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Studies on sensory quality and cost structure of kheer prepared from cow milk blended with different levels of *Chia* (*Salvia hispanica* L.) seeds

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ABSTRACT

The present study was conducted at Department of Animal Husbandry and Dairy Science, Post Graduate Institute, Dr. P. D. K. V. Akola. Kheer is a traditional sweet dairy-based dessert prepared by heating and concentrating milk with sugar and non-dairy ingredients such as rice, semolina, or sago (sabudana). Treatment combinations were used (T_1) control 2.5 % rice, *Chia* seeds 1.5% (T_2), 3% (T_3), 4.5% (T_4) and 6% (T_5) with constant 6% sugar level. The samples of kheer prepared were evaluated of sensory evaluation such as flavour, body and texture and colour and appearance using 9 point hedonic scale by a panel of judges. The data were analyzed by using completely randomized block design. The overall acceptability scores of rice kheer in treatment T_1 , T_2 , T_3 , T_4 and T_5 were 8.40, 7.33, 8.08, 8.66 and 7.16. The cost of production of 1 kg kheer ranged from Rs. 85.2 to Rs. 115.4. The cost of production of different treatment combinations was Rs.85.2, Rs.92, Rs.99.8, Rs. 107.6 and Rs.115.4 for treatment T_1 , T_2 , T_3 , T_4 and T_5 respectively. It is concluded from the present studies that, the good quality of Kheer can be prepared by using 4.5 per cent *Chia* seeds with 6 percent sugar.

Keywords: Kheer, *Chia* seeds, Cow milk, Cost structure of kheer, Sensory evaluation

Introduction

Milk is considered one of the most complete and nutritious foods available in nature and is often referred to as "nature's perfect food." It provides almost all essential nutrients required for the growth, maintenance, and proper functioning of the human body. Milk contains high-quality proteins, fat, lactose, vitamins, and minerals in a highly digestible form, making it an indispensable component of the human diet. Kheer is a traditional sweet rice-based dairy dessert that holds a significant place in festive and ceremonial meals, particularly in India. Historical references to a sweetened rice dish cooked in milk can be found in Buddhist and Jain literature around 400 B.C., where it was known as 'Payasa'. In southern India, a similar milk-based delicacy called 'Payasam' is widely consumed and carries cultural and religious significance comparable to that of kheer in northern India. (Jha *et al.*, 2013) [1].

There are several method of kheer preparation by using various based products such as Pulse based kheer (Bengal gram kheer, Green gram kheer), Cereal based kheer (Rice kheer, Pal kheer, Wheat kheer, Rice suji Kheer, Gogdi kheer, Avalakki kheer), Tuber crop based kheer (Sabakki kheer, Kaddu ki kheer, Movina kheer), Fruit based kheer (Mango kheer, Jackfruit kheer), Seed based kheer (Poppy seed kheer). (Unnikrishanan 2000) [2]. *Chia* seeds are highly valued for their nutritional properties, containing approximately 25–38% fat, with the majority consisting of polyunsaturated fatty acids (PUFAs). Among plant sources, chia is recognized for having one of the highest concentrations of alpha-linolenic acid (ALA), an omega-3 fatty acid, which makes up about 68% of its total fatty acid content. This is important because humans cannot produce polyunsaturated fatty acids on their own and must obtain them through dietary sources. Additionally, when chia seeds are immersed 4 in water, they develop a mucilaginous gel, which functions as a natural thickening and stabilizing agent in food applications (Rai *et al.*, 2014) [3].

Materials and Methods

The kheer was prepared from cow milk, *Chia* seeds and 6% sugar constant for all the treatments. Kheer prepared with T_1 control 2.5% rice, T_2 (1.5% *Chia* seeds), T_3 (3% chia seeds), T_4 (4.5%) and T_5 (6% chia seeds) used for experimental study.

The samples of chia kheer were evaluated for their flavour, colour and appearance, body and texture and overall acceptability.

The sensory evaluation was carried out by using 9 point hedonic scale as prescribed by Nelson *et al.* (1964) [4]. The data obtained in the present investigation was statistically analysed by CRD as prescribed by Amble (1975) [5].

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Flow chart for manufacture of chia kheer

Collection of fresh cow milk
 Standardization of cow milk at 4 fat per cent
 Filtration
 Heating of milk above 90 °C
 Addition of rice @ 2.5%
 Condensing (2:1)
 Addition of sugar (6%)
 Addition of chia seeds (as per treatment)
 Kheer (2:1)
 Cooling at room temperature and storage at 4 °C

Results and Discussion**Sensory evaluation**

The data obtained in respect to sensory parameters i.e. Flavour, Body and texture, Colour and appearance and Overall acceptability was statistically analysed and presented in the Table 1.

Flavour

The chia kheer was subjected to sensory evaluation by panel of judges using 9 point hedonic scale. The critical difference (CD) was calculated and treatment differences were tested at 5 percent level of sig-

nificance. It was observed that the overall score of chia kheer in treatment T₁, T₂, T₃, T₄ and T₅ were 8.30, 7.20, 7.97, 8.35 and 7.30, respectively. Treatment T₄ (4.5 per cent chia seeds) in cow milk was preferred by the judges than the control sample as far as flavour character is concerned. It gives pleasant flavor. The results indicate that increasing the amount of chia seeds in kheer improves its flavour up to an optimum level, beyond which the scores begin to decline gradually.

Narwade *et al.* (2003) [6] reported that increased incorporation of safflower milk reduced flavour and overall acceptability due to the characteristic flavour imparted by safflower milk. The scores for flavour range between 8.75 to 7.80.

Aundhkar *et al.* (2024) [7] also reported that barnyard millet kheer containing 1.5 per cent millet achieved the highest flavour and overall acceptability scores, whereas further increase in millet level decreased sensory scores because of darker colour and pronounced cereal flavour.

Kadam (1998) [8] observed that incorporation of coloured rice significantly influenced the sensory quality of kheer, and higher levels of rice resulted in lower colour and appearance scores because of the darker product colour.

Table 1. Sensory evaluation of chia kheer

Treatments	Mean values			
	Flavour	Body and texture	Colour and appearance	Overall acceptability
T ₁	8.30	8.25	8.40	8.40
T ₂	7.20	7.31	7.33	7.33
T ₃	7.97	7.75	7.83	8.08
T ₄	8.35	8.33	8.50	8.66
T ₅	7.30	7.08	7.33	7.16

Body and texture

The average sensory score for body and texture in treatment T₁, T₂, T₃, T₄ and T₅ were 8.25, 7.31, 7.75, 8.33 and 7.08, respectively. The critical difference (CD) was calculated and treatment differences were tested at 5 percent level of significance. It was noticed that the treatment T₄ was significantly superior over treatments T₁, T₂, T₃ and T₅. The above observation clearly indicates that, the highest liking was towards the T₄. As far as body and texture concerned, treatment T₁, T₂ and T₃ were also acceptable for panel of judges. As level of chia seeds goes on increasing the consistency of the kheer seems to be more thick than the normal kheer which ultimately resulted into the lowest sensory score for body and texture.

Narwade *et al.* (2003) [6] prepared kheer from safflower milk blended with buffalo milk with different level of sugar and reported that the body and texture scores increased upto certain level after that score decreased due to further addition of safflower milk.

Aundhkar *et al.* (2024) [7] also reported that kheer prepared with 1.5 per cent barnyard millet recorded the highest body and texture score (9.00), whereas further increase in millet level resulted in an excessively thick consistency and lower sensory scores.

Kadam (1998) [8] The rate of decrease in body and texture scores was more pronounced in treatment T₅ as compared to T₁, T₂, T₃ and T₄. This reduction in scores may be attributed to the higher level of incorporation, which resulted in increased thickening and alteration in the characteristic consistency of kheer.

Colour and appearance

Overall colour and appearance score of chia kheer in treatment T₁, T₂, T₃, T₄ and T₅ were 8.40, 7.33, 7.83, 8.50 and 7.33, respectively. Blending of 4.5 percent chia seeds in cow milk was preferred by the judges than the control sample and other treatments as far as colour and appearance character are concerned. As level increases the colour

is seems to be dark in the product so the score goes on decreasing in subsequent levels.

Narwade *et al.* (2003) [6] reported that the colour and appearance score range between 8.25 to 6.25. It was concluded that colour and appearance enhanced due to addition of safflower milk.

Aundhkar *et al.* (2024) [7] reported that barnyard millet kheer containing 1.5 per cent millet obtained the highest colour and appearance score, whereas higher millet levels significantly reduced sensory acceptability due to the darker cereal colour.

Kadam (1998) [8] reported that incorporation of coloured rice significantly influenced the visual quality of kheer, and higher levels resulted in a darker product with lower colour and appearance scores.

Overall acceptability

Overall score of acceptability of chia kheer for treatments T₁, T₂, T₃, T₄ and T₅ were 8.40, 7.33, 8.08, 8.66 and 7.16, respectively. The critical difference (CD) was calculated and treatment differences were tested at 5 percent level of significance. It was observed that treatment T₄ was significantly superior over all treatment. T₅ which had the lowest mean score than other treatments. The treatment T₄ had comparatively highest mean overall score than the T₁, T₂, T₃ and T₅. The lowest overall acceptability score i.e. 7.16 was found in treatment T₅ which was due to increase level of chia seeds which decreased flavour, colour and appearance and body and texture, hence overall acceptability score was less as compared to other treatments.

Narwade *et al.* (2003) [6] reported that the overall acceptability scores of kheer decreased with increasing proportion of safflower milk. The overall acceptability score ranged from 8.55 to 5.44. The decline in overall acceptability may be attributed to the changes in flavour and other sensory characteristics associated with higher incorporation of safflower milk. The findings indicated that excessive incorporation of safflower milk adversely affected the overall sensory acceptability of kheer.

Aundhkar *et al.* (2024) [7] prepared kheer from barnyard millet and reported the overall acceptability score highest as 8.75 whereas higher levels significantly reduced sensory scores due to darker colour, pronounced cereal flavour and increased thickness.

Kadam (1998) [8] reported that incorporation of coloured rice significantly influenced the visual quality of kheer, and higher levels resulted in a darker product with lower overall acceptability scores.

Cost of production chia kheer

The cost involved for preparation of kheer on account of raw material used i.e. cost of cow milk, Basmati rice, chia seeds, sugar, labour, fuel and miscellaneous charges etc. were taken into account for calculating

the cost of production of kheer for different treatments. The data in respect to cost of production of chia kheer is presented in Table 2.

From Table 2 it revealed that the cost of production of 1 kg kheer ranged from Rs. 85.2 to Rs. 115.4. The cost of production of different treatment combinations was Rs. 85.2, Rs. 92, Rs. 99.8, Rs. 107.6 and Rs. 115.4, for treatments T₁ (control), T₂ (1.5% chia seeds), T₃ (3% chia seeds), T₄ (4.5% chia seeds) and T₅ (6% chia seeds) respectively. The study indicated that good quality kheer can be prepared by adding 4.5 % chia seeds in cow milk.

Table 2. Cost of production of chia kheer prepared from cow milk

Particulars	Treatments									
	T ₁		T ₂		T ₃		T ₄		T ₅	
	Qty.	Values (Rs.)	Qty.	Values (Rs.)	Qty.	Values (Rs.)	Qty.	Values (Rs.)	Qty.	Values (Rs.)
Quantity of standardized milk required (g) @ Rs. 60/kg	1000	60	1000	60	1000	60	1000	60	1000	60
Quantity of <i>Chia</i> seeds used by weight in (g) @ 520/kg	-	-	15	7.8	30	15.6	45	23.4	60	31.2
Sugar used in (g) @ Rs. 45/kg	60	2.7	60	2.7	60	2.7	60	2.7	60	2.7
Rice used in (g) @ Rs. 40/kg	25	1	-	-	-	-	-	-	-	-
Ghee used in (g) @ Rs. 650/kg	10	6.5	10	6.5	10	6.5	10	6.5	10	6.5
Cost of production (electricity, gas, labour etc.)	-	15	-	15	-	15	-	15	-	15
Total cost of production		85.2		92		99.8		107.6		115.4
Product obtained	585	85.2	575	92	590	99.8	605	107.6	620	115.4

Aundhkar *et al.* (2024) [7] evaluated the preparation of barnyard millet (*Echinochloa esculenta*) kheer by incorporating barnyard millet at 1.5, 2.5, 3.5 and 4.5 per cent levels as T₁, T₂, T₃ and T₄, respectively, with T₀ as the control containing rice. The findings revealed that the cost of producing 1 kg of kheer increased with an increase in the level of barnyard millet incorporation. The treatment-wise cost of production was ₹93.44, ₹93.54, ₹93.94, ₹94.34 and ₹94.74 per kg for T₀, T₁, T₂, T₃ and T₄, respectively.

Bhosale *et al.* (2020) [9] conducted a study on the preparation of minor millet kheer blended with paneer using finger millet flour at different levels, viz., 1 per cent (T₁), 1.5 per cent (T₂) and 2 per cent (T₃), while T₀ (control) consisted of rice kheer. The authors reported that the cost of production of 1 kg kheer ranged from ₹93.24 to ₹125.47. The treatment-wise cost of production was ₹93.24, ₹125.47, ₹124.30 and ₹123.32/kg for T₀, T₁, T₂ and T₃, respectively.

Conclusion

Kheer of acceptable quality could be prepared from cow milk with chia seeds. Kheer prepared with 4.5 percent chia seeds and 6 percent sugar were superior in respect of organoleptic quality. The incorporation of chia seeds enhances the nutritional quality of kheer. The cost of production of a most acceptable kheer i.e. 4.5% chia seeds was 107.6/Kg. but this can be compensated with acceptability and enrichment of nutritional value of kheer.

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