

Optimization and Storage Study of *Rabri* Enriched with Date Syrup and Makhana

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Abstract

Rabri is a dairy-based sweet dessert that is very popular in Indian subcontinent. Its high sugar content limits some health conscious people from consuming it. In this study, *rabri* was prepared with date syrup replacing sugar completely. Three formulations were made varying the amount of buffalo milk and date syrup. The formulations were-T1 (95:5), T2 (90:10) and T3 (85:15) (buffalo milk: date syrup). Sensory evaluation was used for the optimization of the treatments. T1 scored highest with overall acceptability of 8.83 ± 0.15 . The shelf-life analysis was conducted for the optimized sample based on physico-chemical, sensory and microbial parameters (total plate count, yeast and molds and coliform count). The results showed a decline in the physico-chemical parameters i.e., pH, protein, fat, moisture and ash decreased from 6.75 ± 0.07 to 6.38 ± 0.12 ; 12.45 ± 0.07 to 10.5 ± 0.14 ; 22.78 ± 0.53 to 17.7 ± 0.14 ; 41.12 ± 1.31 to 33.16 ± 0.77 and 2.7 ± 0.28 to 1.5 ± 0.16 during the storage period. TA and total plate count increased with the storage period; however, yeast and molds were found at the end of the storage study and coliform count was absent throughout the study. The sensory characteristics, i.e. color, texture, mouthfeel and sweetness also decreased during the storage study; however, the optimized formulation was still acceptable with OA (6.67 ± 0.18) at the end of the 15th day of analysis. This study showed an approach of utilizing date syrup instead of sugar for the preparation of *rabri* and, enhancing its nutritional properties with the addition of makhana.

Keywords: *Rabri*, Date syrup, Sensory parameters, Total plate count, Coliform count

Introduction

India ranks first worldwide in the production of milk [1] with the reported production of 187.7mL annually in the year 2018 - 2019 [2]. Out of the total milk production, around 50 to 55 % fluid milk gets converted into variety of traditionally consumed dairy products such as, dahi, paneer, shrikhand, channa and channa based products (coagulated milk products), khoa, rabri, basundi (heat-dessicated milk products), ghee, buttermilk, butteroil, etc. [3,4]. Also, variety of desserts such as carrot supplemented paneer kheer [5], channa kheer, skimmed milk burfi; etc. have been formulated to increase the nutritional value of milk. Milk is rich in essential nutrients such as, protein, conjugated linoleic acids, Vitamin D, minerals (calcium and selenium), omega-3 fatty acids and bioactive peptides [6]. India is a country of festivals and hence milk-based products are an enriching part of its culture [7]. The commercial importance of the milk products lies in the fact that over 90 % of traditional milk products are consumed in India [8]. Around 12 % of the total milk production in the world is contributed by the buffalo milk [9]. Buffalo milk has high content of unsaturated fatty acids and lower concentration of cholesterol than cow milk [10]. Also, as compared with cow's milk, buffalo milk is rich in calcium and phosphorus [11]. Therefore, buffalo milk is more preferred than cow milk for the preparation of value-added dairy desserts [12].

Most of the dairy desserts contain high amount of fat as well as sugar, which makes their consumption restricted. Due to the modern life style that is full of mental stress and lacks physical activity, consumption of sugar-rich products leads to the onset of several diseases, such as diabetes, blood pressure, etc. Dates (*Phoenix dactylifera*) are high-energy yielding sweet fruit which when added with other products enhances its nutritional properties. Date syrup is a natural alternative to sugar which could

provide sweetness to the food products as well as adding flavor to it [4]. Natural sugars present in dates are monosaccharides, i.e. glucose and fructose and human body easily absorbs the monosaccharides [13].

Makhana (*Euryale ferox* S.) also known as gorgon nut or fox nut is an aquatic food crop which grows in ponds. It contains a rich amount of carbohydrate and protein, however, low in fat content [14]. Makhana has a rich amount of macro and micro-nutrients [15], also products made from makhana shows moderate calorific value [16]. The seeds are used widely in the ayurvedic preparations [17] and offered in *prasads* during various religious offerings.

Rabri is a delicious, mouth-watering dairy product made by concentrating and sweetening of whole milk that contains multiple layers of clotted cream. Cream is generally skimmed off by slowly evaporating the milk. Buffalo milk is rich in solid content that is favorable to produce superior quality *rabri*. As calculated on dry weight basis, the sugar and fat content of *rabri* is 20% each [8].

The enrichment of *rabri* by the addition of date syrup and makhana will help to increase its nutritional quality and hence, enhancing the overall acceptability of the formulation by the consumers. Therefore, this study was performed to analyze the physico-chemical parameters, sensory attributes and microbial count of date syrup and makhana enriched *rabri*.

Materials and methods

Preparation of *rabri* enriched with date syrup and makhana

The ingredients used for the preparation of *rabri* were buffalo milk, date syrup (used for sweetness instead of sugar), cardamom and makhana. Cardamom powder was used to enhance the flavor of the formulated product. All these ingredients were procured from the local market at Sudhowala, Dehradun, Uttarakhand, India. *Rabri* was prepared according to the method of Kaushik *et al.* [18] with slight modifications.

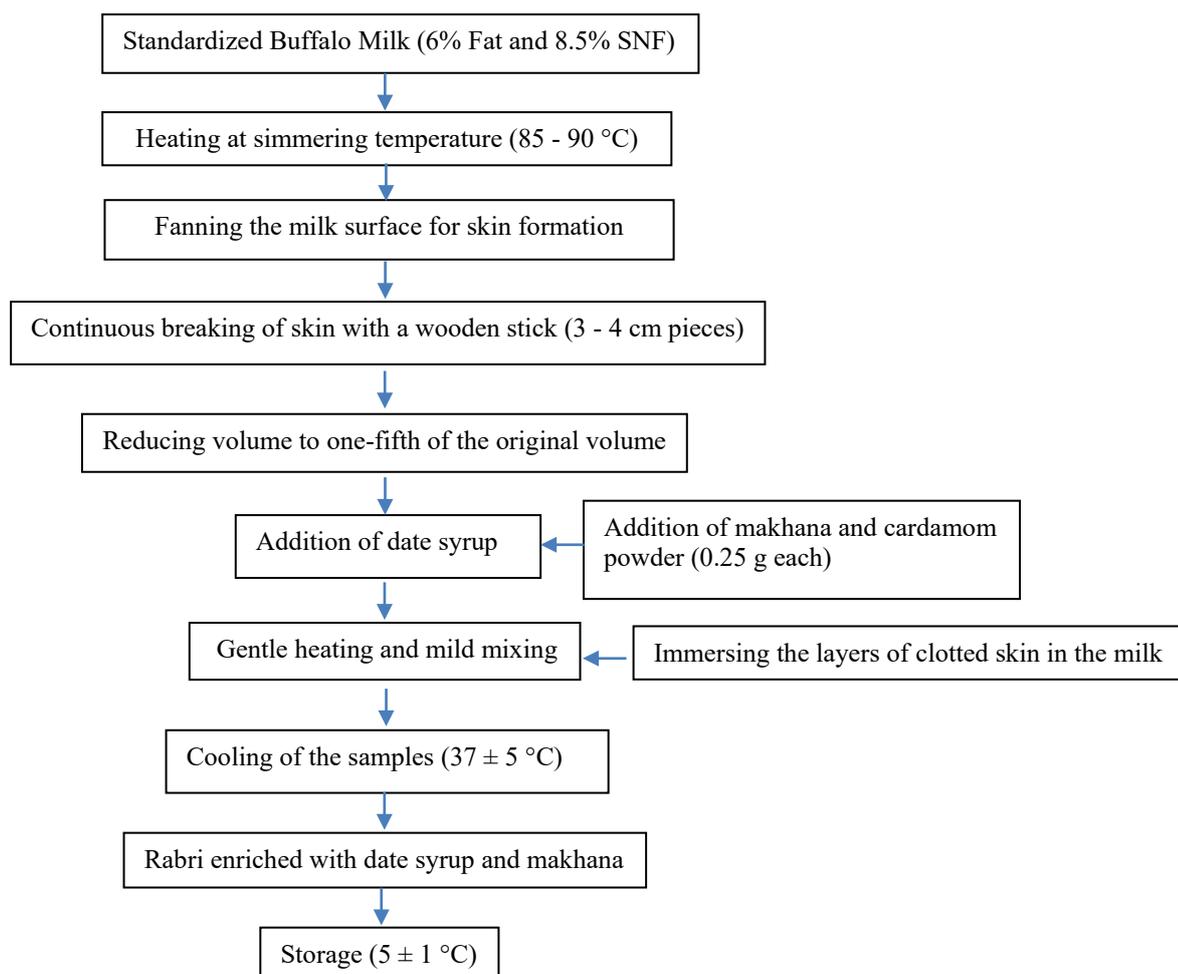


Figure 1 Process flow diagram for the manufacture of *rabri* enriched with date syrup and makhana.

For the preparation of rabri enriched with date syrup and makhana, fresh buffalo milk was procured from local vendor and it was standardized for fat (6 %) and SNF content (solid not fat) (8.5 %). Standardized milk was then properly strained and put in a shallow iron-pan. Milk was then heated at 85 - 90 °C (simmering temperature) and remained undisturbed with the control in the cooking temperature. Fanning was done to help in the skin formation which was separately collected. As the volume of the milk reduced to one-fifth of its original volume, date syrup was added in the mixture followed by addition of makhana. Cardamom powder was added in the mixture to enhance the taste and flavor of the product. The mixture was gently heated with mild mixing. Then, the layer of collected skin was completely immersed in the mixture and allowed to cool at 37 ± 5 °C. The final obtained product was kept at 5 ± 1 °C. The flow-diagram is represented in **Figure 1**.

Standardization of formulation of rabri enriched with date syrup and makhana

Buffalo milk with 6 % fat and 8.5 % SNF was purchased daily from the local vendor during the preliminary trial till the final optimization was performed. Date syrup was prepared by the method given by Kaushik *et al.* [18]. Makhana was slightly roasted and grounded in a mixer grinder before incorporating it in the formulations. Cardamom was added to enhance the taste and flavor of the formulations. Three formulations were made for the standardization of levels of buffalo milk and date syrup. These formulations were T1 (95:5), T2 (90:10) and T3 (85:15). Makhana and cardamom were kept constant at 0.25 %, respectively after preliminary trials. All these 3 formulations were subjected to sensory evaluation.

Sensory evaluation

The sensory analysis of rabri enriched with date syrup and makhana was done by a semi-trained panel consisting of 9 judges drawn from the staff and students of the Department of Food Technology, Doon (P.G.) College of Agriculture, Science and Technology, Dehradun, India. The sensory evaluation was based on 9-point Hedonic scale rating where, 1 = dislike extremely and 9 = like extremely [19]. The judges were asked to score for the following sensory attributes: color, texture, sweetness, mouthfeel and overall acceptability.

Proximate analysis

The moisture and ash content were analyzed by the method by AOAC [20]. The fat content was estimated by the method of AOAC [21] and the protein content was analyzed by Kjeldhal method [22]. pH was analyzed by the Digital pH m (Triode, India). Titratable acidity was calculated by the method given by Ranganna [23].

Storage analysis

The optimized sample of rabri enriched with date syrup and makhana was poured in plastic cups, sealed and stored at 5 °C for 15 days. Samples were withdrawn from storage and analyzed at every 5th day for any significant change in the physico-chemical, sensory and microbial properties.

Statistical analysis

ANOVA (one-way analysis of variance) was used for the statistical analysis. Data obtained were expressed as Mean \pm SD and calculated from triplicates.

Results and discussion

Optimization of formulation of rabri enriched with date syrup and makhana

Table 1 shows the composition of 3 formulations of rabri enriched with date syrup and makhana.

Table 1 Treatment details for rabri enriched with date syrup and makhana.

Treatments	Buffalo Milk (mL)	Date syrup (mL)	Makhana (g)	Cardamom (g)
T1	95	5	0.25	0.25
T2	90	10	0.25	0.25
T3	85	15	0.25	0.25

The optimization was done based on results of sensory evaluation by Hedonic-scale rating (**Table 2**). T1 was more preferred in terms of sensory parameters by the semi-trained panel, followed by T2 and T3. The overall acceptability of T1 was found to be the highest, i.e. 8.83 ± 0.15 followed by T2 (7.8 ± 0.14) and T3 (6.6 ± 0.08).

Table 2 Optimization of *rabri* formulations enriched with date syrup and makhana.

Treatment	Color	Texture	Sweetness	Mouthfeel	Overall acceptability
T1	8.66 ± 0.22	8.66 ± 0.20	8.73 ± 0.25	8.8 ± 0.11	8.83 ± 0.15
T2	8.1 ± 0.06	8.13 ± 0.17	7.23 ± 0.15	7.6 ± 0.08	7.8 ± 0.14
T3	7.13 ± 0.13	7 ± 0.36	6.2 ± 0.16	6.8 ± 0.11	6.6 ± 0.08

Data represented as mean \pm S.D.

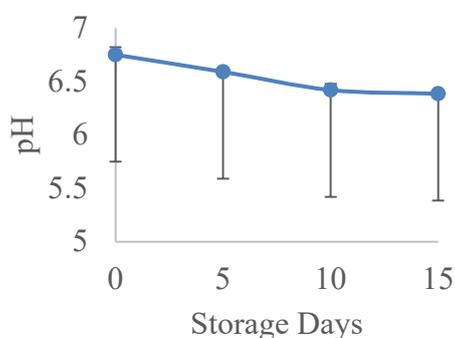
T3 contained the highest level of date syrup, i.e. 15 mL. T3 was least liked by the sensory panel because of the high sweetness intensity and lowest mouth feel. Therefore, T1 formulation with 95-part buffalo milk: 5-part date syrup with 0.25 % makhana and cardamom, respectively was selected as the optimized formulation.

Storage study

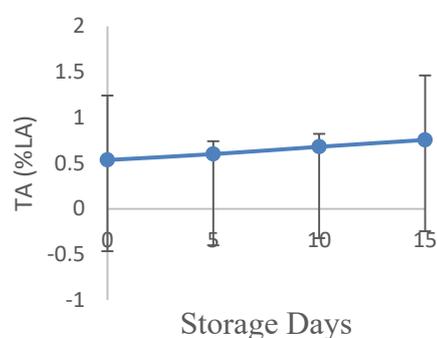
The optimized samples were kept at 5 ± 1 °C for a period of 15 days. The samples were analyzed at an interval of 5 days.

Changes in physico-chemical attributes of *rabri* enriched with date syrup and makhana

pH decreased during the storage period from day 0 to day 15. Initially, pH value was 6.75 ± 0.07 which decreased to 6.38 ± 0.12 on 15th day of storage (**Figure 2(a)**). With decrease in pH, titratable acidity (TA) increased during the storage period of 15 days. On day 0 TA was 0.53 ± 0.21 which increased to 0.75 ± 0.14 on 15th day of storage (**Figure 2(b)**). However, the change of pH and TA was non-significant ($p > 0.05$). Protein, fat and ash content also decreased from 12.45 ± 0.07 to 10.5 ± 0.14 ; 22.78 ± 0.53 to 17.7 ± 0.14 and 2.7 ± 0.28 to 1.5 ± 0.16 , respectively (**Figures 2(c) - 2(e)**). Kaushik *et al.* [18] also reported decrease in pH, TA, protein, fat and ash content in a storage study of 20 days conducted with different formulations of *rabri* fortified with date syrup. Similar results were also reported by Aggarwal *et al.* [24] when khoa was prepared from lactose-hydrolyzed buffalo milk and stored for a duration of 28 days. The reason for increase in acidity could be due to the action of microorganisms on lactose present in milk [25]. Moisture content majorly determines the quality of a product. Loss or gain in moisture directly co-relates with the microbial activity and sensory acceptability of the product. Moisture content decreased from 41.12 ± 1.31 on day 0 to 33.16 ± 0.77 , as observed on day 15th of the storage period (**Figure 2(f)**). Similar results of loss in moisture were also reported by Londhe *et al.* [26] in 20 days storage study of brown *peda* at 30 ± 1 °C. Control was packaged in cardboard box which showed maximum decrease in moisture content as compared with samples stored in MAP and vacuum packaging.



(a)



(b)

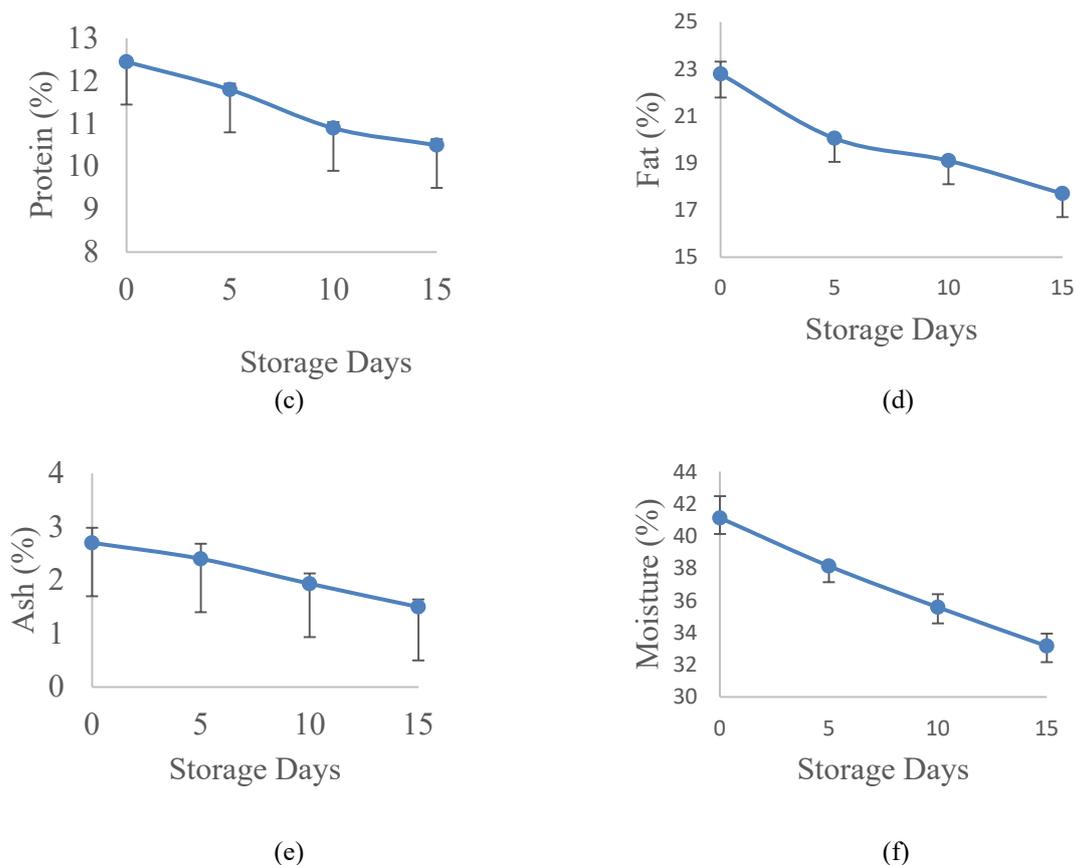


Figure 2 Change in (a) pH, (b) TA, (c) protein content, (d) fat content, (e) ash content, and (f) moisture content.

Change in sensory attributes of *rabri* blended with date syrup and makhana

The sensory evaluation corresponds to the consumer acceptability of the products. During the storage period of 15 days, samples showed a decreasing trend in the sensory scores (**Figure 3**). Color of the sample scored highest on day 0; however, with the storage period the sensory score decreased to 6.6 ± 0.15 on day 15th of the storage. Similarly, the sensory scores for texture, sweetness and mouthfeel also decreased from 8.2 ± 0.16 , 8.5 ± 0.31 , 8.6 ± 0.11 to 6.23 ± 0.16 , 6.97 ± 0.23 and 6.23 ± 0.11 . The texture and mouthfeel of the sample was also enhanced due to the addition of makhana. The incorporation of makhana provided a creamier texture to the sample. The highest sensory scores were obtained at day 0 with the OA score of 8.67 ± 0.21 ; on the onset of 15th day of storage, OA score was the least, i.e. 6.67 ± 0.18 . The decrease in sensory scores were found to be significant ($p < 0.05$). Despite of this decreasing trend, the product was still acceptable. The results obtained in this study were found similar to the findings of Biradar *et al.* [27]; Sharma *et al.* [28] in case of malai peda and Londhe *et al.* [26] in case of brown peda. Kaushik *et al.* [18] also showed the decreasing trend of sensory attributes in case of multiple formulations of *rabri* enriched with date syrup. Singh *et al.* [11] also reported that when dahi was fortified with *Aegle marmelos* juice and kept for a storage period of 15 days; sensory scores decreased from day 0 to day 15. Bharti *et al.* [29] also showed the decreasing trend in sensory properties in the 15 days storage study of apple *rabri*.

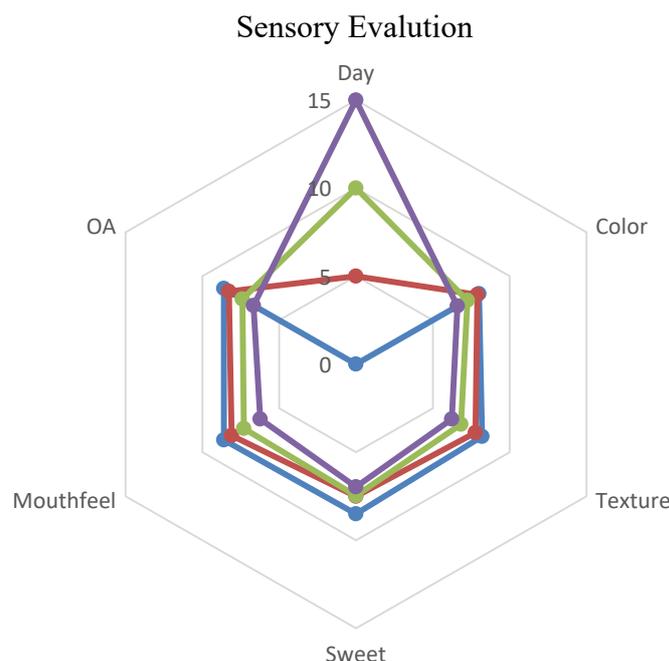


Figure 3 Changes in sensory attributes of *rabri* blended with date syrup and makhana.

Microbiological changes in *rabri* blended with date syrup and makhana during storage

The microbiological changes in *rabri* blended with date syrup and makhana during the storage period of 15 days at 5 °C is shown in **Table 3**. Initial total viable count in the sample was 6.42×10^{-4} cfu/g which increased to 8.81×10^{-4} cfu/g on 5th day, 10.17×10^{-4} cfu/g on 10th day and 13.42×10^{-4} cfu/g on the 15th day of storage period. However, yeast and mold count were observed at the 15th day of the storage period, i.e. 1.24×10^{-5} cfu/g. Coliform count was absent during the storage period. The results of this study are in accordance with the findings reported by Bharti *et al.* [29] in the study of apple *rabri*. The presence of TPC and the complete absence of coliform count was also reported in the study conducted by Malarkannan *et al.* [30].

Table 3 Microbial changes in *rabri* enriched with date syrup and makhana.

Microbial parameters			
Storage days	Total plate count (10^{-4} cfu/g)	Yeast & mold count (10^{-5} cfu/g)	Coliform count (10^{-4} cfu/g)
0	6.42	Absent	Absent
5	8.81	Absent	Absent
10	10.17	Absent	Absent
15	13.42	1.24	Absent

Conclusions

The present study was done as an attempt to substitute sugar with date syrup and enhance the nutritional properties of *rabri*, along with the addition of makhana. *Rabri* enriched with date syrup and makhana was prepared as per the process mentioned in **Figure 1**. The results clearly showed a progressive decrease in physico-chemical and sensory properties; however, increase in the TPC and YMC with the increase in the storage period. The enrichment of *rabri* with date syrup was liked extremely by the sensory panel. Hence, this study has proven the acceptability of blending of date syrup and makhana in *rabri*. Further, studies are needed in order to increase the shelf-life of the said product for its commercialization at a large scale.

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