Effect of Different Levels of Whey Protein Concentrates on Yield and Physico-Chemical Properties of Rasgulla

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Abstract:
Rasgulla is a juicy and spongy sweet meat and prepared from cow and buffalo milk chhana, but good Rasgulla is prepared from cow milk chhana. A study was conducted to utilize whey protein concentrate (WPC) for the preparation of Rasgulla using different ratios of cow milk and WPC i.e., cow milk + 0.5% WPC (T1), cow milk + 1.0% WPC (T2), and cow milk + 1.5% WPC (T3). Milk was heated at 90°C and cooled at 70°C. 1% citric acid was used to coagulate the milk to obtain chhana, chhana was kneaded for making balls. Balls were cooked in sugar syrup. Thus Rasgulla was manufactured. The products were analyzed for organoleptic attributes (flavor and taste, texture, color and appearance and overall acceptability) by trained panelist using 9 point hedonic scale. Physicochemical (Fat, Total Solids, acidity, protein and moisture) and microbiological (SPC, yeast and mould, coliform) analysis was done for estimating its nutritional content and safety. Based on the statistical analysis of data obtained from various parameters using different ratios of mixture, it was found experimental Rasgulla was at par control as far as organoleptic attributes are concerned. Yield value also increased. The highest yield value was found in T3 (43.30%), followed by T2 (42.34%), T1 (40.52%) and T0 (34.15%). 0.5% WPC proved to be best among all treatments. Thus the product acceptability can be rated as T0>T1>T3>T2.

Key Words: cow milk, chhana, WPC, Rasgulla.

Introduction
Whey protein is one of the major proteins found in cow’s milk comprising of 20% of total milk protein. Whey protein referred to as a group of individual proteins contains water, lactose, protein, minerals (Calcium, Phosphorous, and Magnesium) and fat (1). The best known effect of whey protein are its ability to increase lean muscle mass and to boost the immune system. Whey protein contains minerals for bone strength, plus essential, semi-essential and non-essential amino acid for tissue formation. Common WPC available in the market are WPC-35, WPC-60, WPC-70, and WPC-80. Whey protein concentrate is largely used for development of texture in food products, food formulation and for clinical diets. It is also used for health beverages, meat products, bakery products, confectionaries and protein supplement of various coagulated milk products like chhana, paneer (2). Whey proteins are highly functional and nutritional used in a variety of products. The most commonly used value added forms of Whey protein in industry are Whey protein isolates (W.P.I.), WPC contains 34-80% proteins and WPI contains at least 90% protein. Whey protein concentrate (WPC) has the highest biological value and protein efficiency ratio as compared to other protein, which make it suitable for wide range of nutraceutical and functional food system. Whey protein ideally has a bland flavour to facilitate application in foods (3). Rasgulla regarded as the king of Indian milk sweets are prepared by kneaded chhana balls under control cooking in boiling sugar syrup. In appearance it is snow white, soft and succulent sphere shaped (4&5). Keeping in mind the functional properties and other use of WPC, an attempt has been made to explore the use of WPC in rasgulla making using the method of manufacture as laid down by (6).

Material and Methods
First of all, cow milk was standardized to 4% fat and 8.5% SNF. Three different levels of WPC now added i.e. T1 (0.5% WPC), T2 (1% WPC) and T3 (1.5% WPC) with cow milk. It was then heated at 90°C and cooled at 70°C. 1% citric acid was used to coagulate the milk. The chhana obtained then kneaded for making Rasgulla balls. Balls are then cooked in sugar syrup to get Rasgulla. The samples were tested for physicochemical parameters (fat, proteins, total solids, moisture, acidity & yield) and microbiological parameters (SPC, yeast and mould count, coliform count)
as per procedure given in the food chemistry manual of Allahabad Central University. Organoleptic attributes (colour and appearance, body & texture, flavour and taste) were judged by trained panelist using 9 point hedonic scale. The data collected on different aspects as per plan were tabulated and statistically analyzed as per (7).

Table-1: Details of different treatments of Control and WPCRasgulla

<table>
<thead>
<tr>
<th>Materials</th>
<th>Different treatments (Control and WPCRasgulla)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$T_0$</td>
</tr>
<tr>
<td>WPC</td>
<td>-</td>
</tr>
</tbody>
</table>

Cow milk (4% fat and 8.5% SNF) 
↓ 
Cow milk + WPC (0.5%, 1%, 1.5%) 
↓ 
Heating of milk ($90^\circ$ C) 
↓ 
Cooling ($70^\circ$ C) 
↓ 
Coagulation (1% citric acid) 
↓ 
Chhana 
↓ 
Kneading 
↓ 
Making of chhana balls 
↓ 
Cooking in sugar syrup 
↓ 
Control and WPCRasgulla

Figure 1: Flow chart for preparation of Control and WPCRasgulla

Results AND DISCUSSION

Table-2 shows average of different parameters studied.

Moisture percentage:
The moisture content of Control and WPC Rasgulla differed significantly. The highest moisture percentage was found in $T_0$ (51.2), followed by $T_1$ (42.20%), $T_2$ (40.0%) and $T_3$ (38.4). 

Table-2: Physicochemical parameters of Control and WPC Rasgulla.

<table>
<thead>
<tr>
<th>Parameters (%)</th>
<th>Control and WPC Rasgulla</th>
<th>F Value</th>
<th>CD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$T_0$</td>
<td>$T_1$</td>
<td>$T_2$</td>
</tr>
<tr>
<td>Fat</td>
<td>3.68</td>
<td>5.97</td>
<td>6.58</td>
</tr>
<tr>
<td>Protein</td>
<td>3.44</td>
<td>5.52</td>
<td>5.80</td>
</tr>
<tr>
<td>Total Solids</td>
<td>48.8</td>
<td>57.80</td>
<td>60.0</td>
</tr>
<tr>
<td>Moisture</td>
<td>51.2</td>
<td>42.20</td>
<td>40.0</td>
</tr>
<tr>
<td>Acidity</td>
<td>0.17</td>
<td>0.17</td>
<td>0.18</td>
</tr>
<tr>
<td>Yield</td>
<td>341.51</td>
<td>405.22</td>
<td>423.40</td>
</tr>
</tbody>
</table>

* Significant at 5 % level
** Non-significant at 5 % level
8.4%). F value was 290.02, indicating significant effect of treatment on moisture percentage.

**Fat percentage:**
There were significant differences found in the average fat percentage of different treatments. T₃ had highest score of 7.17% followed by T₂ (6.58%), T₁ (5.97%) and T₀ (3.68%). F value was 350.11, indicating significant effect of treatment on fat percentage.

**Protein percentage:**
Protein content also differs significantly. T₃ is the highest (5.92%), followed by T₂ (5.80%), T₁ (5.52%) and T₀ (3.44%). F value was 290.02, indicating significant effect of treatment on protein percentage.

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**Acidity percentage:**
The acidity of the different treatments was non-significant. The highest value was found in T₂ (0.18%), followed by T₀ (0.17%), T₁ (0.17%) and T₃ (0.16%). The treatments were non-significant. F value was 1.42, indicating no significant effect of treatment on acidity percentage.

**Total solids:**
Total solids content was highest in T₃ (61.6%), T₂ (60%), T₁ (57.80%) and T₀ (48.8%). The treatments differed significantly. F value was 350.10, indicating significant effect of treatment on total solids.

**Yield:**
There were significant differences found among the yields of different treatments. The highest value was found in T₃ (433.02%), followed by T₂ (423.40%), T₁ (405.22%) and T₀ (341.51%). F value was 591.04, indicating significant effect of treatment on yield. Thus, the data showed the experimental product was as good as control.
Average of different Microbial Parameters of the Control and WPC Rasgulla

There were non-significant differences found among the treatments for SPC. The highest value was found in T3 (8.4), followed by T2 (8.2), T1 (7.8) and T0 (6.8). Yeast and mould count were non-significant also. The highest value found in T3 (5.20), followed by T2 (4.80), T1 (3.00) and T0 (2.80). Coliform count was negative in all the treatments.

Table-2: Microbial parameters Control and WPC Rasgulla

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control and WPC Rasgulla</th>
<th>F Value</th>
<th>CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC (10^3 cfu/g)</td>
<td>T0 6.8</td>
<td>T1 7.8</td>
<td>T2 8.2</td>
</tr>
<tr>
<td>Yeast and mould (10^2 cfu/g)</td>
<td>T0 2.8</td>
<td>T1 3.0</td>
<td>T2 4.8</td>
</tr>
<tr>
<td>Coliform count (10^1 cfu/g)</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
</tr>
</tbody>
</table>

* Significant at 5 % level
** Non-significant at 5 % level

Discussion

On the basis of the results obtained it can be concluded that the WPC powder can be successfully used for improving physico-chemical quality of Rasgulla, without sacrificing its palatability. Yield value also increased. The highest yield value was found in T3 (433.02%), followed by T2 (423.40%), T1 (405.22%) and T0 (341.51%). 0.5% WPC proved to be best among all treatments.

References