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Studies on the process optimization for preparation of Chhana Kheer by using artificial sweetener aspartame

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Abstract

Kheer is a cereal based traditional dairy dessert. Chhana is a heat-acid coagulated product of milk. Chhana Kheer which is a conventional dessert containing chhana and sugar. Dietetic Chhana Kheer was developed with artificial sweetener aspartame so that it would serve as a dietetic food for consumer and offer the same delicacy as a traditional conventional dairy product. Four treatment samples were studied viz., T₀ (Chhana Kheer Control) prepared from cow milk with sugar (@ 7%), T₁, T₂ and T₃ containing artificial sweetener aspartame at the rate of 0.010%, 0.015% and 0.020% respectively. Highest moisture percentage was recorded in the treatment T₀ (52.72) followed by T₁ (52.02), T₂ (51.92) and T₃ (51.56). All the treatments were sensorily acceptable but Treatment T₁ received highest score (8.35) on 9 point Hedonic scale. The SPC count, Yeast and Mould count were within the limits of microbiological standards. The coliform count was obtained nil among all the samples. The cost of production observed a reducing trend from T₀ to T₃ which further added to the significance of experimental replacement of sugar with aspartame. Thus an acceptable quality of Chhana Kheer can be prepared using aspartame.

Keywords: Aspartame, chhana, coagulant, cost, Kheer, microbiological, milk, sensory

1. Introduction

Major portion of the milk produced in the country is being utilized for the preparation of various indigenous dairy products like khoa and khoa (concentrated milk) based sweets, chhana and chhana (coagulated milk) based sweets, paneer, fermented milks etc. (Shivakumar *et al.*, 2014) [15]. In recent years, dairy industry has been diversifying its production portfolio to include the specialty foods that cater to specific targeted populations. Most of the traditional Indian dairy products contain high fat and high sugar. Today's health conscious consumers are alarmingly concerned about the impact of high fat and sugar intake on health. They are looking for the low or reduced calorie traditional dairy foods. This necessity made it essential to incorporate low calories sweeteners in the preparation of indigenous dairy products. Traditional dairy foods with conventional taste and flavor but with reduced fat and sugar provide an important alternative for consumers (Raju and Pal, 2009) [13].

Traditional Indian products include several innovative blends used in the preparation of different variety of milk based delicacies. Among them Kheer (heat desiccated and sweetened milk) is one which is popular in the northwest, central and eastern part of India, and is popular as payasam in the southern part. Kheer is also a cereal based particulate dairy dessert. It is a unique product representing dairy and food processing going hand in hand (Shivakumar *et al.*, 2014) [15].

If rice is cooked in milk, starch-milk reaction results in a thick product, which is very popular traditional milk product in India known as 'Kheer'. Conventionally it is prepared by partial dehydration of whole milk in a Karhai open pan over direct low fire followed by addition of sugar towards the end (Kadam and Gulati, 2013) [8]. Kheer which contains creamy sweetened concentrated milk is exclusively famous in South-east Asia but has no large-scale production owing to its poor shelf-life (Jha *et al.*, 2011) [7].

Chhana is a heat-acid coagulated product of milk. The concentrated and preserved milk solids in form of Chhana provide sound nutrition and novelty of flavor and texture to consumers. Pattern of milk consumption in India indicates that about 6 percent of milk is coagulated for production of Chhana (Chattopadhyay *et al.*, 2014) [3]. Chhana is a rich source of fat and protein. It also contains fat-soluble vitamins A and D. With high protein and low sugar content, chhana is highly recommended for diabetic patients (Sahu and Das, 2009). According to Chandan *et al.* (2002) [2].

chhana contains an approximate composition of moisture 50-55% fat 22-26% protein 15-20%, and ash.08-2.2%.

Now a days sugar free food are very much popular because of their less calorie content. So food industry uses various artificial sweeteners which are low in calorie content instead of high calorie sugar (Chattopadhyay *et al.*, 2014) [3]. Government of India (PFA 2004) [12], have permitted the use of low-calorie such as aspartame and in sweets like halwa, khoya burfi, rasgolla, gulabjamun and other milk products. U.S. Food and Drug Administration have approved aspartame, acesulfame-k, neotame, cyclamate and alitame for use as per acceptable daily intake (ADI) value (Chattopadhyay *et al.*, 2014) [3]. Aspartame is a high intensity sweetener which has been added to numerous food products and can be incorporated in dietetic Chhana Kheer which is a dessert containing chhana and sugar and is very popular in the Indian subcontinent (Gautam *et al.*, 2013) [4]. Many scientists are working together to increase the shelf life of Chhana Kheer (Gautam *et al.*, 2014) [5]. In view of the above an attempt was made to develop a process for manufacturing Chhana Kheer with artificial sweetener aspartame so that it would serve as a dietetic food for consumer and simultaneously offer the same delicacy as a traditional conventional product.

2. Material and Methods

The experiment was carried out in the lab of Student Training Dairy Plant, Warner College of Dairy Technology, Sam Higginottom University of Agriculture, Technology & Science, Allahabad (U.P.). Raw cow milk was collected from the student training dairy plant. Sweetener (Aspartame) was procured from the local market of Allahabad. Muslin cloth, citric acid, Gerber acid and Amyl alcohol were obtained from the Department laboratory. Four treatment samples were studied *viz.*, T₀: Chhana Kheer (control) prepared from cow milk with sugar (7%); T₁: Addition of artificial sweetener aspartame (@ 0.010%); T₂: Addition of artificial sweetener aspartame (@0.015%) and T₃: Addition of artificial sweetener aspartame (@ 0.020%). Chhana Kheer samples were packaged in polyethylene cups for storage studies.

2.1 Standardization of milk

Cow milk was standardized by the addition of double toned milk using Pearson's square method. The standardized milk had 4% fat, 8.5% SNF.

2.2 Method of preparation of citric acid solution

Citric acid (20gm) was accurately weighted and dissolved in 1000 ml distilled water taken in graduated cylinder and mixed well by gentle stirring with the help of a clean glass rod.

2.3 Preparation of Chhana

Chhana is prepared from cow or mixed milk is boiled in iron-Karahi on a coil or fire wood chullah, cooled to about 80°C to 85 °C and coagulated with 2% citric acid solution by gentle and continuous stirring with ladle until all the milk gets precipitated in lumps and settle down at the bottom with clear whey floating on top which was filtered through a sterile muslin cloth.

2.4 Method for fixation of dosage and addition of sweetener

Dosage of the sweetener (Aspartame) was fixed by several preliminary trials on the basis of sensory evaluation.

Calculated amount of sweetener were added to the freshly made chhana and mixed properly by kneading it well and then cutting in to small cubes.

2.5 Preparation of diabetic Chhana Kheer

Chhana was prepared by coagulating milk with 2% citric acid solution, added with aspartame and properly kneaded together as per the treatments, and then cut into fine cubes. Fresh cow milk was properly filtered and clarified. Fat and SNF was standardized to 4% and 8.5 % respectively. Milk was heated till reached to 95 °C which facilitated further concentration to the ratio 2:1. The mixture was cooled to 37 °C. At this stage chhana cubes containing aspartame was added. Mixture was further heated and thoroughly mixed for proper penetration of aspartame in to chhana cubes and concentrated milk. The Chhana Kheer so obtained was cooled and packed manually in polyethylene cups and stored at 4 °C for further analysis.

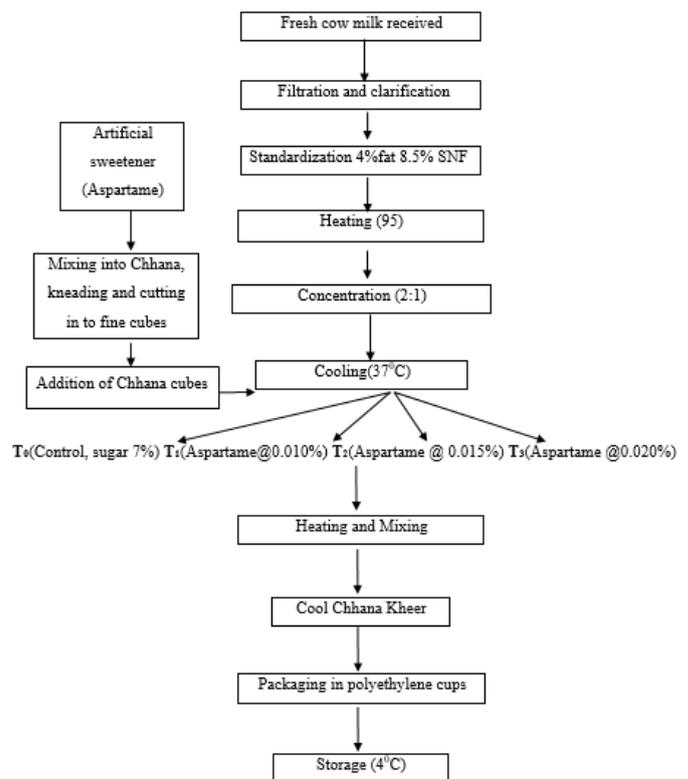


Fig 1: Flow chart for the preparation Chhana Kheer

3. Results and Discussion

Each treatment was replicated four times. In all 20 samples were examined for physico-chemical (Table 1), microbial (Table 2) and sensory characteristics (Table 3). The data was statistically analyzed by using analysis of variance (ANOVA). Percent moisture, fat and ash contents of Chhana Kheer were determined as per the procedure given in Manual of Dairy Chemistry, I.C.A.R (1972). Percent protein of Chhana Kheer was estimated by Kjeldahl method described in AOAC (1980) [1]. The carbohydrate percent of Chhana Kheer was obtained by Phenol-Sulphuric acid method as per adopting the procedure as depicted in manual of food analysis laboratory 2nd edition (Nielsen, 2010) [11].

The microbiological analysis for yeast and mould count, SPC count and presumptive coli form count was estimated by using standardized procedure laid down in ISI (1479) part III (1962) and Manual in Dairy Microbiology I.C.A.R. publication (1972). All the samples of Chhana Kheer were

subjected to sensory analysis for Colour and appearance, Flavour, Body and texture, Overall acceptability by a panel of seven judges using 9 point Hedonic scale. Economies of production were also obtained (Table 4).

3.1 Physico- chemical analysis of Chhana Kheer

3.1.1 Moisture analysis

From the data of moisture percentage in Chhana Kheer samples, significant difference was observed among the different treatments. The highest moisture percentage was recorded in the treatment T₀ (52.72) followed by T₁ (52.02), T₂ (51.92) and T₃ (51.56). Addition of sugar and the subsequent boiling up to a certain extent results in dissolution of sugar which increases the moisture percent of product. But when sugar is replaced by aspartame, the milk begins to concentrate due to direct heat. Hence moisture in it decreases gradually.

3.1.2 Fat analysis

Highest fat percentage was recorded in the Chhana Kheer sample of T₀ (23.10) followed by T₁ (24.14), T₂ (24.72), and T₃ (25.12). Each treatment differed significantly.

3.1.3 Protein analysis

From the data of percentage protein in Chhana Kheer samples of different treatments and control the highest protein percentage was recorded in the Chhana Kheer sample of T₀ (17.56) followed by T₃ (17.30) T₁ (17.16) and T₂(16.80) with significant differences among the treatments.

3.1.4 Carbohydrate analysis

From the data of percentage Carbohydrate in in Chhana Kheer samples of different treatments and control, the highest Carbohydrate percentage was recorded in the Chhana Kheer sample of T₀ (4.24) followed by T₁ (4.22), T₂ (3.84) and T₃ (3.60). The difference was significant, indicating significant effect of treatments on Carbohydrate percentage.

3.1.5 Ash analysis

From the data of percentage Ash in in Chhana Kheer samples of different treatments and control, the highest Ash percentage was recorded in the Chhana Kheer sample of T₀ (2.60) followed by T₃ (2.54), T₂ (2.36), and T₁ (2.26). This may be attributed to the higher sugar present in control samples. The difference was significant, indicating significant effect of treatments on Ash percentage.

3.2 Microbiological analysis of Chhana Kheer (CFU/gm)

Highest SPC was recorded in the Chhana Kheer sample of T₂ (5.60) followed by T₁ (5.00), T₀ (5.00) and T₃ (3.80) in 10⁻³ dilution. Highest Yeast and mould percentage was recorded in the Chhana Kheer sample of T₁ (13.60) followed by T₀ (12.80), T₃ (12.40) and T₂ (10.40) in 10⁻¹ dilution. Significant differences were observed among the treatments for SPC and yeast and mould count. Coli form counts were observed nil in all the treatments in 10⁻² dilutions.

3.3 Sensory analysis of Chhana Kheer

3.3.1 Colour and appearance

There were significant difference between control and experimental Chhana Kheer as the F calculated value (3.94) is higher than the F table value (3.49) at 5% level of significance. The highest mean score for Colour and appearance of Chhana Kheer (7.70) was obtained for

treatment T₂, followed by T₃ (7.66) and (control) T₀ (7.30). The minimum score (7.10) was obtained by T₁ treatment.

3.3.2 Flavour

There were significant difference between control and experimental Chhana Kheer. F calculated value (5.05) is higher than the F table value (3.49) at 5% level of significance. The highest mean score for Flavour of Chhana Kheer (7.86) was obtained for treatment T₃, followed by T₁ (7.84) and T₂treatment (7.70). The minimum score (7.32) was obtained by (Control) T₀.

3.3.3 Body and texture

There were significant difference between control and experimental Chhana Kheer. The F calculated value (4.35) is higher than the F table value (3.49) at 5% level of significance. The highest mean score for Body and texture of Chhana Kheer (7.90) was obtained for treatment T₂, followed by T₃ (7.48) and T₀ (Control) (7.30). The minimum score (7.04) was obtained by (treatment) T₁.

3.3.4 Overall acceptability

There were significant difference between control and experimental Chhana Kheer, because, the F calculated value (3.51) is higher than the F table value (3.49) at 5% level of significance. The highest mean Overall acceptability of Chhana Kheer (8.35) was obtained for treatment T₁ followed by T₂ (8.09) and (control) T₀ (7.77). The minimum score (7.73) was obtained by T₃ treatment.

3.4 Cost of production of Chhana Kheer

The cost of production of Chhana Kheer for T₀ (Control) was Rs. 110.80, (T₁) Rs. 104.56, (T₂) Rs.100.98 and Rs. 97.44 (T₃) per Kg of Chhana Kheer.

Table 1: Physico-Chemical analysis of Chhana Kheer

| SN. No. | Parameters | Treatments (Mean) | | | |
|---------|---------------------|-------------------|----------------|----------------|----------------|
| | | T ₀ | T ₁ | T ₂ | T ₃ |
| 1 | Moisture percentage | 52.72 | 52.02 | 51.92 | 51.56 |
| 2 | Fat percentage | 23.10 | 24.14 | 24.72 | 25.12 |
| 3 | Protein percentage | 17.56 | 17.16 | 16.80 | 17.30 |
| 4 | Carbohydrate | 4.24 | 4.22 | 3.84 | 3.60 |
| 5 | Ash | 2.60 | 2.26 | 2.36 | 2.54 |

Table 2: Microbiological analysis of Chhana Kheer

| SN. No. | Parameters | Treatments (Mean) | | | |
|---------|--|-------------------|----------------|----------------|----------------|
| | | T ₀ | T ₁ | T ₂ | T ₃ |
| 1 | Standard plate count(10 ⁻³) cfu/ gm | 5.00 | 5.00 | 5.60 | 3.80 |
| 2 | Yeast & mould count(10 ⁻¹) cfu/ gm | 12.80 | 13.60 | 10.40 | 12.40 |
| 3 | Coli form count count(10 ⁻²) cfu/ gm | NIL | NIL | NIL | NIL |

Table 3: Sensory analysis of Chhana Kheer

| S.N No. | Parameters | Treatments (Mean) | | | |
|---------|-----------------------|-------------------|----------------|----------------|----------------|
| | | T ₀ | T ₁ | T ₂ | T ₃ |
| 1 | Color and appearance | 7.30 | 7.10 | 7.70 | 7.66 |
| 2 | Body and texture | 7.30 | 7.04 | 7.90 | 7.48 |
| 3 | Flavour | 7.32 | 7.84 | 7.70 | 7.86 |
| 4 | Overall acceptability | 7.77 | 8.35 | 8.09 | 7.73 |

Table 4: Cost analysis of Chhana Kheer

| S.N No. | Parameters | Treatments (Mean) | | | |
|---------|-----------------|-------------------|----------------|----------------|----------------|
| | | T ₀ | T ₁ | T ₂ | T ₃ |
| 1 | Cost (in Rs/kg) | 110.80 | 104.56 | 100.98 | 97.44 |

4. Conclusion

From the experimental results it can be concluded that replacement of sugar with artificial sweetener (aspartame) can be efficiently and acceptably carried out up to (T₁) 0.010%, (T₂) 0.015% and (T₃) 0.020% levels. All the treatments were sensorily acceptable but Treatment T₁ received highest score (8.35) on 9 point Hedonic scale. The SPC count, Yeast and Mould count were within the limits of microbiological standards. The coliform count was obtained nil among all the samples. The cost of production observed a reducing trend from T₀ to T₃ which further added to the significance of experimental replacement of sugar with aspartame. Thus an acceptable quality of Chhana Kheer can be prepared using aspartame.

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