EFFECT OF ASSIMILATION OF CUSTARD APPLE (ANNONA SQUAMOSA) PULP ON CHEMICAL QUALITY AND COST OF ICE-CREAM

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ABSTRACT

Present investigation was conducted to study the chemical composition, quality and cost of ice-cream. Three leaves of custard apple pulp (i.e. 10, 15 and 20 per cent) with two levels of sugar (i.e. 10 and 15 per cent were compared with control where no pulp but 15 % sugar was added. Levels of stabilizer, fat and total solids were kept constant at 0.15, 10 and 36 per cent, respectively. It could be inferred that ice-cream prepared with incorporation of 15 per cent custard apple pulp and 15 per cent sugar level (T₄) had overall acceptability of 8.05 scores of hedonic scale. The production cost and energy value per kg was Rs.61.42 and 97.27 Kcal/100 g, respectively.

Key words: Ice-Cream, Custard apple pulp, Buffalo milk.

INTRODUCTION

India is the world’s largest growing market for milk and milk products with an annual growth rate of about 4.5 per cent of country’s milk production. The rural sector accounts for 98 per cent of all milk produced in India (Anonymous, 2002). Of the total milk produced, 46 per cent is utilized as liquid milk while 50 per cent is converted into traditional products like ghee; makkhan (33 %), dahi (7 %), khoa (7 %) and chhana/paneer (3 %)and the remaining 4 % is converted mainly into Western products such as ice-cream, milk powder, etc. (Aneja et al., 2002).

Ice-cream is a delicious and nutritious frozen dairy dessert with high calorific value but the retail price of ice-cream is higher because of high cost of ingredients. The major reason for the prohibitive cost of the product is the short supply of ingredients required for its manufacture. Fruits not only improve the sensory quality of the product but also improve its nutritive value which varies with the type of fruit used. Therefore, incorporation of fruits, which is also accepted by regulation in India, such as mango, pineapple, strawberry, orange, etc. in the form of juices, pulp or pieces is a common practice. Custard apple (Annona squamosa) –Sitaphal- is one of the major fruits of dry land farming and abundantly available in rangelands where rainfall is minimum. Hence, its utilization in some value added dairy products is one of the alternatives. The present work was planned with objective of standardization on the use of custard apple pulp for preparation of ice-cream from various blends in combination with different sugar levels in terms of chemical quality and economics of production.

MATERIAL AND METHODS

Buffalo milk, standardized to 6 % fat, was used throughout the study. After the preliminary trials, selected levels of custard apple pulp and sugar were finalized. Stabilizer level was decided by taking benefit of natural protein present in custard apple pulp. The experiment was conducted with two factors i.e. three levels of custard apple pulp viz., 10, 15, 20 per cent and two levels of sugar viz., 10 and 15 per cent keeping constant level of stabilizer @ 0.15 per cent sodium alginate. Fat and total solids
contents of ice-cream mix was adjusted to 10 and 36 per cent, respectively. All ice-cream samples were prepared as per the method given by De and Ray (1982) as shown in flow diagram with following treatment combinations.

- $T_0$ - (Control) no custard apple pulp + 15 per cent sugar
- $T_1$ - 10 per cent custard apple pulp + 10 per cent sugar
- $T_2$ - 10 per cent custard apple pulp + 15 per cent sugar
- $T_3$ - 15 per cent custard apple pulp + 10 per cent sugar
- $T_4$ - 15 per cent custard apple pulp + 15 per cent sugar
- $T_5$ - 20 per cent custard apple pulp + 10 per cent sugar
- $T_6$ - 20 per cent custard apple pulp + 15 per cent sugar

**Flow diagram of preparation of custard apple ice cream**

1. Receiving of milk
2. Separation of part of whole milk
3. Determination of fat, SNF and TS of whole milk and cream
4. Washing of fruits and extraction of pulp along with seed
5. Separation seed from pulp
6. Homogenisation of pulp
7. Figuring of mix (milk, cream, SMP, sugar, stabilizer)
8. Making the mix
9. Pasteurization of mix (68°C for 30 min)
10. Cooling mix at room temperature
11. Incorporation of custard apple pulp (as per treatments)
12. Addition of colour and flavour
13. Blending of mix (90 Sec.)
14. Freezing of mix (-4 to -5°C)
15. Packaging
16. Hardening and storage (-12°C to -15°C for 12-16 hrs)
**Chemical analysis**

Fat of the final product was determined as per IS 1224 (Part-II) (1977), protein as per Micro Kjeldahl’s method described by Ranganna (1977), total sugar as per IS-1479, Part-II (1961), total solids as per IS:1479 (Part-II (1961), calorific value by using Bomb calorimeter and overrun was determined with following formula Eckles et al. (1951).

\[
\% \text{ Overrun} = \frac{\text{Weight of unit volume of mix} - \text{Weight of unit volume of ice cream}}{\text{Weight of unit volume of ice cream}} \times 100
\]

**Statistical analysis**

The results obtained during the course of investigation were subjected to statistical analysis by using Completely Randomised Design (Panse and Sukhatme, 1985).

The cost of production of custard apple ice cream was worked out considering the prevailing market prices of all the ingredients used and processing cost of the product.

**RESULTS AND DISCUSSION**

**Chemical composition**

The results on chemical composition of custard apple ice-cream samples prepared from various treatment combinations are presented in Table 1.

**Fat content**

There was no significant effect of level pulp and sugar on the fat content of ice cream. The fat content of ice cream ranged from 10.02 to 10.13 per cent such minimum differences in fat content of ice cream samples were because the mix of each treatment was figured to have 10 per cent fat by the use of cream. Similar observations were recorded by Gund (2003) fat content for bullock’s heart pulp ice cream. Gaikwad (2002) and Amale (1980) reported gradual decrease in fat content with increase in the level of jamun juice and orange juice in ice cream, respectively. Further, the present results are also in agreement with Ratnaparkhi (1981) and Kolpe (1995).

**Protein content**

Treatment T1 was significantly higher in protein content (5.19 per cent) followed by T3 (4.95 per cent), T5 (4.74 per cent) and lowest protein content was observed with treatment T6 (3.56 per cent). Treatment T3 (4.95) was significantly superior over T4 (3.73 %), T5 (4.74 %) and T6 (3.56 %). The observations revealed that as the pulp level in the ice cream increased, the protein content of the ice cream decreased. Pulp did not contribute significantly for the protein content. Similarly, Bajwa (2003) and Murtaza (2004) observed significant effect on protein content in different treatments of ice cream.

<table>
<thead>
<tr>
<th>Treatments (P% - S%)</th>
<th>Fat (%)</th>
<th>Protein (%)</th>
<th>Sugar (%)</th>
<th>Total solids (%)</th>
<th>Overrun (%)</th>
<th>Calorific value cal/100 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 (0-15)</td>
<td>10.11</td>
<td>4.24d</td>
<td>21.84c</td>
<td>36.60</td>
<td>34.04ab</td>
<td>198.92</td>
</tr>
<tr>
<td>T2 (10-10)</td>
<td>10.13</td>
<td>5.19a</td>
<td>19.83e</td>
<td>36.53</td>
<td>36.02a</td>
<td>193.67</td>
</tr>
<tr>
<td>T3 (10-15)</td>
<td>10.12</td>
<td>4.16d</td>
<td>21.79c</td>
<td>36.87</td>
<td>34.70ab</td>
<td>195.68</td>
</tr>
<tr>
<td>T4 (15-10)</td>
<td>10.08</td>
<td>4.95c</td>
<td>19.91d</td>
<td>36.50</td>
<td>34.53c</td>
<td>194.83</td>
</tr>
<tr>
<td>T5 (15-15)</td>
<td>10.09</td>
<td>3.73e</td>
<td>22.51b</td>
<td>36.73</td>
<td>31.62c</td>
<td>197.27</td>
</tr>
<tr>
<td>T6 (20-10)</td>
<td>10.05</td>
<td>4.74c</td>
<td>20.58d</td>
<td>36.43</td>
<td>31.02cd</td>
<td>195.52</td>
</tr>
<tr>
<td>T7 (20-15)</td>
<td>10.02</td>
<td>3.56f</td>
<td>23.12a</td>
<td>36.53</td>
<td>29.85d</td>
<td>198.70</td>
</tr>
<tr>
<td>SE ±</td>
<td>0.111</td>
<td>0.13</td>
<td>0.048</td>
<td>0.207</td>
<td>0.163</td>
<td>0.524</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>0.57</td>
<td>NS</td>
<td>NS</td>
<td>1.45</td>
<td>NS</td>
</tr>
</tbody>
</table>

(P = custard apple pulp levels, S = Sugar level).

SE = Standard error

CD = Critical difference at 5 %

NS = Non significant
Table 2: Cost of production of ice-cream as affected by different treatment combinations.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Rate (Rs.)</th>
<th>T₀</th>
<th>Cost</th>
<th>T₁</th>
<th>Cost</th>
<th>T₂</th>
<th>Cost</th>
<th>T₃</th>
<th>Cost</th>
<th>T₄</th>
<th>Cost</th>
<th>T₅</th>
<th>Cost</th>
<th>T₆</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar (g)</td>
<td>16/kg</td>
<td>150</td>
<td>2.40</td>
<td>100</td>
<td>1.60</td>
<td>150</td>
<td>2.40</td>
<td>100</td>
<td>1.60</td>
<td>150</td>
<td>2.40</td>
<td>100</td>
<td>1.60</td>
<td>150</td>
<td>2.40</td>
</tr>
<tr>
<td>Stabilizer (g)</td>
<td>180/kg</td>
<td>3.00</td>
<td>0.54</td>
<td>1.5</td>
<td>0.27</td>
<td>1.5</td>
<td>0.27</td>
<td>1.5</td>
<td>0.27</td>
<td>1.5</td>
<td>0.27</td>
<td>1.5</td>
<td>0.27</td>
<td>1.5</td>
<td>0.27</td>
</tr>
<tr>
<td>Whole milk (g)</td>
<td>14/kg</td>
<td>653</td>
<td>9.14</td>
<td>549.4</td>
<td>7.69</td>
<td>557.3</td>
<td>7.80</td>
<td>523</td>
<td>7.32</td>
<td>519.6</td>
<td>7.27</td>
<td>470.6</td>
<td>6.58</td>
<td>468</td>
<td>6.55</td>
</tr>
<tr>
<td>Cream (g)</td>
<td>100/kg</td>
<td>135.5</td>
<td>13.55</td>
<td>164.8</td>
<td>16.48</td>
<td>167.1</td>
<td>16.7</td>
<td>157</td>
<td>15.7</td>
<td>155.8</td>
<td>15.5</td>
<td>162.2</td>
<td>16.2</td>
<td>161.4</td>
<td>16.14</td>
</tr>
<tr>
<td>SMP (g)</td>
<td>94/kg</td>
<td>58.50</td>
<td>5.49</td>
<td>84.2</td>
<td>7.90</td>
<td>24</td>
<td>2.25</td>
<td>68.5</td>
<td>6.43</td>
<td>23</td>
<td>2.16</td>
<td>65.7</td>
<td>6.17</td>
<td>19</td>
<td>1.78</td>
</tr>
<tr>
<td>Custard apple pulp (g)</td>
<td>58.40/kg</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>5.84</td>
<td>150</td>
<td>8.76</td>
<td>200</td>
<td>11.68</td>
<td>200</td>
<td>11.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour and flavour cost</td>
<td>0.80</td>
<td>—</td>
<td>—</td>
<td>0.80</td>
<td>—</td>
<td>0.80</td>
<td>—</td>
<td>0.80</td>
<td>—</td>
<td>0.80</td>
<td>—</td>
<td>0.80</td>
<td>—</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>Cups (No.)</td>
<td>25/100 cups</td>
<td>35</td>
<td>8.7</td>
<td>35</td>
<td>8.7</td>
<td>35</td>
<td>8.7</td>
<td>35</td>
<td>8.7</td>
<td>35</td>
<td>8.7</td>
<td>35</td>
<td>8.7</td>
<td>35</td>
<td>8.7</td>
</tr>
<tr>
<td>Labour charges (Rs)</td>
<td>day</td>
<td>—</td>
<td>3.60</td>
<td>—</td>
<td>3.60</td>
<td>—</td>
<td>3.60</td>
<td>—</td>
<td>3.60</td>
<td>—</td>
<td>3.60</td>
<td>—</td>
<td>3.60</td>
<td>—</td>
<td>3.60</td>
</tr>
<tr>
<td>Processing cost (Rs/kg)</td>
<td>0.50/kg</td>
<td>—</td>
<td>0.50</td>
<td>—</td>
<td>0.50</td>
<td>—</td>
<td>0.50</td>
<td>—</td>
<td>0.50</td>
<td>—</td>
<td>0.50</td>
<td>—</td>
<td>0.50</td>
<td>—</td>
<td>0.50</td>
</tr>
<tr>
<td>Miscellaneous cost (Rs)</td>
<td>54.09</td>
<td>63.80</td>
<td>59.28</td>
<td>65.14</td>
<td>61.42</td>
<td>68.60</td>
<td>64.92</td>
<td>40.36</td>
<td>46.90</td>
<td>44.00</td>
<td>48.43</td>
<td>46.67</td>
<td>52.36</td>
<td>50.01</td>
<td></td>
</tr>
<tr>
<td>Cost of production per kg</td>
<td>100</td>
<td>117.95</td>
<td>109.59</td>
<td>120.42</td>
<td>113.35</td>
<td>126.82</td>
<td>120.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Total sugar content
Treatment $T_6$ (23.12%) was highest in per cent total sugar. It was followed by treatment $T_4$ (22.51), which was significantly superior over $T_0$, $T_2$, $T_3$, $T_5$ and $T_1$. Treatment $T_0$ (control) and treatment $T_2$ had comparable sugar contents. Lowest per cent total sugar was observed with treatment $T_1$ (19.83). Results showed that increase in pulp level in ice cream increased per cent total sugar in ice cream as the custard apple pulp imparts its natural sugar. Total sugar in the ice cream is the sum total of sugar contributed chiefly by sucrose and custard apple pulp followed by milk sugar, skim milk powder, whole milk and cream to some extent.

Total solids content
Total solids content in ice cream ranged from 36.43 ($T_5$) to 36.87 ($T_2$) per cent. Results were non significant. In fact, total solids content in the mix were adjusted to 36 per cent. Total solid in ice cream samples remained in the range of 36 to 37 per cent. Gund (2003) found that total solid content of ice cream prepared by use of bullocks heart pulp were in the range of 36 to 37 per cent. Similarly, Amale (1980), Patel (1983) and Gaikwad (2002) reported that the decrease in total solids content of ice cream with an increase in level of jamun juice, orange and pineapple juice, respectively.

Overrun
$T_1$ had significantly higher overrun valued at 36.02 than rest of the treatments. It was followed by $T_4$ (34.71) which was at par with $T_0$ (34.04) and $T_3$ (34.53). The treatment $T_6$ had lowest overrun of 29.85 per cent. It indicated that increase in pulp level in the ice cream decreased the overrun. This trend of decreasing overrun with increase in level of particular fruit was also observed by Amale (1980), Patel (1983) and Kolpe (1995). Similarly, Gund (2003) also reported 33.82, 32.19 and 29.45 per cent overrun with 4, 8 and 12 percent of bullock’s heart pulp ice cream and Gaikwad (2002) reported 0, 5, 10 and 15 per cent jamun juice given 48.04, 47.91, 44.47 and 42.01 per cent overrun, respectively.

Calorific value
The figures on the energetic potential (i.e. calorific values) among various blends of ice cream had non significant differences. Numerically $T_0$ recorded highest calorific value (198.92 cal/100 g) followed by treatment $T_6$ (198.70 cal/100 g). Treatment $T_2$ and $T_3$ also recorded higher values at 195.68 and 197.27 cal/100g, respectively. Lowest values of calorific value was received in treatment $T_1$ (193.67 cal/100 g).

Cost of production
The record on the cost of production of custard apple ice cream is presented in Table 2. Based on experimental trial, the quantity of ingredients required for preparing 1 kg of custard apple ice cream was calculated on the basis of market price of ingredients. The cost of production of 1 kg ice cream with no custard apple pulp ($T_0$) was Rs. 54.09 which increased to Rs. 59.28, 61.42, 63.80, 64.92, 65.14 and 68.60 for treatments $T_2$, $T_4$, $T_1$, $T_6$, $T_3$ and $T_5$, respectively. Increases in per cent cost considering ($T_0$ as 100) for treatments $T_1$, $T_2$, $T_3$, $T_4$, $T_5$ and $T_6$ was found to be Rs. 17.95, 9.59, 20.42, 13.35, 26.82 and 20.02, respectively.

When sugar levels were constant and custard apple pulp levels were increased there were also increase in cost of ice cream. The cost of control sample was lowest among all the treatments where no custard apple pulp in control treatment. Further, the ice cream along with pulp and 15 per cent sugar had the lower cost of production than the ice-cream with 10 per cent sugar. It might be due to higher cost of skim milk powder added to maintain the total solids content of ice-cream at 36 per cent as the custard apple pulp has lower percentage of total solids than the ice-cream mix.

Table 2 reveals that cost of production increased as level of sugar increased. However, it is not due to the cost of increased amount of sugar but it is cost of higher proportion of costly SMP added when sugar level increased. This increase in level of SMP was due to maintenance of required total solids (i.e. 36 %) in a standard ice-cream. Gund (2003) observed that the cost of production of control sample, bullock’s-heart pulp ice cream containing 4 and 8 per cent pulp was Rs.
56.54/kg Rs. 58.60/k and Rs. 59.54/kg. Gaikwad (2002) reported average cost of production for jamun juice incorporated at level of 5, 10 and 15 per cent and control ice cream samples was Rs. 50.91, Rs. 54.06, Rs. 57.09 and Rs. 48.04, respectively. Borhade (1997), Vesvikar (1999) and Gaikwad (2000) also reported increase in cost of ice cream with increase in percentage of karonda pulp, jack fruit pulp and mango pulp, respectively. 

Treatment-combination of T₄ (15 per cent pulp and 15 per cent sugar) has second highest score for overall acceptability for custard apple ice-cream which was having lower cost of production (Rs. 61.42/kg) than treatment-combinations of T₁, T₃, T₅ and T₆ and also with higher calorific value (197.27 Cal/100 g) than the treatments T₁, T₂, T₃ and T₅.

**CONCLUSION**

It may be concluded from the present study that:

- Ice-cream prepared with incorporation of custard apple pulp and sugar at the rate of 15 per cent each (T₄) was with all desired characters with cost of production of Rs. 61.42 per kg. Energy value was found to be 197.27 cal/100g.
- Use of custard apple in the manufacture of ice-cream with its 15% pulp is definitely an encouraging factor in utilizing the custard apple of its peak utility.

**REFERENCES**

