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STANDARDIZATION AND STORAGE EVALUATION OF CARROT-BASED FUNCTIONAL DAIRY FOODS: STERILIZED FLAVOURED MILK AND CARROT KHEER

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ABSTRACT

The incorporation of vegetables into dairy products offers an effective strategy for enhancing their nutritional and functional value. Carrot (Daucus carota L.) is an excellent source of β-carotene, vitamins, minerals, dietary fibre, and natural antioxidants, making it a suitable ingredient for the development of value-added functional dairy foods. The present study was undertaken to standardize and evaluate two carrot-based functional dairy products, namely sterilized carrot-flavoured milk and sterilized carrot kheer, with respect to their physicochemical, sensory, and storage characteristics.

Carrot-flavoured milk was prepared by incorporating carrot juice at levels of 10, 20, and 30 percent. The formulated products were sterilized and stored at room temperature for evaluation of their chemical and sensory attributes. Sensory quality was assessed using a nine-point Hedonic scale. Among the treatments, the product containing 20% carrot juice and 15% sugar received the highest sensory scores and was most preferred by the panel of judges. The product remained acceptable throughout the 28-day storage period under ambient conditions.

Carrot kheer was prepared by incorporating shredded carrot at levels of 20, 30, and 40%, along with 8% sugar, 3% ghee, and 2.5% dry fruits. Among the different formulations, carrot kheer containing 30% shredded carrot was found to be the most acceptable. The optimized product exhibited 8.20% fat, 33.30% total solids, 0.17% titratable acidity, and 21.10°Brix total soluble solids. The overall acceptability score of the fresh product was 7.50, which decreased to 6.50 after 28 days of storage but remained within the acceptable range. The results indicated that carrot incorporation significantly improved the nutritional quality, sensory attributes, and consumer appeal of kheer. Furthermore, sterilization enhanced product stability and extended shelf life during storage at room temperature.

It may be concluded that sterilized carrot-flavoured milk containing 20% carrot juice and sterilized carrot kheer containing 30% shredded carrot are promising functional dairy products with good sensory acceptability, improved nutritional value, and satisfactory storage stability. These products have considerable potential for commercial utilization as value-added dairy foods.

Keywords: Carrot, Functional dairy products, Sterilized flavoured milk, Carrot kheer, Sensory quality, Storage evaluation, Shelf life, β-carotene, Value addition, Dairy processing.

INTRODUCTION

India is the world's largest producer of milk and contributes nearly 25% of global milk production. According to the Basic Animal Husbandry Statistics (BAHS, 2025), milk production in India increased from 239.30 million tonnes during 2023–24 to 247.87 million tonnes during 2024–25, registering a growth of 3.58%. The per capita availability of milk has also increased to 485 g/day, reflecting the significant role of the dairy sector in ensuring nutritional security and supporting rural livelihoods (DAHD, 2025; APEDA, 2025).

The continuous growth of milk production has created a need for efficient processing, preservation, and value-addition technologies to enhance the utilization and shelf life of milk and milk products. Considerable progress has been made in the development and modernization of dairy processing technologies, resulting in

a wide range of traditional and innovative dairy products that cater to diverse consumer preferences and nutritional requirements.
Recent studies have highlighted the growing importance of functional dairy products enriched with plant-based ingredients owing to their enhanced nutritional and health-promoting properties. Functional dairy foods fortified with fruits, vegetables, herbs, and other bioactive components have gained considerable attention because they provide antioxidants, dietary fibre, vitamins, and phytochemicals in addition to the inherent nutritional benefits of milk (Gunjal et al., 2025; Singh and Gupta, 2025).

Carrot (Daucus carota L.) is recognized as a valuable source of β-carotene, polyphenols, dietary fibre, vitamins, and antioxidant compounds. Recent reviews have emphasized the potential of carrot as a functional ingredient for the development of value-added foods and beverages due to its nutritional richness and health-promoting properties (Motegaonkar et al., 2024).
The incorporation of vegetables into dairy products has emerged as a promising strategy for improving nutritional quality, antioxidant activity, sensory characteristics, and consumer acceptance. Vegetable-enriched dairy products have shown considerable potential in meeting the increasing demand for healthy and functional foods among modern consumers (El-Sayed et al., 2025).

Recent research on carrot-fortified dairy products demonstrated significant improvements in nutritional composition, antioxidant activity, sensory quality, and storage stability. Carrot supplementation has been reported to enhance the phytonutrient content and consumer acceptability of dairy products while contributing to improved functional properties (Journal of Agriculture and Food Research, 2025).
Furthermore, studies on carrot milk beverages have reported satisfactory physicochemical quality and storage stability during shelf-life evaluation, indicating the suitability of carrot as an ingredient for the development of commercially viable dairy beverages (Solanki et al., 2025).
Therefore, the present investigation was undertaken to develop and standardize carrot-based functional dairy products, namely sterilized carrot-flavoured milk and carrot kheer, using different levels of carrot juice and shredded carrot. The developed products were evaluated for their physicochemical characteristics, sensory quality, and storage stability under ambient conditions to assess their suitability as value-added functional dairy foods.

MATERIALS AND METHODS

Raw Materials

Fresh cow milk was procured from a private dairy farm located in the vicinity of the College of Dairy Technology, Raipur, Chhattisgarh. Fully matured, fresh, healthy, and defect-free carrots (Daucus carota L.) and food-grade cane sugar were purchased from the local market of Raipur. All raw materials were transported under hygienic conditions and utilized immediately for product preparation to ensure maximum freshness and quality.

Preparation of Carrot Juice and Shredded Carrot

Fresh carrots were thoroughly washed under running potable water to remove adhering dirt, soil particles, and other impurities. The washed carrots were peeled manually and trimmed to remove damaged portions. For the preparation of carrot juice, the peeled carrots were cut into small pieces and processed using a sanitized fruit and vegetable juicer. The extracted juice was filtered through a double-layer muslin cloth to remove coarse fibrous materials and obtain a uniform juice.
For the preparation of carrot-based flavoured milk and carrot kheer, peeled carrots were shredded using a sanitized stainless-steel hand grater. The shredded carrot was used immediately in product preparation to minimize nutrient losses and maintain product quality.

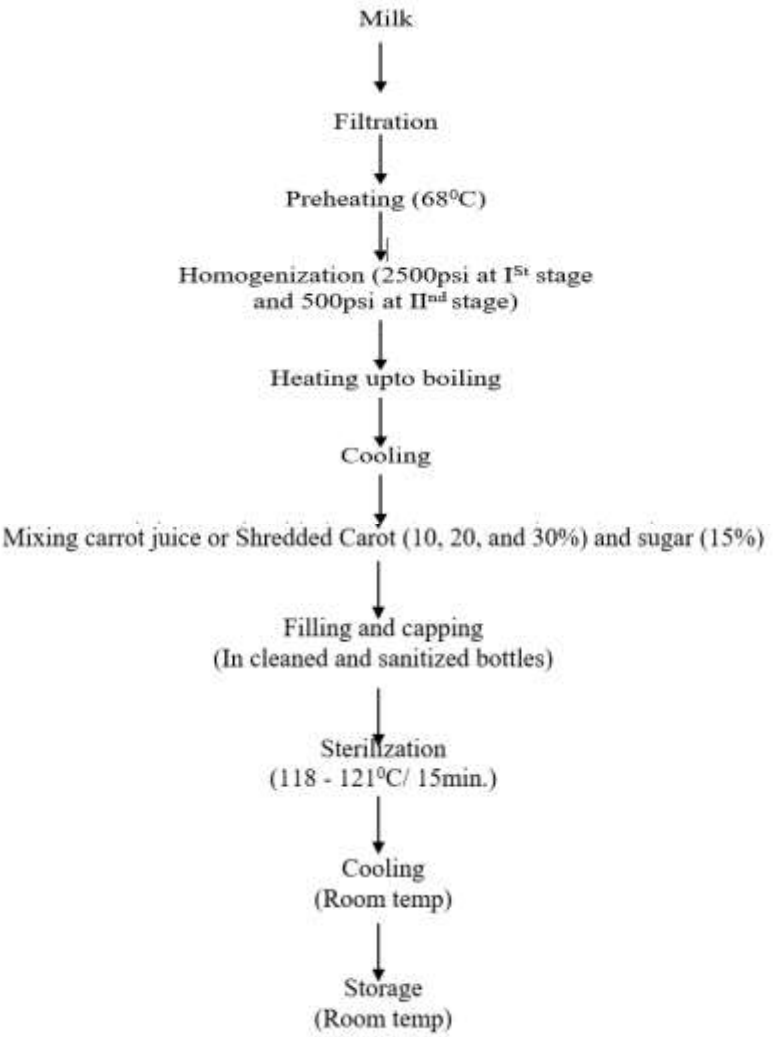
Preparation of Sterilized Carrot-Based Flavoured Milk

Two types of carrot-based flavoured milk were prepared, namely carrot juice flavoured milk and shredded carrot flavoured milk. Each product was formulated by incorporating carrot juice or shredded carrot at three different levels, viz., 10, 20, and 30 per cent. The flow diagram for the preparation of carrot-based flavoured milk is presented in Fig. 1.

Prior to processing, the milk was analyzed for fat, total solids (TS), solids-not-fat (SNF), and titratable acidity using standard analytical procedures. The required quantities of milk, carrot juice or shredded carrot, and sugar (15%) were accurately weighed and blended thoroughly. The mixture was heated to approximately 60°C and continuously stirred to ensure uniform distribution of ingredients and proper dissolution of sugar.

The prepared flavoured milk was filled into pre-sterilized glass bottles, leaving adequate headspace, and sealed using a crown-capping machine. The sealed bottles were sterilized at 108–111°C for 25–30 minutes in a batch sterilizer. Following sterilization, the bottles were rapidly cooled to room temperature to prevent over-processing and maintain product quality.
The sterilized bottles were properly labelled and stored under ambient conditions. The products were evaluated at seven-day intervals for physicochemical characteristics, sensory quality, and storage stability over the designated storage period. Similar approaches for the development and evaluation of vegetable-enriched dairy beverages have been reported by Motegaonkar et al. (2024) and Pop et al. (2024).

Fig. 1 The flow chart for preparation of carrot based flavoured milk (By using carrot juice)



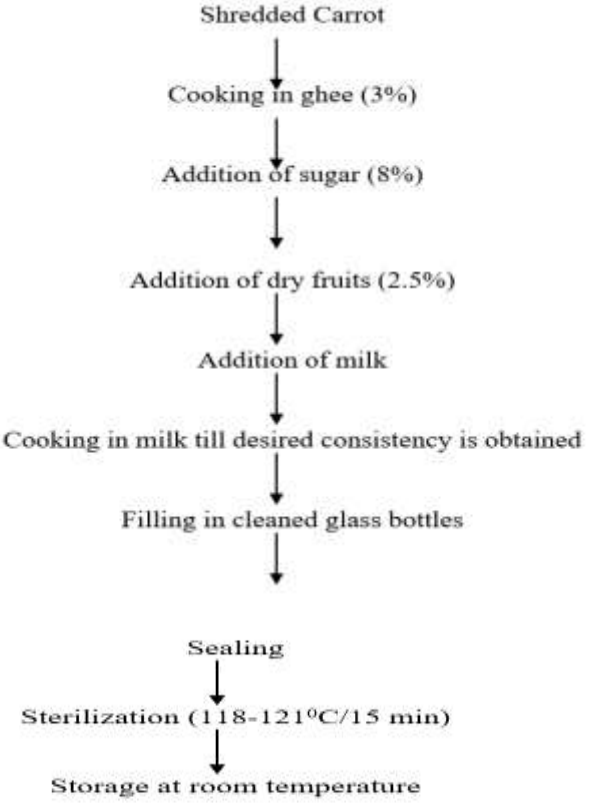
Preparation of Sterilized Carrot Kheer
Carrot kheer was prepared using milk, shredded carrot, sugar, ghee, and dry fruits. Fresh cow milk was analyzed for fat, total solids, and titratable acidity prior to product preparation. Three formulations were

developed by incorporating shredded carrot at levels of 20, 30, and 40% (w/w) based on the quantity of milk. Sugar (8%), ghee (3%), and dry fruits (2.5%) were added uniformly in all treatments.

The required quantity of shredded carrot was sautéed in ghee until softened and characteristic flavour developed. Subsequently, milk was added and the mixture was heated with continuous stirring. Sugar and dry fruits were incorporated during the cooking process, and heating was continued until the desired consistency of kheer was obtained. The finished product was hot-filled into pre-sterilized glass bottles, sealed using a crown-capping machine, and sterilized at 108–111°C for 25–30 min. After sterilization, the bottles were rapidly cooled to room temperature and stored under ambient conditions for further evaluation.

The prepared samples were analyzed for physicochemical characteristics, sensory attributes, and storage stability at predetermined intervals. The flow diagram for the preparation of sterilized carrot kheer is presented in Fig. 2.

Fig.2 The flow chart for preparation of sterilized carrot kheer



Physico-chemical Analysis

Raw milk and the developed carrot-based dairy products were analyzed for their physicochemical characteristics using standard analytical procedures. Fat content was determined by the Gerber method, total solids by the gravimetric method, and titratable acidity by standard titration techniques as prescribed by the Bureau of Indian Standards (BIS, 2022). The pH of the samples was measured at 25°C using a calibrated digital pH meter, while total soluble solids (TSS) were determined using a hand refractometer and expressed as °Brix according to the methods described by AOAC International (2023). All analyses were performed in triplicate and the results were expressed as mean values. Similar analytical approaches for evaluating dairy and vegetable-enriched dairy products have been reported by Motegaonkar et al. (2024) and Solanki et al. (2025).

Sensory Analysis

Sensory evaluation of fresh and stored samples of carrot-based flavoured milk and carrot kheer was conducted using a 9-point Hedonic scale as described by Amerine et al. (1965) with suitable modifications.

A panel of six trained judges evaluated the products for colour and appearance, flavour, body and texture, sweetness, and overall acceptability. The samples were coded and presented randomly to minimize bias during evaluation. Sensory assessment was carried out at 7-day intervals throughout the storage period under ambient conditions. Similar sensory evaluation protocols have been widely employed for assessing the quality and consumer acceptability of functional dairy products (El-Sayed et al., 2025; Solanki et al., 2025).

Statistical Analysis

The experimental data obtained during the investigation were subjected to statistical analysis to determine the effect of carrot incorporation levels and storage duration on the quality attributes of the products. For carrot-based flavoured milk, the experiment was analyzed using a Split Plot Design in a Randomized Block Design (RBD) with three replications. Six treatment combinations comprising three levels of carrot juice (10, 20, and 30%) and three levels of shredded carrot (10, 20, and 30%) were assigned to the main plots, while five storage intervals (0, 7, 14, 21, and 28 days) were assigned to the subplots.

For carrot kheer, the experiment was conducted using a Split Plot Design in RBD with three levels of shredded carrot incorporation (20, 30, and 40%) as the main plot treatments and five storage intervals (0, 7, 14, 21, and 28 days) as subplot treatments. Analysis of variance (ANOVA) was performed to evaluate the significance of treatment effects, storage effects, and their interactions. Differences among treatment means were tested at the 5% level of significance ($P<0.05$) following the procedures described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Physicochemical Characteristics of Fresh Carrot-Based Flavoured Milk

The physicochemical characteristics of fresh carrot-based flavoured milk prepared using different levels of carrot juice and shredded carrot are presented in Table 1. The results revealed that incorporation of carrot in different forms and concentrations had only a marginal effect on the physicochemical properties of the product.

Table 1Physico-chemical characteristics of fresh flavoured milk prepared with different levels of carrot juice or shredded carrot

S.No.	Carrot form and concentration	Fat (%)	Acidity (%)	p^H Value	TSS (^{0}Brix)	TS (%)
1	T_1 (Juice 10%)	4.1	0.14	6.5	21.50	25.71
2	T_2 (Juice 20%)	3.9	0.14	6.4	21.50	25.71
3	T_3 (Juice 30%)	3.6	0.14	6.4	21.00	25.72
4	T_4 (Shredded 10%)	4.1	0.14	6.4	21.00	24.91
5	T_5 (Shredded 20%)	4.0	0.14	6.3	21.00	24.85
6	T_6 (Shredded 30%)	3.9	0.14	6.4	21.0	24.85

Note: All the readings are average of three.

The fat content of the flavoured milk ranged from 3.6 to 4.1%, with the highest value observed in treatments containing 10% carrot juice (T1) and 10% shredded carrot (T4). A slight decrease in fat content was observed with increasing levels of carrot incorporation, which may be attributed to the dilution effect caused by the addition of carrot juice and the replacement of milk solids by carrot solids. Similar observations have been reported in carrot-fortified dairy beverages by Solanki et al. (2025).

Titratable acidity remained constant (0.14%) across all treatments, indicating that the incorporation of carrot juice or shredded carrot did not significantly influence the acidity of the fresh product. The pH values varied from 6.3 to 6.5, which falls within the normal range reported for flavoured milk products. The slight reduction in pH observed with increasing carrot incorporation may be attributed to the presence of naturally occurring organic acids in carrot tissues. Similar findings have been reported for vegetable-enriched dairy beverages by El-Sayed et al. (2025).

The total soluble solids (TSS) of the samples ranged from 21.0 to 21.5°Brix. The results indicated that carrot incorporation had minimal influence on the soluble solids content of the product, mainly because the sugar level was maintained constant in all formulations. Likewise, total solids content varied only slightly among

treatments, ranging from 24.85 to 25.72%. The comparatively higher total solids observed in carrot juice-based formulations may be attributed to the contribution of soluble solids from carrot juice. However, the differences were not appreciable and remained within a narrow range.
Overall, the results demonstrated that incorporation of carrot juice or shredded carrot up to 30% did not adversely affect the physicochemical quality of flavoured milk. These findings are in agreement with the observations of Motegaonkar et al. (2024), who reported that carrot-based ingredients can be incorporated into dairy products without causing substantial changes in their basic physicochemical properties.

Physicochemical Characteristics of Fresh Carrot Kheer
Carrot kheer was prepared by incorporating shredded carrot at three different levels, namely 20% (K1), 30% (K2), and 40% (K3). The physicochemical characteristics of the fresh products are presented in Table 2.

Table 2. Physicochemical characteristics of fresh carrot kheer prepared with different levels of shredded carrot

Treatment	Fat (%)	Acidity (%)	pH	TS (%)	TSS (°Brix)
K1 (20%)	8.4	0.17	6.3	32.0	21.30
K2 (30%)	8.2	0.17	6.3	33.3	21.10
K3 (40%)	8.1	0.17	6.3	33.6	20.90

Note: All the readings are average of three.

The fat, acidity, pH, total solids, and total soluble solids of carrot kheer were influenced by the level of shredded carrot incorporation. An increase in carrot concentration contributed to variations in total solids and soluble solids due to the presence of natural sugars, fibre, and other solids in carrot. The acidity and pH values remained within acceptable limits, indicating the suitability of carrot incorporation in kheer manufacture.
The observed increase in total solids and total soluble solids with increasing carrot levels may be attributed to the concentration of milk during cooking and the contribution of carrot solids. Similar observations have been reported in vegetable-enriched dairy desserts and functional milk products, where incorporation of carrot improved nutritional quality while maintaining desirable physicochemical characteristics (El-Sayed et al., 2025; Solanki et al., 2025).
The results suggest that shredded carrot can be successfully incorporated into kheer formulations without adversely affecting product quality. Moreover, the addition of carrot enhances the nutritional value of the product by contributing β-carotene, dietary fibre, minerals, and antioxidant compounds, thereby improving its functional properties (Motegaonkar et al., 2024).

Sensory Evaluation of Carrot-Based Flavoured Milk
The sensory quality of carrot-based flavoured milk prepared with different levels of carrot juice and shredded carrot was evaluated using a 9-point Hedonic scale by a panel of six trained judges. The mean sensory scores for colour and appearance, flavour, sweetness, mouthfeel, and overall acceptability are presented in Table 3.

Table 3. Effect of carrot concentration on sensory characteristics of fresh flavoured milk

S.No	Carrot Concentration	Sensory Characteristics					
		Colour & Appearance	Flavour			Mouth feel	Overall Acceptability
			IOC	Sweetness	Overall flavour		
1	T1	6.66	7.17	7.17	7.17	7.33	7.17
2	T2	7.17	7.00	6.66	7.66	7.33	7.83
3	T3	7.33	7.67	7.50	7.33	7.83	7.67
4	T4	6.33	6.67	7.33	6.83	6.83	6.83
5	T5	6.67	7.50	7.50	7.67	7.67	7.00
6	T6	7.83	7.00	6.83	7.33	7.33	6.83

Note: All the readings are average of three

The results revealed that carrot incorporation significantly influenced the sensory characteristics of flavoured milk. Among the juice-based formulations, treatment T2 (20% carrot juice) received the highest overall acceptability score (7.83), followed by T3 (30% carrot juice) with a score of 7.67. The higher acceptability of T2 may be attributed to its balanced flavour profile, desirable colour, and pleasant mouthfeel. In contrast, the shredded carrot-based formulations showed comparatively lower overall acceptability scores, ranging from 6.83 to 7.00. The lower scores may be due to the presence of carrot particles, which slightly affected the texture and uniformity of the product.

The colour and appearance scores increased with increasing levels of carrot incorporation, particularly in T6 (30% shredded carrot), which received the highest score (7.83). This improvement may be attributed to the attractive orange colour imparted by the carotenoid pigments present in carrot. Similar observations have been reported for carrot-enriched dairy beverages and functional milk products, where carotenoid-rich ingredients enhanced visual appeal and consumer preference (Solanki et al., 2025; Motegaonkar et al., 2024).

Storage studies indicated a gradual decline in overall acceptability of all flavoured milk samples during the 28-day storage period. The overall acceptability scores of T1, T2, T3, T4, T5, and T6 decreased from 7.17, 7.83, 7.67, 6.83, 7.00, and 6.83 in fresh condition to 6.17, 6.50, 6.00, 6.00, 6.17, and 5.33, respectively, after 28 days of storage. The reduction in sensory scores may be attributed to minor physicochemical changes occurring during storage, which influenced flavour, colour, and texture. Nevertheless, all treatments remained within the acceptable range throughout the storage period, demonstrating the effectiveness of sterilization in maintaining product quality under ambient conditions.

Sensory Evaluation of Carrot Kheer

The sensory attributes of fresh carrot kheer samples prepared with different levels of shredded carrot were evaluated using a 9-point Hedonic scale, and the mean scores are presented in Table 4.

Table 4. Effect of carrot concentration on sensory characteristics of fresh carrot kheer

Treatment	Colour & Appearance	Flavour	Mouthfeel	Overall Flavour	Sweetness	Overall Acceptability
K1	6.34	6.34	7.84	7.67	7.50	7.67
K2	7.50	6.50	7.67	8.50	7.84	8.50
K3	7.84	7.67	7.50	7.84	7.50	7.84

Note: All the readings are average of three.

The results showed that carrot concentration had a marked influence on the sensory quality of carrot kheer. Among the treatments, K2 containing 30% shredded carrot received the highest overall acceptability score (8.50), followed by K3 (40% shredded carrot) and K1 (20% shredded carrot), which recorded scores of 7.84 and 7.67, respectively. The superior acceptability of K2 may be attributed to its optimum balance of carrot flavour, colour, sweetness, and texture. Although K3 exhibited higher scores for colour and appearance (7.84), the increased carrot content may have slightly affected flavour balance and product consistency.

The enhanced colour and flavour scores observed in carrot-incorporated kheer can be attributed to the natural pigments and flavour compounds present in carrot. Similar findings have been reported by Ganesan et al. (2022), who observed that moderate incorporation of vegetable ingredients in dairy desserts improved consumer preference and sensory quality compared with lower or excessive incorporation levels.

The sensory quality of carrot kheer gradually declined during storage. Fresh samples of K1, K2, and K3 recorded overall acceptability scores of 7.67, 8.50, and 7.84, respectively, which decreased to 6.17, 6.84, and 6.67 after 28 days of storage. Statistical analysis revealed that both treatment and storage period significantly ($p < 0.05$) affected overall acceptability, whereas their interaction was non-significant.

The decline in sensory scores during storage may be attributed to slight changes in flavour, colour, and texture resulting from prolonged storage under ambient conditions. Similar trends have been reported in sterilized dairy desserts and heat-processed milk products during storage (Yadav et al., 2023). Despite the reduction in sensory scores, all treatments remained organoleptically acceptable throughout the storage period.

Among the treatments, K2 consistently maintained the highest sensory scores during storage, indicating its suitability for commercial application. The formulation containing 30% shredded carrot, 8% sugar, 3% ghee, and 2.5% dry fruits was most preferred by the sensory panel. The sterilization process effectively enhanced product stability, enabling storage for up to 28 days under ambient conditions without significant deterioration in sensory quality.

The findings of the present study demonstrate that incorporation of 30% shredded carrot not only improved the nutritional and sensory attributes of kheer but also contributed to the development of a shelf-stable functional dairy dessert with high consumer acceptability. These results support the potential application of carrot as a value-added functional ingredient in dairy product development (Kumar et al., 2023; Sharma et al., 2022; El-Sayed et al., 2025).

Effect of Storage on Overall Acceptability

The overall acceptability scores of fresh carrot-based flavoured milk samples ranged from 6.83 to 7.83, indicating good consumer acceptance of all formulations. Among the treatments, T2 (20% carrot juice) received the highest overall acceptability score (7.83), followed by T3 (30% carrot juice) with a score of 7.67. The superior acceptability of T2 may be attributed to its balanced flavour, attractive colour, desirable sweetness, and pleasant mouthfeel. Similar observations have been reported in carrot-enriched dairy beverages, where moderate levels of carrot incorporation resulted in higher consumer preference and sensory acceptability than higher concentrations (Solanki et al., 2025).

A gradual decline in overall acceptability was observed in all treatments during storage under ambient conditions. After 28 days of storage, the overall acceptability scores decreased to a range of 5.33–6.50. The reduction in sensory quality may be attributed to minor physicochemical and organoleptic changes occurring during storage, including slight flavour deterioration, colour degradation, and textural modifications. Comparable reductions in sensory scores during storage have been reported in vegetable-fortified dairy products and sterilized dairy beverages (El-Sayed et al., 2025; Solanki et al., 2025).

Statistical analysis revealed that both treatment and storage period significantly ($p < 0.05$) influenced the overall acceptability of the product. However, the interaction between treatment and storage period was non-significant, indicating a similar pattern of sensory decline among all treatments throughout storage. Despite the reduction in sensory scores, all products remained organoleptically acceptable up to 28 days of storage. Among the formulations, T2 consistently maintained the highest acceptability scores during storage, suggesting that incorporation of 20% carrot juice was optimum for the development of sterilized carrot-based flavoured milk.

CONCLUSION

The present investigation demonstrated the successful development and standardization of sterilized carrot-based flavoured milk and carrot kheer as value-added functional dairy products. The incorporation of carrot significantly enhanced the nutritional and functional value of the products due to its rich content of β-carotene, dietary fibre, minerals, and antioxidant compounds. Recent studies have highlighted the potential of carrot as a functional food ingredient owing to its health-promoting properties and suitability for incorporation into dairy-based products (Motegaonkar et al., 2024).

In carrot-based flavoured milk, incorporation of carrot juice at different levels had minimal influence on acidity, pH, total soluble solids, and total solids, indicating good compatibility of carrot juice with milk. Sensory evaluation revealed significant differences among treatments, with the formulation containing 20% carrot juice and 15% sugar (T2) receiving the highest overall acceptability score. Similar findings have been reported by Solanki et al. (2025), who observed improved sensory quality and consumer acceptance in carrot-fortified milk beverages. Although a gradual decline in sensory quality was observed during storage, the product remained acceptable for up to 28 days under ambient conditions. Therefore, the formulation containing 20% carrot juice was identified as the optimum treatment for the preparation of sterilized carrot-based flavoured milk.

Sterilized carrot kheer was also successfully developed by incorporating shredded carrot at levels of 20, 30, and 40%. The addition of carrot improved the nutritional quality of the product while maintaining desirable physicochemical characteristics. Among the treatments, kheer containing 30% shredded carrot (K2) achieved the highest scores for flavour, colour, mouthfeel, and overall acceptability. The optimized product contained 8.2% fat, 33.30% total solids, 0.17% acidity, and 21.10°Brix total soluble solids, indicating desirable compositional quality.

Storage studies revealed a gradual decline in sensory scores for all carrot kheer treatments; however, the products remained acceptable throughout the 28-day storage period. The sterilization process effectively enhanced shelf life and storage stability while maintaining satisfactory sensory quality. Similar observations have been reported for vegetable-enriched dairy desserts and functional dairy products, where thermal processing contributed to improved product stability and consumer acceptability (El-Sayed et al., 2025).
Based on physicochemical, sensory, and storage studies, the formulation containing 30% shredded carrot, 8% sugar, 3% ghee, and 2.5% dry fruits was found to be the most suitable for the manufacture of sterilized carrot kheer. The findings of the present study demonstrate that carrot can be effectively utilized as a functional ingredient in dairy beverages and desserts to enhance nutritional quality, sensory attributes, and shelf life. The developed products possess considerable potential for commercial production as nutritious, palatable, and shelf-stable functional dairy foods (Motegaonkar et al., 2024; El-Sayed et al., 2025).

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