GEL FORMING BEHAVIOR OF SODIUM ALGINATE AND ITS EFFECT ON ICE CREAM PROPERTIES

1RAJPREET KAURGORAYA, 2USHA BAJWA

12Department of Food Science and Technology Punjab Agricultural University Ludhiana-141004
E-mail: 1ft.rajpreetgoraya@gmail.com, 2ushabajwa@rediffmail.com

Abstract- To prevent icy and coarse texture due to enlargement of ice crystals during storage. Hydrocolloids are added in ice mix to attain smooth body and texture. In the present study, the effects of four different ways of mixing (In control (S1) standard procedure of stabilizer (sodium alginate) mixing with other dry ingredients was used; In S2 and S3, sodium alginate gel formed with milk; In S4 and S5 sodium alginate gel formed with warm water) on the physico-chemical properties, melting rate and sensory attributes of the ice cream was studied. The specific gravity, viscosity and overrun significantly varied (p<0.01) in all samples. The maximum viscosity was observed in S1 while least in S4. The S4 sample took more time to drip first (24.18 min) along with melting rate and also highest overall acceptability among all the samples.

Keywords- Blending, Ingredients and ice cream

I. INTRODUCTION

Ice cream is a complex, partly frozen, four-phase system consisting of ice crystals, air cells, emulsified fat and a continuous serum phase containing dissolved and/or colloidal sugars, salts, proteins and stabilizers [1]. The quality of ice cream is influenced by the size and number of ice crystals formed after freezing. The formation of crystals and their enlargement affect the sensory properties of the product, which in turn have a direct impact on the texture and storage stability [2]. The ice cream structure is mainly influenced by ingredients (like stabilizer and emulsifier), manufacturing process and order of blending ingredients [3].

The stabilizers like alginate, gelatin, guar gum etc. are added into ice cream for increasing mix viscosity, prevent serum separation, enhance melting rate, produce stable foam, retard ice crystal growth, to slow down the moisture migration from product and prevent shrinkage during storage [4]. Alginate is a type of polysaccharide, mostly used in food is in the form of sodium alginate. In order to form a gel, it needs divalent ion like calcium (Ca²⁺) for crosslinking polymers [5] which help in attaining the better sensory attributes[6]. Normally, sodium alginate is mixed with other dry ingredients and added to liquid ingredients. The blending order of it with other ice cream ingredients might help in improving the stabilizing effect. The aim of the present study was to investigate the effect of changing the order of blending ingredients on the physical, sensory and melting properties of ice cream.

II. MATERIAL AND METHOD

Milk, skim milk powder and white butter were procured from the Verka milk plant, Ludhiana and sugar, sodium alginate and glycerol monostearate were obtained from the local market.

2.1 Preparation of ice cream mix

Plain ice cream mix having a composition of fat 11%, SNF 11%, sugar 15%, emulsifiers 0.15% and stabilizer 0.35% was prepared using fresh milk, butter, skim milk powder, sugar, glycerol monostearate and sodium alginate. The ingredients were blended in five different ways. For control (S1), all liquid and dry ingredients were mixed and heated to 80°C as per standard procedure. In sample S2 and S3, the sodium alginate was dissolved in warm (45°C) milk and heated to 80°C. All other dry ingredients were combined and added to this milk followed by butter addition in S4 while reverse trend of mixing butter and dry ingredients used for S5 sample. In S6 and S7, sodium alginate gel was formed in warm water (10 ml) and added to the preheated milk (45°C). The dry ingredients were added followed by butter addition in S6 while in S7, opposite order of mixing ingredients was followed. All samples were homogenized in two stage process at 2000 and 500 psi in a laboratory homogenizer (Taj, New Delhi) at 60°C and then pasteurized (80°C for 25 seconds). Ice cream mix was cooled to 5°C and aged at 4.4°C overnight. It was then frozen in a batch type mechanical freezer of 5 Kg capacity (Sigma Sales Corporation, New Delhi) for 8 min. The frozen ice cream was filled in plastic cups and hardened in a cabinet freezer at −18 to −20 °C overnight.

2.2 Physicochemical analysis

For each parameter, samples were evaluated in three replicates. The total solids, protein, fat, ash and titratable acidity were determined according to AOAC [7] method. The fat content of milk and butter was estimated using Gerber’s method [8]. The viscosity of mix was measured using Brookfield viscometer and antioxidant activity estimated using the method of Brand-William [9]. The specific gravity of mix and ice cream samples was calculated as described by Winton [10]. The overrun of the ice cream was calculated on weight basis and melting property of
Gel Forming Behavior of Sodium Alginate and its Effect on Ice Cream Properties

Ice cream was analyzed at 20 ± 2°C using the method of Akesowan.[11]

2.3 Sensory evaluation
The sensory characteristics of ice cream were evaluated on a 9-point hedonic scale by a semi trained panelists.[12]

2.4 Statistical analysis
The experimental data was analyzed for analysis of variance (ANOVA) using SAS software.

III. RESULTS AND DISCUSSION

3.1 The physico-chemical properties of ice cream
The values of total solids, fat, protein, ash, acidity, pH and antioxidant activity were almost the same while specific gravity, viscosity and overrun differed significantly (p<0.01) as the order of blending the ingredients was altered (Table 1). The viscosity of S1 mix was highest (8932 cP) followed by S2 (7666 cP), S3 (3920 cP), S4 (2186.4 cP) and least in S1 (1482.4 cP). The highest viscosity was in S2 due to the gel formed by exchanging the sodium ions with calcium ions, forming a crosslinked polymer [5] enhanced the viscosity of the mix by storing the diffusion of water on the surface of the ice crystals.

The correlation value (-0.996) between the overrun and specific gravity of ice cream was found to be negative, similar to reported by Arbuckle [13]. The lowest overrun was observed in S1 sample (81.46 %) and highest in S3 (109 %). This might be due to the changed order of blending ingredients which affected in holding the air within the gel complex formed. The specific gravity of the S1 ice cream was highest (0.61), while that of S2 and S3 was the same (0.57) followed by S4 (0.53) and S5 (0.50).

3.2 Melting rate
Melting rate, being an important factor of ice cream, is greatly influenced by its composition, additives used, the way of mixing additive during manufacturing, the amount of air incorporated (overrun), nature of ice crystals and a network of fat globules formed during freezing.[14] The S1 sample minimal melting resistance and S3 maximal (fig. 1). The probable cause of the slower melt down of the sample S1 may be the variance in the heat transfer rate due to the amount of air.[15] Although, S2 took more time to first drip (21.27 min) than S1 (19.21 min) but it melted faster (fig. 2).

3.3 Sensory attributes
The data on the sensory scores of the ice cream are presented in Fig. 2. The S2 scored maximum for overall acceptability (7.94) followed by S4 (7.67), S2 (7.51), S3 (7.38) and in S1 (6.60).

CONCLUSION
Ice cream was manufactured by changing the order of blending the mix ingredients. Stabilizer gel formed with milk was superior to that of the gel formed with water. Therefore, the sample S3 preparation is the better way of making a mix and scored more for sensory attributes. This sample showed more resistance to the melting, due to well distributed air cells as sodium alginate forms a strong gel in presence of calcium divalent ions.

REFERENCES

Table I: The physico-chemical properties of ice cream

<table>
<thead>
<tr>
<th>Sample</th>
<th>Viscosity (cP)</th>
<th>Overrun</th>
<th>Specific gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>1482.4±0.404</td>
<td>81.46±0.211</td>
<td>0.61±0.005</td>
</tr>
<tr>
<td>S2</td>
<td>8932.0±0.590</td>
<td>92.59±0.420</td>
<td>0.57±0.012</td>
</tr>
<tr>
<td>S3</td>
<td>3920.0±0.288</td>
<td>109.00±0.713</td>
<td>0.50±0.020</td>
</tr>
<tr>
<td>S4</td>
<td>7666.0±0.254</td>
<td>100.68±0.302</td>
<td>0.53±0.005</td>
</tr>
<tr>
<td>S5</td>
<td>2186.4±0.628</td>
<td>93.09±0.400</td>
<td>0.57±0.006</td>
</tr>
</tbody>
</table>

ANOVA

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>MSS</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>4</td>
<td>32919662.1**</td>
<td>315.291**</td>
</tr>
<tr>
<td>Error</td>
<td>10</td>
<td>7.2</td>
<td>0.04926</td>
</tr>
</tbody>
</table>

**Significant at p<0.01

Fig 1: The effect of order of blending the ingredients on the melting rate of ice cream at 20°C

Fig 2: The effect of order of blending the ingredients on the sensory scores of ice cream

***