fresh buffalo milk was collected from local buffalo dairy farm of Bikaner. And fresh camel milk was collected from National Research Centre on Camel, Bikaner was standardized to 6% fat and filtered to remove dirt and other extraneous matter, before use. All samples were collected manually in sterile bottles. Good quality sugar, black pepper and ginger powder was procured from Bikaner local market.

Preparation of black pepper, ginger and ginger +black pepper added *Shrikhand*

Shrikhand was prepared as per procedure described by (Aneja *et al.*, 2002) with slight modification.



Sensory evaluation of the herbs-enriched *shrikhand* prepared as per the experimental formulations was conducted using an 8-point hedonic scale by a panel of eight semi-trained members drawn from academic staff, technical staff and students of the Department of Livestock Products Technology, RAJUVAS, Bikaner for various sensory attributes viz., appearance and colour, flavour, body and texture and overall acceptability. In the hedonic scale, a score of '8' denotes "excellent," whereas '1' denotes "extremely poor."

Each treatment was prepared in three independent replications, generating a total of n = 21 sensory observations per attribute. *Shrikhand* samples were presented on plates, coded with a three-digit digital code and the order of presentation was randomized for each panellist. To avoid flavour carryover, panellists rinsed their mouths with potable water between evaluations. The sensory data were statistically analysed by adopting appropriate analysis of variance (ANOVA) procedures as described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Sensory evaluation of various levels of ginger in *shrikhand*

Sensory evaluation of the various levels of ginger in

shrikhand showed that sample T₁G₂ with 1% ginger powder had significantly ($P<0.01$) higher acceptability in all the attributes analysed as presented in Table 1. This is in agreement with the report of Sahu & Pathak (2021), Kumari *et al.* (2021), Waghmare *et al.* (2021) and Yedatkar *et al.* (2022). where the control *shrikhand* samples were preferred by the panelists. Scores for Appearance and Colour, Flavour, Body and Texture, Overall Acceptability ranged from $7.58^d \pm 0.031$ - $5.89^a \pm 0.041$, $7.18^d \pm 0.072$ - $5.33^a \pm 0.046$, $7.49^c \pm 0.032$ - $6^a \pm 0.047$ and $7.44^d \pm 0.039$ - $5.72^a \pm 0.043$, respectively with significant difference ($P\leq 0.01$) between samples. Control had significantly lower scores compared to other samples. Colour and flavour is a very important parameter in judging properly prepared *shrikhand* products that not only reflect in the suitability of raw materials used for the preparation but also provides information about the quality of the product. A significant difference ($p<0.01$) was observed between treatment of ginger enriched *shrikhand* for appearance and colour, flavour, body and texture and overall acceptability of sensory evaluation. Thus, it may be interpreted that the different levels of ginger powder significantly affect the sensory quality of *shrikhand* but 1% ginger powder give best result in *shrikhand* preparation.

Sensory evaluation of various levels of black pepper in *shrikhand*

The mean score for appearance and colour ranged between 5.84 ± 0.052 to 7.50 ± 0.102 . The highest mean score 7.50 ± 0.102 was obtained in 1% (T₂ B₂) black pepper enriched *shrikhand* as compared to the control, T₂ B₁ and T₂ B₃. The addition of 1.5% black pepper to *shrikhand* resulted in a significant decline in the score. The acceptability of any dairy product is influenced by its flavour. The alterations in flavour score of developed *shrikhand* found that there was a significant difference in flavour score when black pepper was introduced at different levels. It was found that 1 per cent level of black pepper got maximum flavour score that was 7.87 ± 0.031 which varied from control, 0.5% and 1.5% level of black pepper enriched *shrikhand* preparation. The average score for body and textural qualities of black pepper enriched *shrikhand* treatments were from 6.25 ± 0.02 to 7.48 ± 0.051 . The maximum score 7.48 ± 0.051 obtained of 1 per cent level of black pepper enriched *shrikhand* as shown in table 2. The addition of 1.5% black pepper resulted in a drop in the overall acceptability score. Out of all the treatments, the 1% black pepper added *shrikhand* sample had the highest overall acceptance score of 7.70 ± 0.041 . A significant difference ($P<0.01$) was reported between treatment of black pepper enriched *shrikhand* for appearance and Colour, flavour, body and texture and

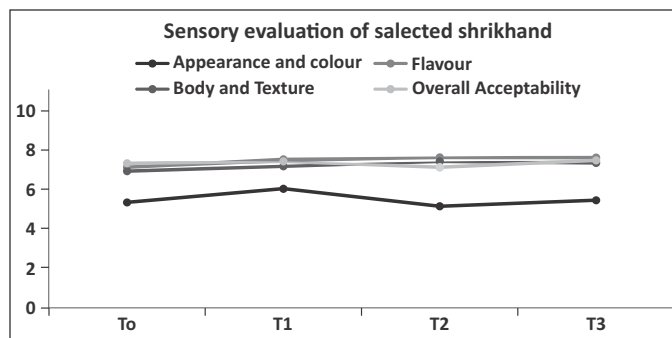


Fig. 1. Sensory evaluation of selected *shrikhand* T₀- Control *shrikhand*, T₁-1% ginger enriched *shrikhand*, T₂- 1% black pepper enriched *shrikhand* and T₃-0.5% ginger+0.5% black pepper enriched *shrikhand*.

overall acceptability. Similar findings have been reported by earlier researchers, where the incorporation of spices or herbal additives in fermented milk products such as *shrikhand*, yoghurt and flavoured dairy desserts showed that moderate levels enhanced sensory attributes, while higher levels led to reduced acceptability. Prajapat (2019) and Meena *et al.* (2020) documented similar trends in spice-enriched *shrikhand* and Sarkar & Ghosh (2020), Kumari *et al.* (2021), Sarnaik *et al.* (2021), Shori (2022) and Kumari *et al.* (2022) all confirmed that excessive addition of spices or botanicals tends to impart sharp or overpowering flavour, thereby reducing consumer preference.

Sensory evaluation of ginger + black pepper enriched *shrikhand*

Ginger + black pepper had a significant ($P<0.01$) influence on Appearance and Colour, Flavour, Body and Texture, Overall Acceptability of the *shrikhand*. The average score for appearance and colour varied from 5.84 ± 0.041 to 7.38 ± 0.043 . The highest score was 7.38 ± 0.043 at the 1(0.5+0.5) percent level. The score declined significantly when 1.5(0.75+0.75) percent ginger and black pepper were added to *shrikhand*. From the Table 3. it is observed that the flavour score increased on addition of ginger + black pepper up to 1 (0.5 + 0.5) per cent. In comparison to control (T₀), T₃(GB)₁ and T₃(GB)₃, the flavour of the ginger + black pepper enriched *shrikhand* sample [T₃(GB)₂] was the greatest, i.e. 7.70 ± 0.035 . However, subsequent addition of ginger + black pepper at the rate of 1.5(0.75+0.75) per cent resulted into reduction in score up to 7.30 ± 0.082 . The body and texture of T₃(GB)₂ sample of ginger + black pepper enriched *shrikhand* was highest i.e. 7.54 ± 0.016 compared to T₀, T₃(GB)₁ and T₃(GB)₃. The results of overall acceptability have been provided in Table 3 found that the sample T₃(GB)₂ (0.5+0.5 per cent) level presents better outcomes score 7.69 ± 0.031 than sample T₀, T₃(GB)₁ and T₃(GB)₃. There was a significant difference ($P<0.01$) in the body and texture,

Table 1. Sensory evaluation of various levels of ginger enriched shrikhanda (Mean±SE)

Parameters/ Treatments	T ₀	T ₁ G ₁	T ₁ G ₂	T ₁ G ₃
Appearance and Colour	5.89 ^a ±0.041	6.83 ^b ±0.053	7.58 ^d ±0.031	7.10 ^c ±0.054
Flavour	5.33 ^a ±0.046	6.62 ^b ±0.043	7.18 ^d ±0.072	6.83 ^c ±0.041
Body and Texture	6.00 ^a ±0.047	7.13 ^b ±0.046	7.49 ^e ±0.032	7.22 ^b ±0.051
Overall Acceptability	5.72 ^a ±0.043	6.80 ^b ±0.041	7.44 ^d ±0.039	7.06 ^c ±0.037

Note: Means bearing different superscript in a row differ significantly. T₀ - Control *Shrikhand*, T₁G₁ - 0.5% ginger *Shrikhand*, T₁G₂ - 1% ginger *Shrikhand* and T₁G₃ - 1.5% ginger *Shrikhand*

Table 2. Sensory evaluation of black pepper enriched shrikhanda (Mean±SE)

Parameters/ Treatments	T ₀	T ₂ B ₁	T ₂ B ₂	T ₂ B ₃
Appearance and Colour	5.84 ^a ±0.052	6.22 ^b ±0.031	7.50 ^d ±0.102	6.80 ^c ±0.035
Flavour	5.34 ^a ±0.039	7.34 ^b ±0.041	7.87 ^d ±0.031	7.46 ^c ±0.031
Body and Texture	6.25 ^a ±0.020	6.83 ^b ±0.031	7.48 ^d ±0.051	7.11 ^c ±0.032
Overall Acceptability	5.76 ^a ±0.039	6.88 ^b ±0.041	7.70 ^d ±0.041	7.17 ^c ±0.06

Means ± SE bearing different superscript in a row differ significantly. T₀ - Control *shrikhand*, T₂B₁ - 0.5% black pepper enriched *Shrikhand*, T₂B₂ - 1% black pepper enriched *shrikhand* and T₂B₃ - 1.5% black pepper enriched *shrikhand*

Table 3. Sensory evaluation of ginger + black Pepper enriched shrikhanda (Mean±SE)

Parameters/ Treatments	T ₀	T ₃ (GB) ₁	T ₃ (GB) ₂	T ₃ (GB) ₃
Appearance and Colour	5.84 ^a ±0.041	6.63 ^b ±0.031	7.38 ^d ±0.043	7.00 ^c ±0.102
Flavour	5.37 ^a ±0.046	7.15 ^b ±0.061	7.70 ^c ±0.035	7.30 ^b ±0.082
Body and Textures	6.12 ^a ±0.040	7.00 ^b ±0.102	7.54 ^c ±0.016	7.17 ^b ±0.047
Overall Acceptability	5.74 ^a ±0.096	6.90 ^b ±0.041	7.69 ^c ±0.031	7.02 ^b ±0.063

Means±SE bearing different superscript in a row differ significantly. T₀ - Control *shrikhand*, T₃(GB)₁ - 0.5% ginger + 0.5% black pepper enriched *shrikhand*, T₃(GB)₂ - 1% ginger + 1% black pepper enriched *Shrikhand* and T₃(GB)₃ - 1.5% ginger + 1.5% black pepper enriched *shrikhand*.

Table 4. Sensory evaluation of selected shrikhanda (Mean±SE)

Parameters/ Treatments	T ₀	T ₁	T ₂	T ₃
Appearance and Colour	5.40 ^a ±0.054	7.20 ^{bc} ±0.108	7.00 ^b ±0.147	7.40 ^c ±0.061
Flavour	6.10 ^a ±0.082	7.60 ^c ±0.074	7.25 ^b ±0.104	7.50 ^{bc} ±0.041
Body and Texture	5.20 ^a ±0.108	7.70 ^c ±0.082	7.50 ^c ±0.054	7.20 ^b ±0.102
Overall Acceptability	5.51 ^a ±0.032	7.69 ^d ±0.032	7.42 ^b ±0.041	7.55 ^c ±0.054

Means±SE bearing different superscript in a row differ significantly. T₀ - Control *shrikhand*, T₁ - 1% ginger enriched *shrikhand*, T₂ - 1% black pepper enriched *shrikhand* and T₃ - 0.5% ginger + 0.5% black pepper enriched *shrikhand*.

appearance and colour, flavour and overall acceptability of sensory evaluation between the ginger and black pepper enriched *shrikhand* treatments. From the sensory assessment of *shrikhand* prepared in preliminary trial, it was indicated that the addition of 1 per cent level of natural preservative in single or in combination provided best acceptable quality of *shrikhand*. Similar results have been reported by several researchers working on spice- or herb-incorporated fermented milk products, particularly *shrikhand* and yoghurt. Felfoul *et al.* (2017) observed that addition of plant extracts to yoghurt enhanced flavour and texture only up to an optimum concentration. Badola *et al.* (2018) found that spice-enriched *shrikhand* showed better

acceptability at moderate levels, whereas excessive incorporation reduced panel scores. Prajapat (2019) and Meena *et al.* (2020) also demonstrated that *shrikhand* fortified with natural spices such as ginger, black pepper and cardamom achieved maximum scores at intermediate levels of addition. Similarly, Kumari *et al.* (2021), Waghmare *et al.* (2021) and Khandagale *et al.* (2022) reported improved sensory characteristics in spice-based dairy desserts but noted a decline at higher dosages due to overpowering flavour. Wakde *et al.* (2023) further confirmed that optimal incorporation of herbal/spice mixtures in fermented dairy products enhances appearance, flavour, body and texture, while excessive addition negatively

affects overall acceptability.

Sensory evaluation of selected *shrikhand*

Based on a sensory evaluation of *shrikhand* enhanced with different amounts of herbs, it was found that the maximum degree of acceptability for the *shrikhand* was achieved when 1% of ginger and 1% of black pepper were added, either separately or in combination. The mean values for all the attributes like flavour, body and texture, appearance and colour and overall acceptability for various *shrikhand* range from 5.20 ± 0.108 to 7.70 ± 0.082 . The mean scores for the appearance and colour of the control *shrikhand* (T_0) were determined to be 5.40 ± 0.054 , while the scores for herbs enriched *shrikhand* i.e. for T_1 , T_2 and T_3 were 7.20 ± 0.108 , 7.00 ± 0.147 and 7.40 ± 0.061 , respectively. As a result, the panellists awarded T_3 (0.5+0.5% ginger + black pepper enriched buffalo and camel milk *shrikhand*) the maximum possible score of 7.40 ± 0.061 and minimal score achieved by the control group (T_0) for appearance and colour was 5.40 ± 0.054 . The average score for flavour of control *shrikhand* (T_0) was found to be 6.10 ± 0.082 and for herbs enriched *shrikhand* i.e. for T_1 , T_2 and T_3 it was found to be 7.60 ± 0.074 , 7.25 ± 0.104 and 7.50 ± 0.041 , respectively. Thus, it may be concluded that T_1 (1% ginger enriched *shrikhand*) had highest flavour score 7.60 ± 0.074 for flavour by the panellist. The average body and texture score for control *shrikhand* (T_0) was 5.20 ± 0.108 , while T_1 , T_2 and T_3 had scores of 7.70 ± 0.082 , 7.50 ± 0.054 and 7.20 ± 0.102 , respectively. Therefore, it can be concluded that T_1 (1% ginger enhanced *shrikhand*) received a maximum score of 7.70 ± 0.082 for body and texture from the panellists, while T_0 (control *shrikhand*) received a minimum score of 5.20 ± 0.108 for body and texture. On the basis of results obtained in the present study as shown in Table 4 the ginger enriched *shrikhand* (T_1) had gained maximum overall acceptance 7.69 ± 0.032 . Whereas control and other treatments i.e. (T_0), (T_2) and (T_3) it was determined to be 5.51 ± 0.032 , 7.42 ± 0.041 and 7.55 ± 0.054 , respectively that is shown in figure 1.

The present study demonstrated that ginger, black pepper and their combinations significantly improved the sensory attributes of *shrikhand* up to an optimum level, beyond which acceptability declined. These findings are in close agreement with earlier research on herb- and spice-enriched fermented dairy products. Rathod *et al.* (2019) reported improved sensory quality in *shrikhand* fortified with ginger, tulsi and cinnamon extracts, showing that moderate incorporation enhanced flavour and texture, similar to the effect of 1% ginger in the present study. Maji *et al.* (2020) evaluated yoghurt enriched with mint and

tulsi extracts and found that optimum levels improved body and texture, consistent with the enhancement observed in our formulations containing 1% black pepper and 1% ginger. Meena *et al.* (2020) worked with *shrikhand* supplemented with cardamom, clove and cinnamon, reporting maximum acceptability at moderate spice levels, which supports our observation that higher concentrations (1.5%) reduce sensory scores. Mishra *et al.* (2021) studied fermented dairy desserts fortified with fenugreek, ginger and turmeric extracts and similarly found that botanical additives improved sensory perception, in line with our results for ginger and ginger–black pepper blends. Prajapat *et al.* (2021) used ginger, black pepper and cardamom in *shrikhand* and reported enhanced acceptability at middle-range levels, closely matching the outcomes of our study. Waghmare *et al.* (2021) observed that medicinal spice blends including ginger, cinnamon and pepper improved appearance, flavour and texture, which parallels our findings across all sensory attributes. Kumari (2022) documented improved sensory characteristics in *shrikhand* fortified with cardamom, clove and nutmeg, again reporting decline at higher inclusion levels, similar to the 1.5% treatments in our work. Khandagale *et al.* (2022) demonstrated that dairy products enriched with black pepper, cinnamon and ginger achieved maximum scores at moderate concentrations, comparable to the behaviour of 1% black pepper and combined ginger–pepper formulations in our study. Savaliya *et al.* (2023) found that yoghurt enriched with mint, ginger and tulsi exhibited improved sensory acceptance only up to an optimum level, supporting our conclusion that moderate incorporation (1% or 0.5+0.5%) provides the best results.

CONCLUSION

Sensory evaluation of herb-enriched *shrikhand* prepared from a standardized blend of buffalo and camel milk (70:30; 5.68% fat and 9.26% SNF), supplemented with 40% sugar and 1–2% starter culture, demonstrated that all formulations possessed desirable sensory attributes. Among the different incorporation levels of ginger, black pepper, and their combination, the formulation containing 1% ginger consistently achieved superior scores for colour, flavour, body and texture and overall acceptability. The findings clearly indicate that the buffalo–camel milk blend, when optimally fortified with ginger, can significantly enhance the sensory appeal of *shrikhand*, offering a promising approach for developing value-added fermented dairy products.

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IMPORTANT INFORMATION

- Research/Clinical articles are invited for next issue from the Scientists/Veterinarians engaged in Veterinary Profession.
- Please follow strictly the format of ‘The Haryana Veterinarian’ for manuscript writing/ submission.
- **The article processing and publication charges will be revised from Rs. 1200/- to 1500/- per manuscript with effect from the next year (01.01.2027).**
- We solicit your co-operation.
- All correspondence should be addressed to the ‘Editor, The Haryana Veterinarian’, Department of Veterinary Parasitology, College of Veterinary Sciences, LUVAS, Hisar-125004, Haryana.

Editors