International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 3462-3465

Received: 13-07-2018
Accepted: 19-08-2018

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Effect of ash gourd shreds on the shelf stability of *kheer*

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DOI: https://doi.org/10.22271/chemi.2018.v6.i5bh.12320

Abstract
This research article investigates the effect of incorporating ash gourd shreds on the shelf stability of *kheer*, a popular traditional dessert. The study aims to assess the impact of ash gourd shreds on the sensory attributes of *kheer* during storage. Various parameters such as colour & appearance, flavour, body and texture and overall acceptability were employed to evaluate the shelf stability of *kheer* with and without ash gourd shreds. The results provide valuable insights into the potential of ash gourd shreds as a natural ingredient for enhancing the shelf life of *kheer*. *Kheer* was prepared using mixed milk with a consistent sugar level of 8% and rice at 2.5% of the weight of the milk. Different proportions of ash gourd shreds at 0.0%, 2.0%, 4.0%, and 6.0% of the weight of milk were incorporated. The shelf life of the final product was evaluated at refrigerated temperature (5 °C) using a 9-point hedonic scale. The results indicated that all *kheer* samples (T_1, T_2, and T_3) remained acceptable for up to 3 days at refrigeration conditions. Among the experimental treatments, T_1 received the highest scores for color (7.98), body and texture (7.68), appearance (7.76) and overall acceptability (7.76) while T_2 received highest score for flavour (8.022) at 5 °C for 3 days as compared to control.

Keywords: Ash gourd, *kheer*, optimization, sensory attributes

Introduction
In recent years, there has been a growing interest in the utilization of natural ingredients and traditional methods to improve the shelf stability of food products (Lanciotti *et al*., 2004) [11]. This shift towards more sustainable and healthier options has led researchers and culinary experts to explore the potential of incorporating ingredients like ash gourd into traditional recipes.

Ash gourd, scientifically known as *Benincasa hispida*, is a versatile and widely consumed vegetable known for its numerous health benefits. With its mild flavor and high-water content, ash gourd is often used in a variety of culinary preparations, ranging from curries and stir-fries to desserts (Al-Snafi, 2013) [2]. It is a popular vegetable crop, especially among Asian communities both for nutritional and medicinal purposes (Nimbal *et al*., 2011) [13]. It was preferred as a cooked vegetable, boiled alone, boiled with meat, or included in a variety of dishes. Also, it was used raw like sliced cucumbers (Stephens, 2012) [16]. However, the plant was used medicinally in various complains such as gastrointestinal problems, respiratory disease, heart diseases, diabetes mellitus and urinary diseases (Joshi, 2000) [9]. Fruits were traditionally used as a laxative, diuretic, tonic, aphrodisiac, cardiotonic, urinary calculi, blood disease, insanity, epilepsy, schizophrenia and other psychologic disorders, jaundice, dyspepsia, fever, and menstrual disorders (Jayasree *et al.*, 2011) [7].

Ash gourd not only adds a unique flavor and texture to dishes but also possesses several nutritional benefits. It is low in calories and fat, high in water content, and packed with essential vitamins and minerals such as vitamin C, calcium, and iron. Furthermore, its high fiber content promotes digestive health and provides a feeling of satiety. The major constituents of *Benincasa hispida* fruits are volatile oils, flavonoids, glycosides, sacchrides, proteins, carotenes, vitamins, minerals, ß-sitosterin and uronic acid (Rana and Suttee 2012; Chidan Kumar *et al*., 2012: Mandana *et al.*, 2012) [14, 6, 12]. One such traditional dessert where ash gourd finds its place is in the famous Indian delicacy called "*Kheer*."

Kheer, a beloved traditional dish, holds a special place in the hearts of people from all walks of life. Its preparation involves simmering rice in milk with sugar or jaggery until the rice starch transforms into a delightful gelatinous texture (Aneja *et al*., 2002) [3].

As dietary preferences and lifestyles evolve, there is an increasing demand for nutrient-dense foods that are convenient and affordable. *Kheer* fits this description perfectly, offering a luxurious treat that can be enjoyed by all. *Kheer* is often referred to as "Amrit," the heavenly nectar, and is hailed as "the life-giving food" with a sense of mystique surrounding it. The word "*Kheer*" originates from the Sanskrit term 'ksheer,' meaning milk, and 'kshirika,' denoting any dish prepared with milk. Across different regions of the country, *Kheer* is known by various names such as 'payasam' in the Southern region, 'payas' in the Eastern region, 'phirni' in the Northern region, 'kheech' in Mewar, and 'payesh' in Bengal (Aneja *et al.*, 2002) [3].

The objective of this study was to evaluate the sensory attributes of *kheer* incorporated with ash gourd shreds, with a focus on determining its shelf life under both room temperature and refrigerated conditions.

Materials and Methods

The present research work was undertaken in the Department of Dairy Technology, Warud (Pusad), Maharashtra. The fresh buffalo milk was procured from local market, Pusad. Other ingredients such as Madhur sugar, rice and ash gourd fruit was purchased from the local market.

Preparation of Ash gourd shreds

For the ash gourd treatment, the ash gourd was selected and thoroughly washed. It was then cut into large pieces, and the peel was carefully removed. Using a shredder, the ash gourd was transformed into shreds. These shreds were then placed in a muslin cloth and blanched in boiling water for approximately 6-8 minutes. After blanching, the shreds were removed from the water and spread out on a plate to cool down at room temperature.

Preparation of *kheer* blended with ash gourd shreds

Kheer blended with ash gourd shreds was prepared in different treatment combinations as detailed below:

T_0: Rice @ 2.5 per cent without ash gourd shreds
T_1: Ash gourd shreds @ 2.0 per cent by weight of milk
T_2: Ash gourd shreds @ 4.0 per cent by weight of milk
T_3: Ash gourd shreds @ 6.0 per cent by weight of milk

The *kheer* was prepared by method as suggested by Changade *et al.* (2012) [5] with slight modifications. Treatment T_0 without ash gourd shreds served as control.

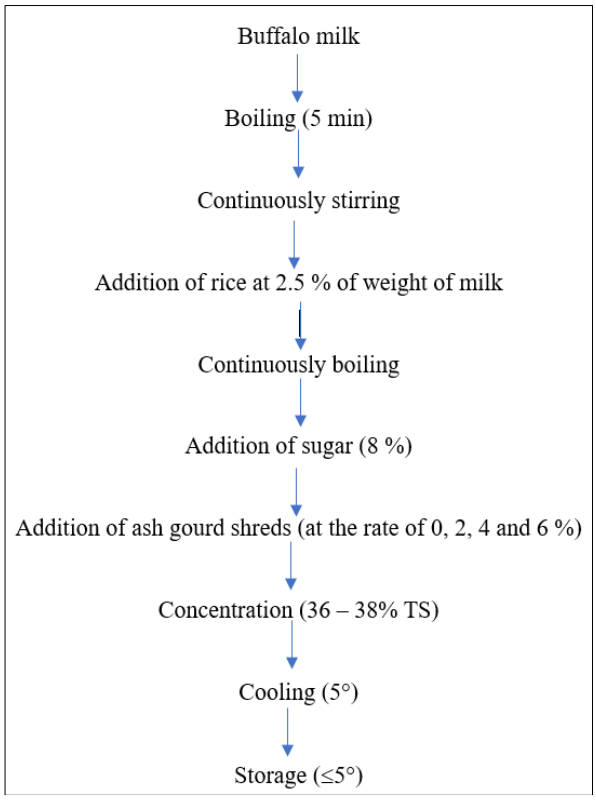

Fig 1: Protocol for manufacturing of ash gourd *kheer*

Shelf stability assessment

A comprehensive investigation was conducted to evaluate the shelf life of *kheer* blended with ash gourd shreds at refrigerated temperature (5 ℃). A panel of judges assessed the sensory attributes of the *kheer* samples using a 9-point hedonic scale.

Statistical analysis

Statistical analysis of the data was performed using Completely Randomized Design (CRD). The mean values arrived at based on the analysis of duplicate samples of frozen yoghurt, obtained in six replications (three treatments), were tested for their significance at 5.0% level using CRD (Steel and Torrie, 1980) [15].

The results of effect of different levels of ash gourd shreds on the sensory attributes and keeping qualities of *kheer* are shown in Table 1.

Results and Discussion

Effect of bottle gourd shreds on sensory attributes of *kheer* through storage period

Sensory evaluation of control and experimental *kheer* supplemented with ash gourd shreds was done by panel of

judges using 9-point hedonic scale. The effect of storage period on sensory qualities for first, second and third day is described as below.

Color: It is observed from Table 1 that the score for treatment T_1 was close to that of control *kheer* and there is decrease in score for color with increase in level of ash gourd shreds. The control sample recorded equal sensory score (8.20) for color on first and second days. However, the score decreased to 7.60 on third day. The statistical analysis revealed that period of storage had significant effect on color score for both control as well as in all experimental *kheer* samples. The findings of our study align with those reported by Adil *et al.* (2015) [1], who investigated the keeping qualities of pumpkin-based *kheer* over a 3-day storage period. Similarly, we observed a decrease in the rate of color and appearance scores as the storage period increased. This led to the conclusion that the alterations in color and appearance scores occurred more rapidly at room temperature compared to refrigerator temperature.

Flavor: Table 1 revealed that flavor attributes of ash gourd shreds *kheer* sample T_1 decreased from initial value of 7.80 to 7.32 and 6.85 on second and third days of storage respectively. Flavor score for control sample also decreased from 8.12 to 7.68 and 7.10 on second and third days of storage respectively. There was significant difference for changing flavor scores in control as well as in experimental *kheer* samples.

Body and texture: The scores for body and texture of all the samples decrease gradually throughout the storage. The rate of decline in the scores of (T_3) was more as compared to the remaining (7.64 on 1st day to 6.90 on 3rd day). The findings of our study are consistent with those reported by Jha *et al.* (2011) [8] who examined the scores of body and texture for long-life *kheer* processed at high temperatures. They observed a slight decrease in these scores from day 0 to day 150, ranging from 8.00 to 6.72. Similarly, Adil *et al.* (2015) [1] investigated the keeping qualities of pumpkin-based *kheer* over a 3-day storage period and found that the rate of decrease in body and texture scores increased as the storage period extended. These observations highlight the impact of storage conditions on the body and texture characteristics of the *kheer*.

Appearance: The score for appearance of control *kheer* and experimental *kheer* samples was affected by storage period. There was significant effect of different levels of ash gourd shreds, storage period and their interaction on score for appearance of different *kheer* samples. There was decrease in appearance of score for treatment T_0 (8.04 to 7.40) at the end of third day of storage. The rate of decline in the score of control was faster than experimental samples. There was significant difference in the score for appearance in control as well as in experimental *kheer* samples on first day while the difference between treatments was non-significant on second and third days of storage. The results are in close agreement with Bhat *et al.* (2010) [4], who observed decrease in appearance of *Kashmiri* saffron *phirne*.

Table 1: Effect of storage period on sensory attributes of *kheer* with or without ash gourd shreds

Parameters	Treatment	Day 1	Day 2	Day 3
Color	T0 (Control)	8.20 ± 0.81^{a}	8.20 ± 0.70^{a}	7.60 ± 0.76^{a}
	T1	7.98 ± 0.69^{ab}	7.96 ± 0.62^{ab}	7.25 ± 0.82^{ab}
	T2	7.80 ± 0.57^{bc}	7.66 ± 0.53^{b}	7.15 ± 0.48^{bc}
	T3	7.68 ± 0.66^{bc}	7.40 ± 0.57^{c}	6.90 ± 0.55^{bc}
Flavor	T0 (Control)	8.12 ± 0.74^{a}	7.68 ± 0.92^{a}	7.10 ± 0.86^{a}
	T1	7.80 ± 0.76^{ab}	7.32 ±0.96^{abc}	6.85 ± 0.75^{ab}
	T2	7.92 ± 0.78^{a}	7.44 ± 0.90^{ab}	6.85 ± 0.82^{ab}
	T3	7.74 ± 0.70^{bc}	7.08 ± 0.89^{bc}	6.40 ± 0.82^{b}
Body and texture	T0 (Control)	8.08 ± 0.79^{a}	7.80 ± 0.86^{a}	7.40 ± 0.75^{a}
	T1	7.80 ± 0.91^{a}	7.56 ± 0.59^{ab}	7.10 ± 0.65^{ab}
	T2	7.68 ± 0.83^{ab}	7.48 ± 0.74^{ab}	6.93 ± 0.72^{bc}
	T3	7.64 ± 0.68^{ab}	7.32 ± 0.65^{b}	6.90 ± 0.78^{bc}
Appearance	T0 (Control)	8.04 ± 0.83^{a}	7.80 ± 0.81^{a}	7.40 ± 0.59^{a}
	T1	7.76 ± 0.78^{ab}	7.48 ± 0.74^{a}	7.20 ± 0.59^{a}
	T2	7.44 ± 0.85^{ab}	7.52 ± 0.67^{a}	7.00 ± 0.69^{a}
	T3	7.40 ± 0.64^{bc}	7.32 ± 0.65^{a}	7.00 ± 0.61^{a}
Overall acceptability	T0 (Control)	8.10 ± 0.79	7.80 ± 0.86^{a}	7.20 ± 0.82^{a}
	T1	7.88 ± 0.70	7.60 ± 0.57^{ab}	7.10 ± 0.47^{a}
	T2	7.72 ± 0.75	7.56 ± 0.59^{ab}	7.00 ± 0.61^{a}
	T3	7.48 ± 0.69	7.36 ± 0.58^{b}	6.85 ± 0.60^{a}

Data represented as mean ± standard deviation means with different superscripts in a column differ significantly at 5% level of significance (n=5).

Overall acceptability: The score for overall acceptability of all *kheer* samples were decreased throughout the storage period. The rate of decline of the overall acceptability score for treatment T_0 from 8.10 on first day to 7.20 on third day and for treatment T_3 from 7.68 on first day to 6.90 on third day was more when compared with the other samples. Among all the samples T_0 obtained highest score (8.10) and T3 recorded lowest score (7.68) than T_1, T_2 and T_3 during the period of storage. Changade *et al.* (2012) [5] reported that pumpkin *kheer* obtained from fresh pumpkin in the form of cubes and shreds influences the consumer acceptance and further stated that if the *kheer* with added preservatives stored in glass bottle at refrigerated temperature. Kadam *et al.* (2011) [10] reported that overall acceptability of the *kheer* depends on color and appearance, consistency and flavour and further observed that with the increase in the proportion of

rice, whole milk powder and sugar results in reduced score for overall acceptability. The results are also in close agreement with Bhat *et al.* (2010) [4].

Conclusion

Based on the aforementioned results, we can conclude that the storage life of *kheer* prepared with ash gourd shreds is 3 days at refrigerated conditions. The overall acceptability of the *kheer*, when blended with ash gourd shreds, decreased as the storage period increased, irrespective of the temperature conditions. Furthermore, the incorporation of ash gourd shreds in *kheer* holds promise for improving its shelf stability while maintaining its sensory qualities. This research contributes to the growing body of knowledge on natural preservatives and their applications in food preservation, highlighting the potential of ash gourd as a viable ingredient in extending the shelf life of dairy-based desserts like *kheer*.

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