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PHYSICO-CHEMICAL PROPERTIES AND COST STRUCTURE OF BHANDARA CHINNOR RICE (*Oryza sativa*) KHEER

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ABSTRACT

The research work entitled "Utilization of Bhandara chinnor rice (*Oryza sativa)* for the preparation of kheer" was carried out during the year 2023-24. Milk was standardized to 4 per cent fat and the kheer prepared with addition of Bhandara chinnor rice at 1.5 per cent (T_1), 2.0 per cent (T_2), 2.5 per cent (T_3) and 3.0 per cent (T_4) by weight of milk. The results of four treatments with five replications were statistically analyzed by using completely randomized design (CRD). The data obtained after sensory evaluation for flavour, body and texture, colour and appearance and overall acceptability and chemical analysis of fat, total solids, protein, ash, moisture were subjected to statistical analysis. The kheer prepared by adding 2.5 per cent Bhandara chinnor rice (T_3) contained 5.31 per cent fat, 41.53 per cent total solids, 3.87 per cent protein, 1.82 per cent ash and 58.47 per cent moisture. Total solids, protein, ash percentage of kheer were increased with the increase in the level of Bhandara chinnor rice and fat and moisture percentage was decreased with the increase in the level of Bhandara chinnor rice. The cost of production of kheer was increased with the increase in the level of Bhandara chinnor rice. The cost of production was higher of treatment T_4 with addition of 3.0 per cent Bhandara chinnor rice (Rs. 104.90 kg^{-1}) while, the kheer prepared by adding 2.5 per cent Bhandara chinnor rice (T_3) costing Rs. 104.80 kg^{-1} was superiorly accepted by the panel of judges. Hence, it is inferred that superior quality kheer can be prepared by addition of 2.5 per cent of Bhandara chinnor rice.

(Key words: Kheer, Bhandara chinnor rice, physico-chemical attributes, cost structure)

INTRODUCTION

Milk provided all essential nutrients for the nourishment of the body. It is consumed as a whole or by converting it into various milk product such as fermented milk product and coagulated milk product, concentrated milk product. Milk sweets have been an inseparable part of socio-cultural life in sub-continent. This reflects wealth and status of the people

Kheer is rice – based sweetened dairy dessert immensely popular in the Indian sub-countries and Middle-East countries. It is obtained by cooking pre-soaked rice in the boiling milk with simultaneous concentration that leads to a reasonably thick consistency ranging from a viscous fluid to a semi-solid rice pudding- like UK and USA and Amazake-like Japan milk-rice dairy dessert. It is often garnished with raisins, cashew nuts, pistachios or almonds and flavored with cardamom and saffron (Borad *et al.,* 2017).

Kheer has been known to mankind since times immemorial. It was used as sweet dish at all the ceremonial occasions and festivals and is relished by all age groups thought to be a very nutritious food. It is closely resembles "rice pudding" a popular dessert in the United States and in North and Central Europe (Kokani *et al.*, 2019).

Bhandara chinnor rice is one of the traditional rice variety of Bhandara district. It is specially famous for its aroma, fragrance and nutritional value. It is an indigenous variety of Maharashtra. Its grain is short, fat free and gluten free with high protein content and white appearance. It contents 5.99 mg Fe 100 g^{-1}. Na 14.67 mg, Mg 188.68 mg, K 502.70 mg, Ca 76.84 mg, Mn 5.5 mg, Cu 0.94 mg and Zn 5.30 mg 100 g^{-1}. The rice remains non sticky even after it has been cooked and it is firm and tender without splitting and bursting. It is known for its taste and aroma and the major chemical constituent responsible for aroma is 2 Acetyl-I- by moline (2AP). It have highest elongation ratio. The grain is short medium, soft in touch and white in colour. It has hard texture with a shelf life of 18 months. Taste is sweet and appealing.

Keeping these in mind, the present study entitled "Utilization of Bhandara chinnor rice (*Oryza sativa*) for the preparation of kheer'' was undertaken with the objectives to find out the suitable level of Bhandara chinnor rice along with the physico-chemical quality and its cost structure.

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MATERIALS AND METHODS

The research work entitled "Utilization of Bhandara chinnor rice (*Oryza sativa*) for the preparation of kheer" was carried out at the Section of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur during the year 2023-2024. During the entire study fresh, clean, whole cow milk was obtained from Dairy farm of Animal Husbandry and Dairy Science section, College of Agriculture, Nagpur. The milk was strained through clean muslin cloth and transferred into well cleaned and sterilized flat bottom stainless steel vessel. Dry and clean Bhandara chinnor rice soaked in water for 3 hrs. used for preparation of kheer.

Fresh cow milk was standardized at 4 per cent fat and 8.5 per cent SNF and then it was taken in an iron karahi and heated on gentle fire. At the same time of boiling, milk was stirred with the help of stainless steel ladle in a circular manner. For adequately cooking and concentrating the initial kheer mixture, it was boiled and reduced to 40 per cent volume. Thus, table servable kheer contained 1.5, 2, 2.5 and 3 per cent Bhandara chinnor rice paste in Bhandara chinnor rice based kheer.

Treatment details

T_1 = 98.5 parts of cow milk + 1.5 parts of Bhandara chinnor rice

T_2 = 98.0 parts of cow milk + 2.0 parts of Bhandara chinnor rice

T_3 = 97.5 parts of cow milk + 2.5 parts of Bhandara chinnor rice

T_4 = 97.0 parts of cow milk + 3.0 parts of Bhandara chinnor rice

Note: 8 per cent sugar was common in all treatments.

Chemical analysis of kheer

Determination of fat

Fat content in kheer was determined by Mojonnier fat extraction apparatus method as prescribed by Anonymous (1981).

Determination of total solids

The percentage of total solids in kheer was determined by using gravimetric method as prescribed by Anonymous (1961).

Determination of protein

The protein content in kheer was determined as per the procedure recommended by Anonymous (1961).

Determination of ash

The ash content in Kheer was determined as per the method recommended by Anonymous (1980).

Cost structure of kheer

The cost ($Rs.kg^{-1}$) of prepared kheer was worked by taking into consideration the prevailing retail rates of the ingredients used as milk, rice and sugar in addition to fuel and labour charges etc. During experimental period, procedure followed for estimation of cost was on the lines of the standard economic procedure.

Statistical analysis

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

RESULTS AND DISCUSSION

Chemical composition of kheer

The finished product of Bhandara chinnor rice kheer was subjected for the proximate analysis *viz*., fat, total solids, protein, ash and moisture. The results obtained on account of these parameter are presented in Table 1.

Fat content

The mean fat content in kheer samples was significantly affected due to the addition of Bhandara chinnor rice at different levels. The fat content in the kheer prepared with addition of Bhandara chinnor rice at 1.5 per cent (T_1), 2.0 per cent (T_2), 2.5 per cent (T_3) and 3.0 per cent (T_4) were recorded as 5.63, 5.46, 5.31 and 5.19 per cent, respectively. Highest fat percentage (5.63 per cent) was significantly found in kheer prepared with addition of 1.5 per cent of Bhandara chinnor rice (T_1) while, fat content was lowest (5.19 per cent) in kheer prepared with addition of 3.0 per cent of Bhandara chinnor rice (T_4). The results indicated that, with the increase in the levels of Bhandara chinnor rice there was significant reduction in fat percentage of kheer. This might be due to the fact that fat content of Bhandara chinnor rice was considerably less as compared to the fat content of milk.

Prajapati *et al.* (2021) recorded that the average fat content for treatment 5 parts of plain rice (T_1), 2 parts of red rice (T_2), 4 parts of red rice (T_3) and 6 parts of red rice (T_4) were 5.11, 5.44, 5.31 and 4.98 per cent, respectively. The fat content in treatment T_2 was highest as 5.44 per cent and that of lowest observed in treatment T_4 i.e. 4.98 per cent.

Chavhan *et al.* (2019) also recorded the fat content in khamang rice kheer which was ranged from 5.31 to 5.81 per cent.

Total solids content

The mean total solids content in kheer samples was significantly affected due to the addition of Bhandara chinnor rice at different levels. The total solids content in the kheer prepared with addition of Bhandara chinnor rice at 1.5 per cent (T_1), 2.0 per cent (T_2), 2.5 per cent (T_3) and 3.0 per cent (T_4) were recorded as 39.42, 40.22, 41.53 and 42.69 per cent, respectively. The total solids percentage was significantly highest (42.69 per cent) in kheer prepared with addition of 3.0 per cent of Bhandara chinnor rice (T_4) while, total solids content was lowest (39.42 per cent) in kheer prepared with addition of 1.5 per cent of Bhandara chinnor rice (T_1). The results indicated that, with the increase in the levels of Bhandara chinnor rice there was significantly

increase in total solids percentage of kheer. This might be due to the fact that total solids content of Bhandara chinnor rice was considerably more as compared to the total solids content of milk.

Chavhan *et al.* (2019) revealed that the mean total solids content of the finished product was found in the range 36.42 to 39.56 per cent. The highest total solids content was recorded for treatment T_4 (3.0 parts of khamang rice) i.e. 39.56. The lowest total solids contents was recorded for treatment T_1 (1.5 parts of khamang rice) i.e., 36.42.

Prajapati *et al.* (2021) recorded that the average total solids content for treatments 5 parts of plain rice (T_1), 2 parts of red rice (T_2), 4 parts of red rice (T_3) and 6 parts of red rice (T_4) were 40.45, 38.16, 39.35 and 41.47 per cent, respectively. The total solids in treatment T_4 was highest as 41.47 per cent and that of lowest in treatment T_2 i.e. 38.16 per cent.

Protein content

The mean protein content in kheer samples was significantly affected due to the addition of Bhandara chinnor rice at different levels. The protein content in the kheer prepared with addition of Bhandara chinnor rice at 1.5 per cent (T_1), 2.0 per cent (T_2), 2.5 per cent (T_3) and 3.0 per cent (T_4) were recorded as 3.78, 3.82, 3.87 and 3.93 per cent, respectively. The protein percentage was significantly highest (3.93 per cent) in kheer prepared with addition of 3.0 per cent of Bhandara chinnor rice (T_4) while, protein content was lowest (3.78 per cent) in kheer prepared with addition of 1.5 per cent of Bhandara chinnor rice (T_1). The results indicated that with the increase in the levels of Bhandara chinnor rice there was significantly increase in protein percentage of kheer. This might be due to the fact that protein content of Bhandara chinnor rice was considerably more as compared to the protein content of milk.

Chavhan *et al.* (2019) recorded that the protein content of khamang rice kheer was found higher in treatment T_4 (3.78) prepared with 3.0 parts of khamang rice followed by T_3 (3.76) with 2.5 parts of khamang rice followed by T_2 (3.73) with 2.0 parts of khamang rice and T_1 (3.69) with 1.5 parts of khamang rice.

Prajapati *et al.* (2021) revealed the average protein content of the kheer was found to be 3.99, 3.82, 3.91 and 4.09 per cent for treatment 5 parts of plain rice (T_1), 2 parts of red rice (T_2), 4 parts of red rice (T_3) and 6 parts of red rice (T_4), respectively.

Ash content

The mean ash content in kheer samples was significantly affected due to the addition of Bhandara chinnor rice at different levels. The ash content in the kheer prepared with addition of Bhandara chinnor rice at 1.5 per cent (T_1), 2.0 per cent (T_2), 2.5 per cent (T_3) and 3.0 per cent (T_4) were recorded as 1.68, 1.76, 1.82 and 1.91 per cent, respectively. The ash percentage was significantly highest (1.91 per cent) in kheer prepared with addition of 3.0 per cent of Bhandara chinnor rice (T_4) while, ash content was lowest (1.68 per cent) in kheer prepared with addition of 1.5 per cent of Bhandara chinnor rice (T_1). The results indicated that with the increase in the levels of Bhandara chinnor rice there was significantly increase in ash percentage of kheer. This might be due to the fact that ash content of Bhandara chinnor rice was considerably more as compared to the ash content of milk.

Prajapati *et al.* (2021) prepared kheer with addition of red rice at different levels. The ash content in the kheer prepared with addition of plain rice 5 parts (T_1), red rice at 2 parts (T_2), 4 parts (T_3) and 6 parts (T_4) were recorded as 1.88, 1.73, 1.86 and 1.97 per cent, respectively.

Chavhan *et al.* (2019) reported the average ash content of the kheer were found to be 1.38, 1.45, 1.57 and 1.61 per cent for treatment 1.5 parts of khamang rice (T_1), 2.0 parts (T_2), 2.5 parts (T_3) and 3.0 parts (T_4), respectively, which was lowest as compared to present study.

Moisture content

The mean moisture content in kheer samples was significantly affected due to the addition of Bhandara chinnor rice at different levels. Moisture contents in the kheer prepared with addition of Bhandara chinnor rice at 1.5 per cent (T_1), 2.0 per cent (T_2), 2.5 per cent (T_3) and 3.0 per cent (T_4) were recorded as 60.58, 59.78, 58.47 and 57.31 per cent, respectively. Significantly, highest moisture per cent was (60.58 per cent) recorded in kheer prepared with the addition of 1.5 per cent of Bhandara chinnor rice (T_1) and was lowest (57.31 per cent) in kheer prepared with the addition of 3.0 per cent of Bhandara chinnor rice (T_4). The results indicated that, with the increase in the levels of Bhandara chinnor rice there was significant reduction in moisture percentage of kheer.

More or less similar results was observed by Prajapati *et al.* (2021). They prepared kheer with addition of red rice at different levels. Moisture contents in the kheer prepared with addition of 5 parts of plain rice (T_1), red rice at 2 parts (T_2), 4 parts (T_3) and 6 parts (T_4) were recorded as 59.55, 61.84, 60.66 and 58.53 per cent, respectively.

Chavhan *et al.* (2019) prepared kheer with different parts of khamang rice (1.5, 2.0, 2.5 and 3.0 parts by weight of milk). On an average khamang rice kheer had moisture of 60.44 to 63.61 per cent.

Cost of production

The cost of production of 1 kg Bhandara chinnor rice kheer ranged from Rs. 104.60 to Rs. 104.90. The cost of production for treatment T_1, T_2, T_3 and T_4 were Rs. 104.60, Rs. 104.70, Rs. 104.80 and Rs. 104.90, respectively. Lowest cost of production (Rs. 104.60) was recorded in case of kheer prepared with addition of 1.5 per cent of Bhandara chinnor rice (T_1). However, the highest cost of production (Rs. 104.90) of kheer prepared with addition of 3.0 per cent of Bhandara chinnor rice (T_4). Cost of production of kheer prepared with addition of 2.5 per cent of Bhandara chinnor rice (T_3) was found Rs. 104.80 and it was the best treatment selected by panel of judges for sensory evaluation.

Table 1. Physico- chemical attributes of kheer as affected by different levels of Bhandara chinnor rice (per cent)

Treatments	Fat	Total solids	Protein	Ash	Moisture
T_1 = 98.5 parts of cow milk + 1.5 parts of Bhandara chinnor rice	5.63[a]	39.42[d]	3.78[d]	1.68[d]	60.58[a]
T_2 = 98.0 parts of cow milk + 2.0 parts of Bhandara chinnor rice	5.46[b]	40.22[c]	3.82[c]	1.76[c]	59.78[b]
T_3 = 97.5 parts of cow milk + 2.5 parts of Bhandara chinnor rice	5.31[c]	41.53[b]	3.87[b]	1.82[b]	58.47[c]
T_4 = 97.0 parts of cow milk + 3.0 parts of Bhandara chinnor rice	5.19[d]	42.69[a]	3.93[a]	1.91[a]	57.31[d]
SE (m)±	0.011	0.023	0.009	0.007	0.023
CD @ 5 %	0.033	0.069	0.027	0.021	0.069

Table 2. Cost of production of 1 kg kheer prepared from different levels of Bhandara chinnor rice (Rs.)

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})	60	985	59.10	980	58.80	975	58.50	970	58.20
Bhandara chinnor rice (Rs.kg^{-1})	80	15	1.20	20	1.60	25	2.00	30	2.40
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 @ 5 unit^{-1}	5	0.40	2.00	0.40	2.00	0.40	2.00	0.40	2.00
Labour charges @ Rs. 290 8 hrs^{-1}.	290	1 hr.	36.25	1 hr.	36.25	1 hr.	36.25	1 hr.	36.25
Total cost of 1 kg kheer	—	—	104.60	—	104.70	—	104.80	—	104.90

Prajapati (2020) calculated the cost structure of red rice kheer. The cost of production for treatment 5 parts of plain rice (T_1), 2 parts of red rice (T_2), 4 parts of red rice (T_3) and 6 parts of red rice (T_4) were Rs. 76.80, Rs. 77.60, Rs. 78.80 and Rs. 79.20, respectively.

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