

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 9; September 2026; Page No. 576-581

Received: 19-06-2026
Accepted: 23-07-2026

Indexed Journal
Peer Reviewed Journal

Studies on sensory and microbiological quality of *kalakand* blended with kiwi fruit (*Actinidia deliciosa*) pulp

¹AS Kadam, ²DS Chauhan, ³BC Andhare, ⁴SS Thorat and ⁵RB Helge

^{1,4,5}PG Scholar, Department of Animal husbandry and Dairy Science, College of Agriculture, Latur, Maharashtra, India

²Professor, Department of Animal husbandry and Dairy Science, College of Agriculture, Latur, Maharashtra, India

³Assistant Professor, Department of Animal husbandry and Dairy Science, College of Agriculture, Ambajogai, Maharashtra, India

DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i9h.4238>

Corresponding Author: AS Kadam

Abstract

The present investigation was undertaken to study the sensory and microbiological quality and shelf life of *kalakand* blended with kiwi fruit (*Actinidia deliciosa*) pulp. Four treatments were prepared by incorporating kiwi fruit pulp at 0, 2.5, 3.5 and 5.0 parts, designated as T₁, T₂, T₃ and T₄, respectively. The prepared *kalakand* samples were evaluated for sensory quality using a 9-point hedonic scale, while microbiological analysis was determined using standard analytical methods. Among the sensory attributes, the flavour score increased from 7.38 to 8.88 with increasing levels of kiwi fruit pulp. The highest scores for colour and appearance (8.75), body and texture (8.75) and overall acceptability (8.88) were recorded for T₃ containing 3.5 parts kiwi fruit pulp. The samples were stored under refrigerated conditions at 7 ± 2°C and evaluated on the 0th, 6th and 12th day for standard plate count, yeast and mould count and coliform count. The standard plate count increased progressively during storage, ranging from 9.0 to 13.0 × 10³ cfu/g on the 0th day, 12.0 to 17.0 × 10³ cfu/g on the 6th day and 15.0 to 23.0 × 10³ cfu/g on the 12th day. Similarly, the yeast and mould count increased during storage, ranging from 0.42 to 0.60 × 10³ cfu/g on the 0th day and 1.00 to 1.75 × 10³ cfu/g on the 12th day. Coliform organisms were not detected in any of the treatments throughout the storage period. The product remained microbiologically satisfactory up to 12 days under refrigerated storage. Based on sensory and microbiological quality, T₃ containing 3.5 parts kiwi fruit pulp was identified as the most acceptable formulation. The study indicated that incorporation of kiwi fruit pulp at an appropriate level can improve the sensory quality of *kalakand* while maintaining satisfactory microbiological quality during refrigerated storage.

Keywords: *Kalakand*, kiwi fruit pulp, *Actinidia deliciosa*, sensory quality, microbiological quality, shelf life, standard plate count, yeast and mould count, coliform count

Introduction

India has maintained its status as the world's leading producer of milk since 1998, currently accounting for nearly one-fourth of global milk output. The nation's milk production has experienced substantial growth, rising from 146.30 million tonnes during the 2014–15 period to 247.87 million tonnes in 2024–25, which reflects a year-over-year growth rate of 3.58 per cent. Consequently, the per capita availability of milk has increased from 319 g per day to 485 g per day, significantly exceeding the global average of approximately 350 g per day. This consistent growth is primarily driven by enhanced productivity of milch animals; specifically, during 2024–25, production increased by 4.97 per cent from exotic and crossbred cattle, 3.51 per cent from indigenous and non-descript cattle, and 2.45 per cent from buffaloes. The states of Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat, and Maharashtra collectively generate 54.09 per cent of the national milk output, with Maharashtra contributing 6.71 per cent independently.

Scientifically acknowledged as a "complete food," milk possesses a balanced profile of high-biological-value proteins, essential fatty acids, lactose, and a diverse range of

micronutrients. Within the Indian subcontinent, milk is predominantly consumed in processed forms, most notably as Traditional Indian Dairy Products (TIDPs). These traditional products hold a crucial position within the Indian dairy sector, making substantial contributions to the nutritional, economic, social, and cultural health of the population. Converting surplus milk into indigenous dairy products is highly advantageous, particularly when storage and transportation infrastructure for liquid milk is inadequate. Processing milk into TIDPs not only extends its keeping quality and preserves its valuable constituents but also generates rural employment and supplementary income, cementing these products as a dominant segment of the Indian dairy market.

Among the wide array of TIDPs, *kalakand* holds a prestigious status as a partially desiccated, acid-coagulated milk sweet renowned for its characteristic danedar (grainy) texture, caramelized flavour, and moist consistency. Technologically, its preparation requires the continuous heating of milk, or a mixture of *khoa* and sugar, alongside controlled acidification to facilitate the necessary grain formation. The conventional manufacturing process involves heating milk in a suitable

vessel with continuous stirring to prevent scorching, followed by the addition of diluted citric acid to induce partial protein coagulation. The mixture is further heated and stirred until a semi-solid granular mass forms, after which sugar and optional flavouring agents like cardamom are incorporated before uniformly spreading the mass in greased trays to cool and set at room temperature.

Kalakand remains highly favoured across various socio-economic demographics and is a staple during cultural, social, and religious events such as weddings, birthday celebrations, inaugural functions, and festivals like Diwali, ensuring consistent year-round demand. The product serves as an effective mechanism for valorizing surplus milk, aiding the economic advancement of rural dairy enterprises. To adapt to evolving consumer tastes, markets in Maharashtra now offer diverse varieties of *kalakand*, including fig, mango, ash gourd, sapota, strawberry, plain, and Kashmiri variants. However, plain *kalakand* possesses a high moisture content of approximately 20–25 per cent and high nutrient density, making it exceedingly vulnerable to microbial spoilage and restricting its ambient shelf life to a mere 2–3 days.

Simultaneously, the modern dairy industry is navigating an increasing consumer demand for "functional foods" that deliver health benefits alongside basic nutrition. Fortifying dairy matrices with fruits and vegetables is a promising strategy to address this trend, as fruits provide dietary fibre and natural antioxidants that can improve the physico-chemical properties of the product and offer protection against oxidative stress and chronic ailments such as cardiovascular disease. Kiwi fruit (*Actinidia deliciosa*), a member of the Actinidiaceae family and *Actinidia* genus, is an exceptional candidate for such fortification. In India, its cultivation occurs primarily in the mid-hills of the North-Eastern region, Himachal Pradesh, Uttarakhand, and Jammu & Kashmir. Arunachal Pradesh is the dominant producer, yielding approximately 7.05 thousand tonnes and accounting for nearly 45 per cent of the national output in 2023–24, followed by Manipur, Sikkim, Meghalaya, and Nagaland.

Kiwi fruit thrives in slightly acidic soils with a pH range of 6.0–6.5 under full sunlight or partial shade. It is consumed fresh and also processed into juices, purees, candies, spirits, syrups, and lyophilized products. It is recognized as a nutritional powerhouse loaded with vitamin C (ascorbic acid), vitamin E, and vital minerals like potassium and magnesium. It boasts a high concentration of phytonutrients, including lutein, flavonoids, and chlorophyll, which add considerable therapeutic value and promote digestive function, metabolic health, and immune response. Consuming these beneficial constituents helps reduce the risk of cardiovascular disease by lowering the platelet aggregation response to collagen and reducing blood triglyceride levels. Furthermore, the natural acidity and unique enzymatic profile of kiwi fruit, most notably the cysteine protease actinidin, can be exploited in dairy processing lines to influence coagulation and textural behaviour. Actinidin constitutes more than half of the soluble protein in kiwi fruit pulp and is capable of hydrolysing milk casein. Accordingly, kiwi fruit extract has been demonstrated to possess milk-clotting activity comparable to that of purified actinidin. This distinctive proteolytic activity provides a plausible biochemical foundation for the expected interaction between kiwi fruit pulp and the casein matrix of *khoa* during the manufacturing of a blended *kalakand* product.

Exploring these technological intersections is imperative to

create value-added commodities that cater to modern, health-conscious consumers while preserving the essence of traditional sweets. Accordingly, the present research project, entitled "Studies on Preparation of *Kalakand* Blended with Kiwi Fruit (*Actinidia deliciosa*) Pulp", was undertaken with the objectives to standardize the process of *kalakand* preparation blended with kiwi fruit pulp, to study its sensory quality and proximate composition, to evaluate its microbiological shelf life, and to estimate the cost of production of the product.

Materials and Methods

The present research was conducted during 2025–2026 in the Department of Animal Husbandry and Dairy Science, College of Agriculture, Latur. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Materials

Fresh standardized buffalo milk containing 6% fat and 9% solids-not-fat (SNF), fresh & matured kiwi fruit and crystalline cane sugar were procured from local market.

Microbiological Media

The *kalakand* samples were analyzed for standard plate count, yeast and mould count, coliform count by using Nutrient Agar (NA), Potato Dextrose Agar (PDA), Violet Red Bile Agar (VRBA).

Methods

Preparation of *kalakand* blended with kiwi fruit pulp

Standardized buffalo milk containing 6% fat and 9% SNF was filtered and concentrated by boiling for 20–25 min with continuous stirring and scraping. Citric acid (0.02% w/v) was added for partial coagulation, and heating was continued until a semi-solid *danedar* mass was obtained. Kiwi pulp was incorporated according to the treatment, followed by sugar at 30% of the *khoa*-pulp blend. The mixture was cooked for 5 min over low flame with continuous stirring, transferred to greased trays, set at 25–30 °C, cut into uniform pieces and used for further analysis.

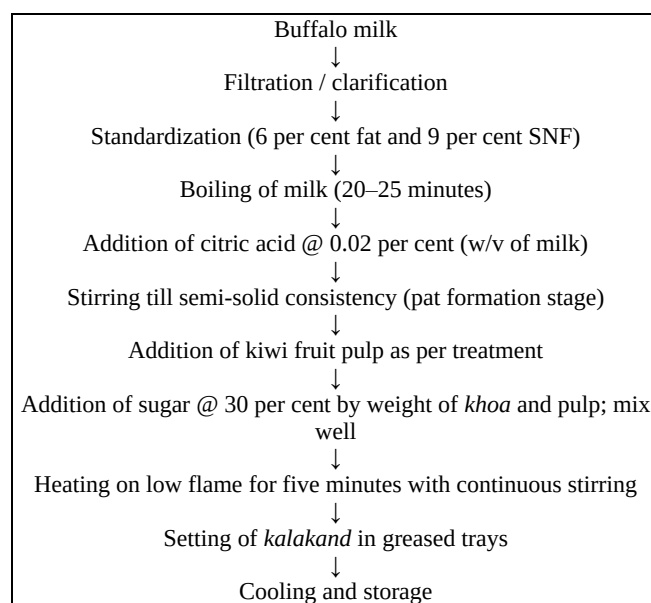


Fig 1: Flow diagram for preparation of *kalakand* blended with kiwi fruit pulp (Maske et al. 2023) ^[10]

Treatment combinations

Kalakand blended with kiwi fruit pulp was prepared using sugar at 30 per cent by weight of the *khoa* in the control, and at 30 per cent by weight of the *khoa* and kiwi fruit pulp blend in the treatment groups, as follows:

T₁ - 100 parts of *khoa* by weight (control)

T₂ - 97.5 parts of *khoa* + 2.5 parts of kiwi fruit pulp by weight

T₃ - 96.5 parts of *khoa* + 3.5 parts of kiwi fruit pulp by weight

T₄ - 95.0 parts of *khoa* + 5.0 parts of kiwi fruit pulp by weight

Sensory evaluation

The sensory evaluation of the control and the kiwi fruit blended *kalakand* samples was carried out by a panel of five semi-trained judges. The samples were evaluated for colour and appearance, flavour, body and texture and overall acceptability. Each panellist was provided with a standardized score card (Appendix I) on which to record observations. The evaluation was performed using the 9-point hedonic scale developed by the Quartermaster Food and Container Institute, U.S.A., as reported by Gupta (1976) [6].

Microbiological analysis

The microbiological analysis of *kalakand* samples for standard plate count, yeast and mould count, coliform count was performed according to A.O.A.C. method (1975).

Statistical analysis

The experimental data generated during the study were analysed statistically using a Completely Randomized Design (CRD) as described by Panse and Sukhatme (1967), with four treatments and four replications.

Results and Discussion

Colour and appearance of *kalakand* blended with kiwi fruit pulp

Table 1: Colour and appearance score of *kalakand* blended with kiwi fruit pulp

Treatment	Replication				Mean
	R ₁	R ₂	R ₃	R ₄	
T ₁	8.50	8.00	7.50	8.00	8.00 ^{bc}
T ₂	9.00	8.50	8.00	8.50	8.50 ^{ab}
T ₃	8.50	9.00	8.50	9.00	8.75 ^a
T ₄	8.00	7.50	7.50	7.00	7.50 ^c
S.E. $\pm$ 0.1909 C.D. at 5% 0.5883					

Means bearing different superscripts differ significantly ($p < 0.05$).

The mean colour and appearance scores of T₁, T₂, T₃ and T₄ were 8.00, 8.50, 8.75 and 7.50, respectively. T₃ (3.5 parts kiwi fruit pulp) recorded the highest score, while T₄ (5.0 parts) recorded the lowest. The treatments differed significantly ($p < 0.05$), with T₃ being superior to T₁ and T₄, whereas T₂ was statistically at par with T₁ and T₃. Incorporation of kiwi fruit pulp up to 3.5 parts imparted an attractive light greenish tinge, enhancing the visual appeal of *kalakand*. At 5.0 parts, the higher pulp level and heat treatment resulted in a duller and less uniform colour, leading to lower scores. The present results are in close agreement with those of Deshmukh *et al.* (2022) [4], who recorded that *kalakand* prepared with 15 per cent guava pulp recorded a higher colour and appearance score (8.75) than the control

(8.35). Similar findings were recorded by Kushwaha and Shukla (2019) [9], who noted that *shrikhand* prepared with 6 per cent kiwi fruit pulp achieved a higher colour and appearance score (8.20) than the control.

Flavour score of *kalakand* blended with kiwi fruit pulp

Table 2: Flavour score of *kalakand* blended with kiwi fruit pulp

Treatment	Replication				Mean
	R ₁	R ₂	R ₃	R ₄	
T ₁	8.00	7.00	7.00	7.50	7.38 ^d
T ₂	8.00	8.00	7.50	8.00	7.88 ^c
T ₃	8.50	8.50	8.00	8.50	8.38 ^b
T ₄	9.00	9.00	8.50	9.00	8.88 ^a
S.E. $\pm$ 0.161, C.D. at 5% 0.497					

Means bearing different superscripts differ significantly ($p < 0.05$).

The mean flavour scores of treatments T₁, T₂, T₃ and T₄ were 7.38, 7.88, 8.38 and 8.88, respectively. The control (T₁) recorded the lowest flavour score, while T₄, containing 5.0 parts of kiwi fruit pulp, received the highest. All treatments differed significantly ($p < 0.05$) from one another. The flavour scores increased consistently with increasing levels of kiwi fruit pulp. This improvement is attributed to the pleasant fruity aroma and the mild natural acidity of kiwi fruit, which balanced the intense sweetness of the *khoa*-sugar base and relieved the flatness of the control sample. The present findings are in agreement with those of Kumar and Singh (2017) [8], who reported improved flavour scores (7.20 to 8.60) with increasing levels of wood apple pulp incorporation in *kalakand*. Similar observations were observed by Kushwaha and Shukla (2019) [9], who reported an improved flavour score (8.20) in *shrikhand* containing 6 per cent kiwi fruit pulp.

Body and texture score of *kalakand* blended with kiwi fruit pulp

Table 3: Body and texture score of *kalakand* blended with kiwi fruit pulp

Treatment	Replication				Mean
	R ₁	R ₂	R ₃	R ₄	
T ₁	8.00	7.50	7.50	7.00	7.50 ^b
T ₂	8.50	8.50	8.00	8.00	8.25 ^a
T ₃	9.00	9.00	8.50	8.50	8.75 ^a
T ₄	8.00	8.50	8.00	9.00	8.38 ^a
S.E. $\pm$ 0.1875 C.D. at 5% 0.5777					

Means bearing different superscripts differ significantly ($p < 0.05$).

The mean body and texture scores of T₁, T₂, T₃ and T₄ were 7.50, 8.25, 8.75 and 8.38, respectively. T₃ (3.5 parts kiwi fruit pulp) recorded the highest score, while the control (T₁) recorded the lowest. The treatments differed significantly ($p < 0.05$), with all pulp-incorporated treatments being superior to the control but statistically at par with one another. Incorporation of kiwi fruit pulp up to 3.5 parts improved the body and texture by imparting a smooth, moist and desirable granular consistency. At 5.0 parts, the increased moisture resulted in a softer body and comparatively coarser texture, leading to a slight decline in score. The present findings are consistent with those of Bhutkar *et al.* (2015) [3], who noted that the treatment containing 10 per cent ash gourd pulp

achieved the highest body and texture score (8.50) in *kalakand*. Similar observations were made by Deshmukh *et al.* (2022) [4], who observed that the treatment containing 15 per cent guava pulp recorded the highest body and texture score (8.88).

Overall acceptability score of *kalakand* blended with kiwi fruit pulp

The mean overall acceptability scores of T₁, T₂, T₃ and T₄ were 7.75, 8.25, 8.88 and 8.50, respectively. T₃ (3.5 parts kiwi fruit pulp) recorded the highest score, while the control (T₁) recorded the lowest. The treatments differed significantly ($p < 0.05$), with T₃ being superior to T₁ and T₂ and statistically at par with T₄. Incorporation of kiwi fruit pulp improved overall acceptability up to 3.5 parts, owing to its desirable colour, pleasant fruity flavour, acceptable body and texture and balanced sweetness. The slight decline at 5.0 parts was associated with softer body, coarser texture and duller colour. Thus, T₃ was identified as the optimum level for achieving better overall acceptability of *kalakand*. The

results of the present investigation are in close agreement with those of Deshmukh *et al.* (2022) [4], who reported the highest overall acceptability score (8.65) for *kalakand* prepared with 15 per cent guava pulp. Similar results were observed by Kushwaha and Shukla (2019) [9], who recorded that the incorporation of 6 per cent kiwi fruit pulp improved the overall acceptability of *shrikhand* compared with the control.

Table 4: Overall acceptability score of *kalakand* blended with kiwi fruit pulp

Treatment	Replication				Mean
	R ₁	R ₂	R ₃	R ₄	
T ₁	7.50	7.50	8.00	8.00	7.75 ^c
T ₂	8.00	8.50	8.50	8.00	8.25 ^b
T ₃	9.00	9.00	9.00	8.50	8.88 ^a
T ₄	8.50	8.50	8.00	9.00	8.50 ^{ab}

S.E. $\pm$ 0.1572 C.D. at 5% 0.4846

Means bearing different superscripts differ significantly ($p < 0.05$).

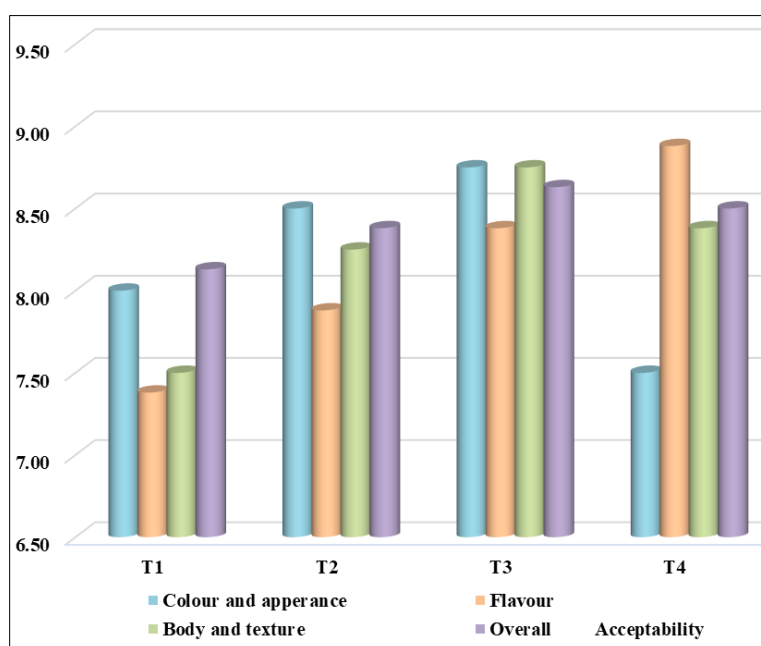


Fig 2: Graphical presentation of sensory quality of *kalakand* blended with kiwi fruit pulp

Microbiological Quality and Shelf Life of *Kalakand* Blended with Kiwi Fruit Pulp

The microbiological quality of *kalakand* blended with different levels of kiwi fruit (*Actinidia deliciosa*) pulp was evaluated during refrigerated storage at $7 \pm 2^\circ\text{C}$ on the 0th, 6th and 12th day of storage. The standard plate count, yeast and mould count and coliform count were determined to assess the microbiological quality and keeping quality of the product.

The standard plate count of *kalakand* ranged from 9.0 to 13.0×10^3 cfu/g on the 0th day, 12.0 to 17.0×10^3 cfu/g on the 6th day and 15.0 to 23.0×10^3 cfu/g on the 12th day. The highest count was observed in control (T₁), while the lowest was recorded in T₄ throughout storage. Thus, the count decreased with increasing kiwi fruit pulp level but increased progressively during storage. The lower counts in pulp-incorporated treatments may be attributed to the acidic nature and antimicrobial constituents of kiwi fruit. All treatments

remained within acceptable limits during the 12-day refrigerated storage. The results obtained are analogous to those of Hande (2016) [7], who recorded that the standard plate count increased from the 0th to the 10th day of refrigerated storage in a kiwi fruit pulp incorporated *chhana* whey beverage. A similar trend was documented by Maske *et al.* (2023) [10] in kinnow juice blended *kalakand*, in which the product remained microbiologically acceptable up to 12 days under refrigerated storage.

Table 5: Standard plate count of *kalakand* blended with kiwi fruit pulp during refrigerated storage ($\times 10^3$ cfu/g)

Treatment	0 th day	6 th day	12 th day
T ₁	13.0	17.0	23.0
T ₂	12.0	15.0	20.0
T ₃	10.0	13.0	17.0
T ₄	9.0	12.0	15.0

Yeast and mould count of *kalakand* blended with kiwi fruit pulp

Table 6: Yeast and mould count of *kalakand* blended with kiwi fruit pulp during refrigerated storage ($\times 10^3$ cfu/g)

Treatment	0 th day	6 th day	12 th day
T ₁	0.60	1.00	1.75
T ₂	0.52	0.90	1.50
T ₃	0.47	0.80	1.35
T ₄	0.42	0.70	1.00

The yeast and mould count of *kalakand* ranged from 0.42 to 0.60×10^3 cfu/g on the 0th day, 0.70 to 1.00×10^3 cfu/g on the 6th day and 1.00 to 1.75×10^3 cfu/g on the 12th day. The highest count was observed in control (T₁), while the lowest was recorded in T₄ throughout storage. The count decreased with increasing kiwi fruit pulp level but increased progressively during storage. The lower counts in pulp-incorporated treatments may be attributed to the acidity and

antioxidant constituents of kiwi fruit, whereas the increase during storage may be due to gradual microbial growth. The counts remained within acceptable limits throughout the 12-day refrigerated storage. The results obtained are analogous to those of Hande (2016) [7], who noted that the yeast and mould count increased from the 0th to the 10th day of refrigerated storage in a kiwi fruit pulp incorporated *chhana* whey beverage. Comparable results were noted by Maske *et al.* (2023) [10] in kinnow juice blended *kalakand*, in which the yeast and mould count increased during refrigerated storage while the product remained microbiologically acceptable up to 12 days.

Coliform count of *kalakand* blended with kiwi fruit pulp

Coliform organisms were not detected in any treatment throughout the storage period. Their complete absence indicates satisfactory hygienic conditions during preparation, packaging and storage, and adequate heat treatment during manufacture.

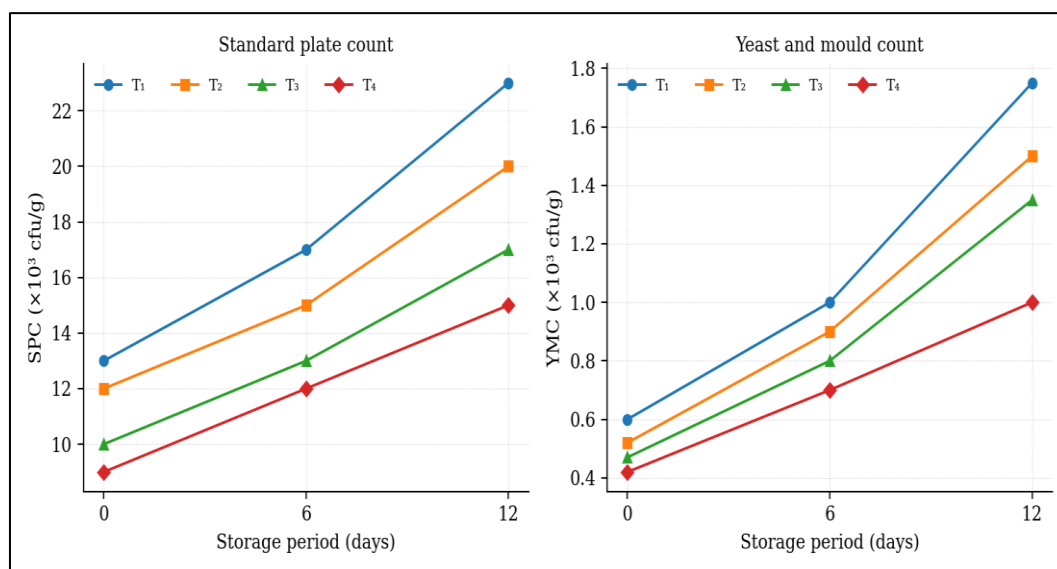


Fig 3: Graphical presentation of microbiological quality of *kalakand* blended with kiwi fruit pulp during refrigerated storage ($7 \pm 2^\circ\text{C}$)

Conclusion

The incorporation of kiwi fruit (*Actinidia deliciosa*) pulp improved the sensory quality and microbiological stability of *kalakand*. Among the treatments, T₃ (96.5 parts *khoa* + 3.5 parts kiwi fruit pulp with 30% sugar) was identified as the optimum formulation, recording the highest overall acceptability (8.88), colour and appearance (8.75), and body and texture (8.75) scores. Although T₄ (5.0 parts pulp) recorded the highest flavour score (8.88), its lower colour and appearance and body and texture scores resulted in lower overall acceptability (8.50). During refrigerated storage at $7 \pm 2^\circ\text{C}$ for 12 days, microbial counts increased gradually, but T₃ maintained lower SPC and yeast and mould counts than the control, while coliforms remained undetected throughout. Thus, T₃ produced a sensory-preferred and microbiologically acceptable *kalakand* with a shelf life of up to 12 days under refrigerated storage.

References

1. Anonymous. Annual report 2025-2026, Department of Animal Husbandry and Dairying, New Delhi:

Government of India; 2026.

2. Association of Official Analytical Chemists. Official methods of analysis. 12th ed. Washington, DC: Association of Official Analytical Chemists; 1975.
3. Bhutkar SS, Nimbalkar SS, Kumbhar TV. Effect of different levels of ash gourd pulp for manufacturing of *kalakand*. IOSR Journal of Agriculture and Veterinary Science. 2015;8(3):4-6.
4. Deshmukh KS, Undratwad DT, Nichal CR, Zinjarde RM, Mendhe HS. Effect of different levels of guava pulp on sensory quality and cost of production of *kalakand*. The Pharma Innovation Journal. 2022;11(Special Issue 1):595-597.
5. Grozdanovic MM, Burazer L, Gavrovic-Jankulovic M. Kiwifruit (*Actinidia deliciosa*) extract shows potential as a low-cost and efficient milk-clotting agent. International Dairy Journal. 2013;32(1):46-52.
6. Gupta SK. Sensory evaluation in food industry. Indian Dairyman. 1976;28(8):293-295.
7. Hande AM. Studies on *chhana* whey beverage prepared by using kiwi fruit pulp (*Actinidia deliciosa*). Rahuri:

- Mahatma Phule Krishi Vidyapeeth; 2016.
8. Kumar P, Singh SB. Formulation and evaluation of wood apple supplemented kalakand. The Pharma Innovation Journal. 2017;6(4):145-147.
 9. Kushwaha S, Shukla S. Studies on quality parameters of shrikhand prepared using kiwi fruit pulp. Journal of Pharmacognosy and Phytochemistry. 2019;8(5):466-469.
 10. Maske GV, Londhe GK, Zine PL. Studies on the physicochemical attributes of kalakand and the effect of kinnow juice addition. International Journal of Environment and Climate Change. 2023;13(8):1292-1297.