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Quality Evaluation of Ice Cream Prepared with Different Stabilizers/Emulsifier Blends

M. ANJUM MURTAZA†, G. MUEEN UD DIN, NUZHAT HUMA, M. ASIM SHABBIR AND SHAHID MAHMOOD
Institute of Food Science and Technology, University of Agriculture, Faisalabad–38040, Pakistan
†Corresponding author's E-mail: anjum_ft@hotmail.com, anjum_ft@yahoo.com

ABSTRACT

Ice cream samples were prepared using different stabilizers and emulsifier blends. The blends contained guar gum and xanthan gum in different ratios along with distilled monoglyceride. The sample having commercially available blend (Cremodan) was kept as reference standard. Ice cream was analyzed for physico-chemical and sensory characteristics at 0, 10, 20, 30 and 40 days of storage. Overrun, standup time, meltdown, moisture, total solids, pH and acidity were affected significantly by ice cream samples as well as storage. While non significant effects of treatments and storage were found on fat, protein, milk solids not fat and ash contents of ice cream. On organoleptic evaluation, the highest scores were awarded to the ice cream sample prepared with 75% guar gum and 25% xanthan gum based stabilizers and emulsifier blend followed by the sample containing both the stabilizers in equal quantities. The ice ream samples prepared with single stabilizers were liked the least. There was a progressive deterioration in all sensory parameters but non significant effect of storage on overall acceptability was observed. It was found that by using different locally available stabilizers and emulsifiers in the form of blends, ice cream with better quality and less cost can be prepared.

Key Words: Ice Cream; Stabilizers; Emulsifier; Guar gum; xanthan gum

INTRODUCTION

Ice cream is a frozen dairy product made by suitable blending and processing of cream and other milk products, together with sugar and flavor, with or without stabilizer or color, and with the incorporation of air during the freezing process (Sukumar, 1980). A typical compositional range for the components used in ice cream mix is milk fat 10-16%, milk solids not fat 9-12%, sucrose 9-12%, corn syrup solids 4-6%, stabilizers/emulsifiers 0-0.5%, total solids 36-45% and water 55-64% (Goff, 1997). Stabilizers and emulsifiers are the important ingredients of ice cream. Stabilizers are added in ice cream to increase the viscosity of the mix, to improve air incorporation, air cell distribution, body and texture, storage stability and melting properties. Stabilizers also minimize the development of large crystals and ultimately to get finished structure in ice cream.

Guar gum is one of the important gums being used as stabilizer in ice cream manufacturing. Guar gum is a complex carbohydrate obtained from a legume crop, guar. This is widely grown in India and Pakistan and is very much cheap (Rutenberg & Molar, 1981). Xanthan is one of the most extensively investigated polysaccharides; its rheological behavior enables it to contribute to good sensory qualities, including mouth-feel and flavor release in ice cream. It is not possible to produce ice cream with the desired characteristics by using a single stabilizer. Therefore, most ice cream manufacturers use blends of stabilizers to achieve the desired characteristics (Bhandari, 2001). Guar and Xanthan gums are used on a widespread basis throughout the food industry to thicken the products, and to impart creamy consistency to ice creams, they also contribute good mouth feel, as well as help to protect the product during the distribution chains' inevitable heat/thaw cycles. Emulsifiers are sometimes integrated with the stabilizers in blends but their function and action is very different from stabilizers. They are used to improve whipping quality of the mix, produce a drier ice cream, provide smoothness body and texture in finished product and produce a product with good stand up properties and melt resistance (Goff, 1988).

Presently ice cream industries are using stabilizers/ emulsifier blends, which are imported and very costly. So, present research was undertaken to find out the best combination of locally available stabilizers/emulsifier which can be used as an alternative to expensive imported stabilizers/emulsifier blends and can be used by small scale ice cream manufacturer as well as lager ice cream industries.

MATERIALS AND METHODS

UHT milk, cream and other ingredients were purchased from local market. After various preliminary trials with different combinations of stabilizers and emulsifier, and their sensory evaluation by a panel of judges, the following treatments were developed to proceed for the study.

Preparation and storage of ice cream. Weighed dry ice cream ingredients were mixed with the liquid material by

Table I. Treatments of ice cream prepared

Treatments	Guar gum (%)	Xanthan gum (%)	Distilled monoglyceride (%)	D-Glucose (as filler) (%)
T_1	20	-	15	65
T_2	-	20	15	65
T_3	10	10	15	65
T_4	15	5	15	65
T_5	5	15	15	65
T_0 (control)	commercially available stabilizers/emulsifiers blend Cremodan			

constant mechanical stirring. The prepared ice cream mix was pasteurized at 72^0C for 30 min and then homogenized by using high speed homogenizer. After homogenization, the material was kept for 5 to 6 h for ageing at 4^0C. The ice cream was frozen at a temperature of –1 to $–9^0$C along with the whipping of air into the mix by agitation in hand operated ice cream freezer (machine). The ready ice cream was filled in 100 mL disposable cups and kept in the hardening unit at -30^0C for 24 h. The prepared ice cream was stored at $–25^0$C in a freezer for 40 days.

Physico-chemical and sensory evaluation. Ice cream samples were evaluated at 0, 10, 20, 30, and 40 days of storage for Physico-chemical and sensory characteristics. The results obtained were statistically analyzed.

Overrun was estimated according to the method described by Varnam and Sutherland (1994), while standup time and meltdown according to Bhandari (2001). Methods given by Kirk and Sawyer (1991) were applied to determine moisture, MSNF and acidity. Protein, ash, total solids and pH were calculated according to AOAC (1990). Gerber method (Davide, 1977) was applied for fat determination. Sensory evaluation was carried out using 9-point hedonic scale (Larmond, 1977). Statistical analysis was done according to Steel *et al.* (1996).

RESULTS AND DISCUSSION

Physico-chemical analysis of ice cream. The physico-chemical analysis of the ice cream revealed that overrun, standup time, meltdown, moisture, total solids, pH and acidity were significantly affected by ice cream samples having different stabilizers/emulsifier blends (treatments) (Table II) as well as storage period (Table III). However, treatments and storage had non significant effects on fat, protein, milk solids not fat and ash contents of ice cream.

The highest overrun was noted in sample containing 75% guar gum and 25% xanthan gum (Table II). During storage, overrun values of all the samples decreased significantly, however, minimum change was observed in the above mentioned sample (Table III). The shrinkage during storage due to loss of air in ice cream is also reported by Rothwell (1991). Significant differences in melting qualities of ice cream samples were due to use of different stabilizers and emulsifier combinations. Because melting of ice cream is influenced by its composition and by fat globule size (Koxholt *et al.*, 2001).Increase in standup time while decrease in melt down of ice cream was found during the storage period. The least changes in the melting quality

Table II. Comparison of means for physico-chemical analysis as influenced by treatments

Analysis / Treatments	T_0	T_1	T_2	T_3	T_4	T_5
Overrun (%)	53.58c	53.76c	53.36c	55.12b	57.80a	55.24b
Stand up time (min.)	11.42c	11.68c	12.40a	12.08b	11.74c	12.52a
Melt down (ml/10 min.)	29.36c	27.84e	30.06a	28.76d	29.22c	29.72b
Moisture (%)	63.38bc	64.12a	63.09c	63.35bc	63.71b	63.15c
Total Solids (%)	36.62b	35.88d	36.91a	36.65b	36.29c	36.85a
Fat (%)	10.16a	10.15a	10.15a	10.16a	10.17a	10.16a
Protein (%)	4.09a	4.06a	4.10a	4.12a	4.08a	4.11a
pH	6.796c	6.768d	6.858a	6.810bc	6.828b	6.858a
Acidity (%)	0.201a	0.202a	0.192b	0.201a	0.199a	0.194b
Ash (%)	0.57a	0.58a	0.57a	0.57a	0.59a	0.58a
Milk solids not fat (%)	11.28a	11.31a	11.30a	11.33a	11.27a	11.29a

Table III. Comparison of means for physico-chemical analysis as influenced by storage

Analysis / Storage days	0	10	20	30	40
Overrun (%)	56.57a	55.73b	54.87c	53.88d	53.00e
Stand up time (min.)	10.02e	10.90d	11.92c	13.02b	14.02a
Melt down (ml/10 min.)	31.03a	30.17b	29.15c	28.23d	27.22e
Moisture (%)	63.67a	63.58a	63.50ab	63.41ab	63.16b
Total Solids (%)	36.33d	36.42cd	36.50bc	36.59b	36.84a
Fat (%)	10.16a	10.17a	10.16a	10.15a	10.15a
Protein (%)	4.05a	4.07a	4.08a	4.10a	4.11a
pH	6.857a	6.842a	6.822b	6.797c	6.782c
Acidity (%)	0.195b	0.196b	0.198ab	0.199ab	0.202a
Ash (%)	0.58a	0.58a	0.59a	0.59a	0.59a
Milk solids not fat (%)	11.30a	11.28a	11.26a	11.24a	11.23a

Table IV. Comparison of means for sensory characteristics as influenced by treatments

Characteristics / Treatments	T_0	T_1	T_2	T_3	T_4	T_5
Appearance	7.04e	7.26d	7.18d	7.50b	7.86a	7.38c
Taste	7.30b	7.42b	7.26b	7.78a	7.84a	7.20b
Flavour	7.94a	7.84ab	7.84ab	7.72b	7.92a	7.84ab
Body/Texture	7.94a	7.64c	7.46d	7.80b	7.96a	7.70bc
Overall acceptability	7.68a	7.34b	7.28b	7.70a	7.92a	7.34b

Table V. Comparison of means for sensory characteristics as influenced by storage

Characteristics / Storage days	0	10	20	30	40
Appearance	7.65a	7.53b	7.43b	7.22c	7.02d
Taste	7.65a	7.55a	7.47a	7.41a	7.29a
Flavour	7.95a	7.88ab	7.87ab	7.80b	7.75b
Body/Texture	7.92a	7.83ab	7.77bc	7.70c	7.53d
Overall acceptability	7.68a	7.67a	7.58a	7.52a	7.37a

occurred in the sample containing 75% guar gum and 25% xanthan gum (Table III).

Moisture contents also showed a decreasing trend throughout the storage resulting in an inverse effect on total solids (Table III). The pH has direct influence on the flavour perception of the dairy products (Hegenbert, 1991). The results showed that there was a gradual decrease in pH through out the storage (Table III). This decrease was correlated with the increase in acidity, possibly due to the conversion of lactose into lactic acid by certain bacteria during storage (Khan, 1989).

However, there were non significant differences in fat, Protein, Ash and milk solids not fat contents of ice cream samples (Table II), and also no significant change was noted in all these parameters during storage (Table III).

Sensory evaluation of ice cream. Ice cream samples were organoleptically evaluated for appearance, taste, flavour, body/texture and overall acceptability, following the 9-point hedonic scale.

All the sensory parameters were significantly affected by ice cream samples (Table IV). The highest scores were awarded to the ice cream sample containing 75% guar gum and 25% xanthan gum followed by the ice cream containing both the stabilizers in equal amounts. While ice cream samples containing single stabilizers got the minimum scores. During storage, deterioration occurred in all the samples. However, overall effect of storage was non significant (Table V). Palich (1994) also reported the deterioration in sensory quality of ice cream with the passage of time.

CONCLUSIONS

It is concluded that ice cream prepared with stabilizers/emulsifier blends mentioned above is comparable with the ice cream prepared from imported and costly blends. Therefore, by using locally made stabilizers/emulsifier blends, the cost of production can be reduced and thus foreign exchange can be saved.

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