

SENSORY QUALITY AND COST STRUCTURE OF RED RICE (*Oryza sativa*) KHEER

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ABSTRACT

The research work entitled “Utilization of red rice (*Oryza sativa*) for preparation of kheer” was carried out during the year 2019-20. Milk was standardized to 4 per cent fat and the kheer prepared with addition of 5 parts of plain rice + 95 parts of cow milk (T₁), 2 parts of red rice + 98 parts of cow milk (T₂), 4 parts red rice + 96 parts of cow milk (T₃) and 6 parts of red rice + 94 parts of cow milk (T₄), respectively. The results of four treatments with four replications were statistically analyzed by using completely randomized design (CRD). The data obtained after sensory evaluation for flavor, body and texture, colour and appearance and overall acceptability were subjected to statistical analysis. The sensory evaluation for overall acceptability carried out by the panel of judges, showed that kheer prepared by adding with 2 parts of red rice + 98 parts of cow milk (T₂) had secured the highest score (8.65 out of 9) and ranked as acceptable treatment. The cost of production of kheer was increased with the increase in the level of red rice. The cost of production was higher of treatment T₄ with addition of 6 parts of red rice + 94 parts of cow milk (Rs.79.20 kg⁻¹) while, the kheer prepared by adding 2 parts of red rice + 98 parts of cow milk (T₂ treatment) costing Rs. 77.60 kg⁻¹ which was superiorly accepted by the panel of judges. Hence, it is concluded that superior quality kheer can be prepared by addition of 2 parts of red rice + 98 parts of cow milk with 8 per cent sugar.

(Key words: Red rice, sensory quality, cost structure)

INTRODUCTION

Milk is of paramount importance to survival, proper development and vigorous growth of the neonate (new born). Milk is the only supply of the water, organic nutrients, and minerals to which the neonate has access. Milk supplies everything to the neonate except air. It has a high calorific value and generally is balanced for nutrient needs of the rapidly developing young of that species. Colostrum (the first milk taken from the mammary gland after parturition) and milk also contain non-nutrient substance (such as antibodies and bioactive factors) that may be important for growth, development, and survival of the neonate.

Kheer is one of the most common traditional dairy desserts which is mainly offered on religious occasions, social functions and festivals. Kheer has evolved itself to suit regional and personal preferences (Kadam *et al.*, 2011). It is a semi solid cereal-based dairy dessert prepared by cooking rice with sugar or jaggery in milk till the point when rice starch gets gelatinized. The major ingredients of kheer are milk, sugar, rice, dry fruits and flavoring ingredients (Jha *et al.*, 2013). Several methods of kheer preparation were adopted by using various value added 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 *et al.*, 2000).

Rice is one of the most popular and important cereal crops. It is the staple food of more than three billion people (Bhattacharjee *et al.*, 2002) in 39 countries, that comprises of nearly half of the world's population. Commercially more than two thousand varieties of rice are grown throughout the world. Over 2 billion people in Asia derive 80% of their energy needs from rice, which contains 80% carbohydrates, 7–8% crude protein, 3% crude fat, and 3% crude fiber (Juliano, 1985). Rice with a red bran layer is called red rice. Ancient Indian literature Charaka Samhita, authored by great Charaka mentioned rice with red husk and grain as the best which is efficacious and subdues the diseases (Kumar, 1988). Red rice is commonly consumed in Himachal Pradesh, Uttar Pradesh and South India, especially Karnataka and Tamil Nadu and is predominantly known for its aroma and taste. In some areas of India, red rice are considered highly nutritive and medicinal. The rice is eaten as whole grain.

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Keeping these in mind, the present paper focused to study on sensory evaluation and cost structure of red rice (*Oryza sativa*) kheer.

MATERIALS AND METHODS

During the entire study fresh, clean, whole cow milk was obtained from Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur. The milk was strained through clean muslin cloth and transfer into well cleaned and sterilize flat bottom stainless steel vessel.

The cow milk was standardized at 4 per cent fat by using Pearson's square formula by the addition of skim milk as followed for adjustment of 4 per cent fat.

Good quality red rice, plain rice and ingredients like sugar, skim milk were purchased from local market of Nagpur.

Treatment details

T₁ = 95 parts of cow milk + 5.0 parts of plain rice

T₂ = 98.0 parts of cow milk + 2.0 parts of red rice

T₃ = 96.0 parts of cow milk + 4.0 parts of red rice

T₄ = 94.0 parts of cow milk + 6.0 parts of red rice
(8 per cent sugar was added in all treatments)

Sensory evaluation of kheer

The product for sensory characteristics viz., flavor, color and appearance, body and texture and overall acceptability was determined by a trained sensory panel (minimum of 6 members) on a 9-point hedonic scale as prescribed by Nelson and Trout (1964).

Statistical analysis

The experiment was laid out in CRD with four treatments and four replications. The data obtained were analyzed statistically according to method described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Sensory evaluation of red rice kheer

The sample of fresh product were subjected to evaluation by panel of 5 trained judges. The same judges evaluated sample of each trial throughout the experiment to avoid the possibility to variation. The evaluation was done for the flavour, body and texture, colour and appearance and overall acceptability as per 9 point hedonic scale described by Nelson and Trout (1964).

The data with respect to sensory evaluation of red rice kheer are presented in Table 1.

Flavour

The flavour score of kheer was significantly ($P < 0.05$) affected due to addition of different levels of red rice. The flavour score of kheer prepared with addition of 5 parts of plain rice + 95 parts of cow milk (T₁), 2 parts of red

rice + 98 parts of cow milk (T₂), 4 parts of red rice + 96 parts of cow milk (T₃) and 6 parts of red rice + 94 parts of cow milk (T₄) were recorded as 7.90, 8.40, 7.35 and 6.55, respectively. Highest score (8.40) was obtained by kheer prepared with 2 parts of red rice + 98 parts of cow milk (T₂) as compared to other treatments. The red rice kheer prepared with 2 parts of red rice + 98 parts of cow milk was superior over 5 parts of plain rice + 95 parts of cow milk (T₁), 4 parts of red rice + 96 parts of cow milk (T₃) and 6 parts of red rice + 94 parts of cow milk (T₄).

More or less similar results were recorded by Ashwini Mukhekar *et al.* (2019). They recorded that, 3.5 per cent rice powder in cow milk was preferred by the judges. It gives pleasant flavour of Govindbhog variety rice which is a characteristics flavour of the used rice variety. But as the level of rice powder goes on increasing the flavour score goes on decreasing.

Solanki *et al.* (2018) recorded lowest score i.e. 6.25 under treatment T₃ (6 parts of finger millet + 94 parts of buffalo milk), which was due to increased level of finger millet powder in preparation of kheer. It was further noticed that the flavour score significantly affected (8.75 to 6.25) in finished product.

Body and texture

The body and texture score of kheer was significantly ($P < 0.05$) affected due to addition of different levels of red rice. The body and texture score of kheer prepared with the addition of 5 parts of plain rice + 95 parts of cow milk (T₁), 2 parts red rice + 98 parts of cow milk (T₂), 4 parts red rice + 96 parts of cow milk (T₃) and 6 parts of red rice + 94 parts of cow milk (T₄) were recorded as 7.90, 8.50, 7.45 and 6.95, respectively. Highest score (8.50) was obtained by kheer prepared with 2 parts of red rice + 98 parts of cow milk (T₂) as compared to other treatments. The red rice kheer prepared with addition of 2 parts of red rice + 98 parts of cow milk (T₂) was appreciated by panel of judges. The kheer prepared with 2 parts of red rice was superior over 5 parts of plain rice + 95 parts of cow milk, 4 parts of red rice + 96 parts of cow milk (T₃) and 6 parts of red rice + 94 parts of cow milk (T₄).

Ashwini Mukhekar *et al.* (2019) noticed that, as level of rice powder 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) also inferred that kheer prepared from different proportions of safflower milk and buffalo milk with addition of different levels of sugar viz., 6, 7 and 8 per cent recorded the decreased body and texture score ranged from 8.70 to 5.20.

Colour and appearance

The colour and appearance score of kheer was significantly ($P < 0.05$) affected due to addition of different levels of red rice. The colour and appearance score of kheer prepared with addition of 5 parts of plain rice + 95 parts of

Table 1. Combined table for sensory attributes of kheer affected by different level of red rice

Treatments	Parameters			
	Flavour	Body & Texture	Colour & Appearance	Overall acceptability
T ₁	7.90	7.90	7.95	7.90
T ₂	8.40	8.50	8.70	8.65
T ₃	7.35	7.45	7.35	7.40
T ₄	6.55	6.95	6.50	6.90
SE (m) ±	0.17	0.16	0.18	0.14
CD	0.49	0.48	0.54	0.41

Table 2. Cost of production of 1 kg kheer prepared from different levels of red rice

Ingredients	Rate (Rs.)	Treatments							
		T ₁		T ₂		T ₃		T ₄	
		Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)	Qty (g)	Cost (Rs.)
Cow milk (Rs.lit ⁻¹)	40	950	38	980	39.20	960	38.40	940	37.60
Red rice (Rs.kg ⁻¹)	80	-	-	20	1.60	40	3.20	60	4.80
Plain rice (Rs.kg ⁻¹)	40	50	2.0	-	-	-	-	-	-
Sugar @ 8% (Rs.kg ⁻¹)	40	80	3.20	80	3.20	80	3.20	80	3.20
Fuel charges @ Rs.750 14.2 kg ⁻¹	750	54	2.85	54	2.85	54	2.85	54	2.85
Electricity charge @ Rs. 5 unit ⁻¹	5	0.40	2	0.40	2	0.40	2	0.40	2
Labour charges @ Rs. 230 8 hrs ⁻¹ .	230	1 hr.	28.75	1 hr.	28.75	1 hr.	28.75	1 hr.	28.75
Total cost kheer kg⁻¹ Rs.	—	—	76.80	—	77.60	—	78.80	-	79.20

cow milk (T_1), 2 parts red rice + 98 parts of cow milk (T_2), 4 parts red rice + 96 parts of cow milk (T_3) and 6 parts red rice + 94 parts of cow milk (T_4) were recorded as, 7.95, 8.70, 7.35 and 6.50, respectively. The highest score (8.70) was significantly obtained by kheer prepared with 2 parts red rice + 98 parts of cow milk (T_2) as compared to other treatments. The red rice kheer (T_2) was appreciated by judges. The kheer prepared with 2 parts of red rice + 98 parts of cow milk (T_2) was superior over 5 parts of plain rice + 95 parts of cow milk, 4 parts of red rice + 96 parts of cow milk (T_3) and 6 parts of red rice + 94 parts of cow milk (T_4).

The results recorded in the present investigation for colour and appearance are comparable with the finding of Ashwini Mukhekar *et al.* (2019). They noticed that, addition of 3.5 per cent Govindbhog rice powder in cow milk was preferred by the judges. As level increases the natural purple colour seems to be dark in the product so the score goes on decreasing in subsequent levels.

Likewise, Solanki *et al.* (2018) was also noticed decreased score (6.25) for colour and appearance under kheer prepared with finger millet powder 6 parts + buffalo milk 94 parts.

Overall acceptability

The mean scores for overall acceptability of kheer prepared with 5 parts of plain rice + 95 parts of cow milk (T_1), 2 parts red rice + 98 parts of cow milk (T_2), 4 parts red rice + 96 parts of cow milk (T_3) and 6 parts red rice + 94 parts of cow milk (T_4) were recorded as 7.90, 8.65, 7.40 and 6.90, respectively.

It was observed that, the treatment T_2 (red rice at 2 parts + 98 parts of cow milk) was significantly superior over all treatments T_1 (5 parts of plain rice + 95 parts of cow milk), T_3 (4 parts of red rice + 96 parts of cow milk) and T_4 (6 parts of red rice + 94 parts of cow milk), respectively. Treatment T_4 (6 parts of red rice + 94 parts of cow milk) had the lowest mean score than control kheer prepared with plain rice.

Ashwini Mukhekar *et al.* (2019) revealed that the lowest overall acceptability score (6.96) was for treatment T_3 (4.5 % Govindbhog rice) was due to increase in level of rice powder which decreased flavour, colour and appearance and body and texture. Hence, overall acceptability score was less as compared to T_1 (3.5 % Govindbhog rice) treatment.

Solanki *et al.* (2018) found lowest overall acceptability score i.e. 6.46 in treatment T_3 (6 per cent finger millet powder) which was due to increased level of finger millet powder which decreased flavour, colour and appearance and body and texture, hence overall acceptability score given by the judges was less as compared to T_0 (2.5 % rice) treatment,

Cost of production

The cost of production of 1 kg red rice kheer ranged from Rs. 76.80 to 79.20. The cost of production for treatment T_1 (5 parts of plain rice + 95 parts of cow milk), T_2 (2 parts of

red rice + 98 parts of cow milk), T_3 (4 parts of red rice + 96 parts of cow milk) and T_4 (6 parts of red rice + 94 parts of cow milk) were Rs. 76.80, 77.60, 78.80 and 79.20, respectively. Lowest cost of production (Rs. 76.80) was recorded in case of kheer prepared with addition of 5 parts of plain rice + 95 parts of cow milk (T_1). However, the cost of production of kheer with 6 parts of red rice + 94 parts of cow milk (T_4) was Rs. 79.20. Cost of production of kheer prepared with addition of 2 parts of red rice + 98 parts of cow milk (T_2) was Rs. 77.60 and it was the best treatment selected by panel of judges for sensory evaluation.

Chavhan *et al.* (2019) calculated the cost structure of khamang rice kheer. The cost of production of different treatment combinations was Rs. 81.40, Rs. 82.93, Rs. 84.47 and Rs. 86.00 for treatments 98.5:1.5 (T_1), 98.0:2.0 (T_2), 97.5:2.5 (T_3) and 97.0:3.0 (T_4) parts of cow milk to khamang rice, respectively.

On contrary, Ashwini Mukhekar *et al.* (2019) noticed lowest cost of rice kheer prepared with different treatment combinations were used (T_0) 5% of boiled Basmati rice powder, Govindbhog rice powder 3.5% (T_1), 4% (T_2) and 4.5% (T_3) with milk and 8% sugar level. The cost of production of 1kg kheer ranged from Rs. 66.40 to Rs. 67.00. The cost of production of different treatment combinations was Rs. 67.00, Rs. 65.60, Rs. 66.00 and Rs. 66.40 for treatments T_0 , T_1 , T_2 and T_3 respectively.

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