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ORIGINAL ARTICLE

Evaluation of Physicochemical Properties of Food Formulation of Low Fat Whipped Cream

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ABSTRACT
Today cream products, especially dairy desserts have obtained a major share of the food market in industrialized countries. In this study the physicochemical properties of low-fat whipped cream is studied by stabilizer substitution. The results showed that the cream fat and consequently the amount of energy can be substantially reduced without significant change in physical and sensory properties by emulsifier and stabilization substitution. In general the results of modeling and quantification of the relationships between different variables showed that although by increasing the fat percentage the cream firmness increased and the leakage was reduced, at lower percentages 7.5 and 5% fat by increasing the percentage of emulsifier and stabilization up to 1.7%, firmness was preserved similar to high fat cream. Also in terms of increasing the volume or overrun, by reducing the fat content to 10%, the increase in volume is acceptable but with higher than 10% reduction of fat content, the creamy texture characteristics was not fully preserved.
Keywords: *Low-fat cream, stabilizers, functional properties*

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INTRODUCTION

Today cream products, especially dairy desserts have obtained a major share of the food market in industrialized countries. These products are differently whipped by the air and create foam like system including air bubbles in the continuous phase in the form of a thin layer, fat as emulsion, thickener and colloidal non- milk fat solids where sugar and salts form the real solution[1-3].
In recent years there a strong tendency has emerged in the world for low-fat products. Due to increasing consumption of whipped cream in different forms of desserts, ice cream, cakes and salad, this study attempts to produce a whipped cream with quality compared with 30% fat cream products by additives that has the same physicochemical, organoleptic and applied properties in the food.

MATERIALS AND METHODS

In this study two-factorial design was used. The effect of fat (at five levels of 5, 7.5, 10, 12.5 and 15%) and the emulsifier and stabilizer (at five levels of 0.9, 1.1, 1.3, 1.5 and 1.7%) on cream firmness, overrun, whipping and leakage were analyzed after one and two hours in three replications. The mean independent and interactive effects of treatments were compared by least significant difference (LSD) test.

The method of producing low-fat whipped cream

To prepare the cream, ingredients such as milk, sugar, cream, stabilizers and emulsifiers at the levels of 0.9, 1.1, 1.3, 1.5 and 1.7% were distributed based on appropriate amount in terms of formulations at the fat levels of 5, 7.5, 10, 12.5 and 15% by Pearson square method. First the milk and cream were weighed and mixed and whipped by electric mixer for 2 minutes. The above mixture was poured into a stainless steel container and controlled on the gas light until reaching the temperature 40°C by the thermometer. Then, sugar, emulsifier and stabilizer were added slowly to the mixture and mixed by a spoon. This mixture was then whipped and pasteurized by the electric mixer for 25 seconds at 80°C and cooled down to a temperature of 5°C immediately with ice and salt and sent to sewing machines for packing and was

refrigerated for 24 hours. At the end of this time the permitted essences such as cream essence was used at the amount of 0.3 ml. The emulsifier and stabilizer were purchased from Danisco Co. – Denmark and cream essence prepared from Robertet Co. with TAU-1 code.

Sensory tests

The prepared samples were evaluated by judges in terms of smell, flavor, texture and overall acceptability. It should be noted that at each the sensory test 5 samples were evaluated by judges and the sensory feature evaluation was conducted based on the 5-point hedonic method. Minitab and SPSS programs were used for ANOVA, fitting lines and plotting the curves. Modeling the relations between the input and response variables was performed by linear quadratic and fourth degree models using Design Expert Version 6 program and response level charts were plotted.

RESULTS AND DISCUSSION

The results of the statistical analysis by Duncan's multiple range test to evaluate the effect of fat content, the percentage of stabilizers and their interaction on evaluated characteristics of low-fat cream are given in Table 1. Based on Table 1 it is determined that the effect of fat, stabilizer and the simultaneous effect of these two factors on overrun of the whipped cream was significant ($p < 0.05$).

Table 1.Analysis of variance on the effect of fat, stabilizer and the simultaneous effect of them on the practical properties of cream

practical properties of cream	Analysis of variance		
	Fat	Stabilizer	Simultaneous effect
Overrun	*[1]	*	*
Whipping	*	*	*
Firmness	*	*	*
Leakage after an hour	*	*	*
Leakage after two hours	*	*	*

[1]Significance at the level of $p < 0.05$

Figure 1 presents the chart of fat and stabilizer percent response level versus cream overrun. Also in Figure 2, the mean overrun of the whipped cream is presented at different levels of fat and stabilizer.

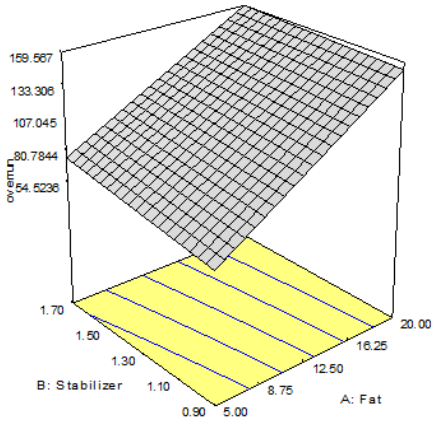

Figure 1- Fat and stabilizer percent response level versus cream overrun

The data of response level chart indicates that by increasing the amount of fat or stabilizer in cream formula the overrun is increased. Also, as can be seen in this figure, the rate of change in overrun versus fat is slightly higher. On the other hand, according the results it can be observed that at the optimal level of the stabilizer (about 1.3%) by reducing the amount of fat to 10%, the overrun is acceptable but at fat levels of lower than 10% the overrun is very low

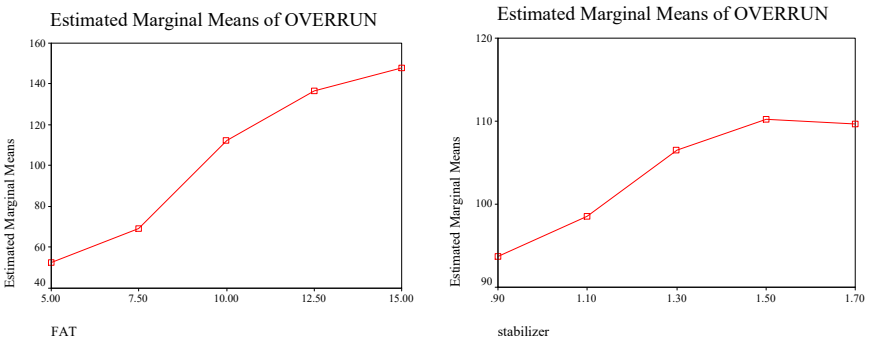

Figure 2 - The mean overrun of the whipped cream at different levels of fat and stabilizer

The effect of fat and stabilizer percentage on whipping

According to Table 1, both factors of fat and stabilizer have had significant effect on whipping both simultaneously and independently and the mean whipping is reduced by the reduced fat content ($p < 0.05$). Figure 3 presents the chart of fat and stabilizer percent response level versus cream whipping. In Figure 4, the whipping of the whipped cream is presented at different levels of fat and stabilizer.

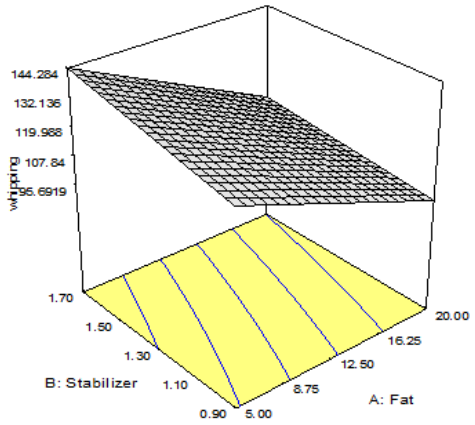

Figure 3- Fat and stabilizer percent response level versus cream whipping

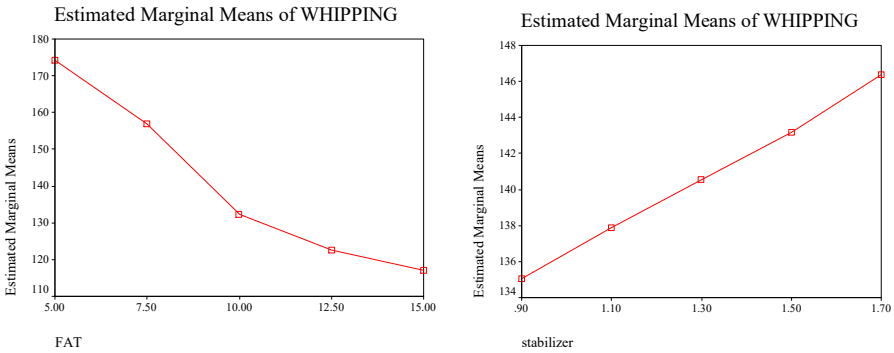

Figure 4 - The effect of whipping of the whipped cream at different levels of fat and stabilizer

As it can be observed by reducing the fat percentage, the mean whipping is increased but by increasing the stabilizer more whipping is required and also the whipping time variation of cream is higher by increasing the amount of stabilizer in cream formulation.

The effect of fat and stabilizer percentage on whipping

Figure 5 presents the chart of fat and stabilizer percent response level versus cream firmness. The results of data analysis show that fat, stabilizers and interaction of these two factors have been effective in creamy firmness.

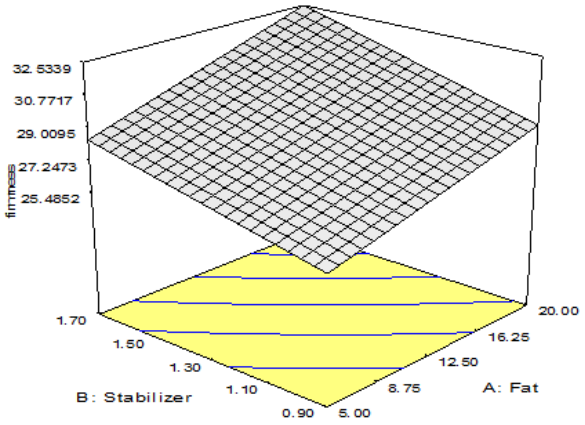

Figure 5- Fat and stabilizer percent response level versus cream firmness

Figure 6 presents the interactive effect of the factors on cream firmness. This figure shows that an increase in fat and stabilizer percentage in cream formula has increased its firmness and the change in firmness due to the increased fat is slightly higher.

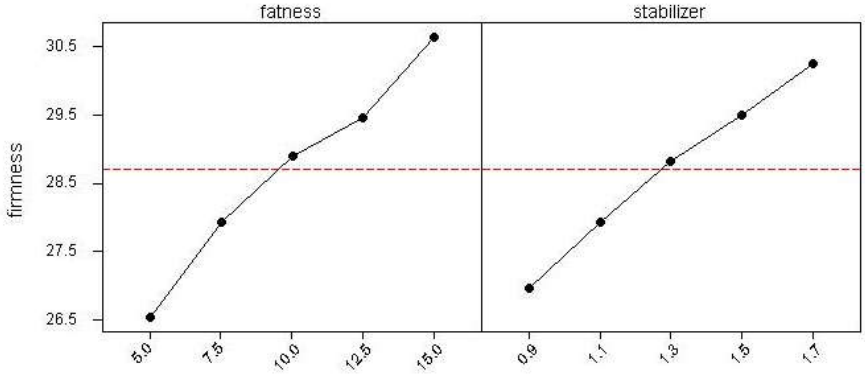

Figure 6 - The independent effect fat and stabilizer level on cream firmness

The effect of fat and stabilizer percentage on cream leakage after an hour

Figure 7 presents the chart of fat and stabilizer percent response level versus cream leakage after an hour.

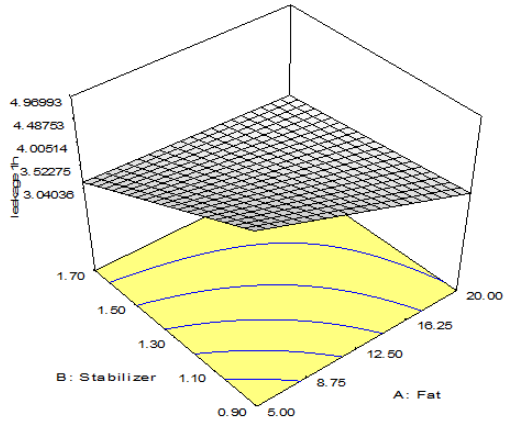

Figure 7- Fat and stabilizer percent response level versus cream leakage after an hour

The results show that the effect of fat stabilizer and the interactive effect of these two factors on cream leakage were significant after one hour. Also by analyzing the data it can be understood that by increasing both factors the amount of fat and stabilizer, the amount of leakage is reduced after an hour which is presents in Figure 8.

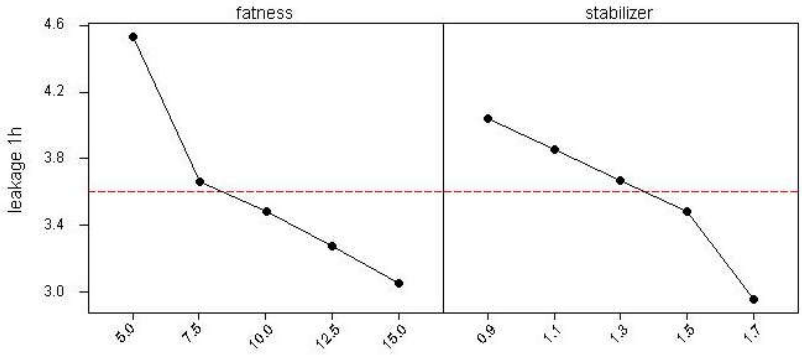

Figure 8- The independent effect fat and stabilizer level on cream leakage after an hour

As it can be observed by increasing these two treatments the mean cream leakage is reduce after an hour and the leakage variation of cream is higher by increasing the amount of fat in cream formulation. Also the severe reduction of this variable is observed by increasing the fat content from 5 to 7.5%.

The effect of fat and stabilizer percentage on cream leakage after two houra

After reviewing the data it was concluded that the both fat and stabilizer factors are effective in leakage after two hours simultaneously which is presented in Figure 9.

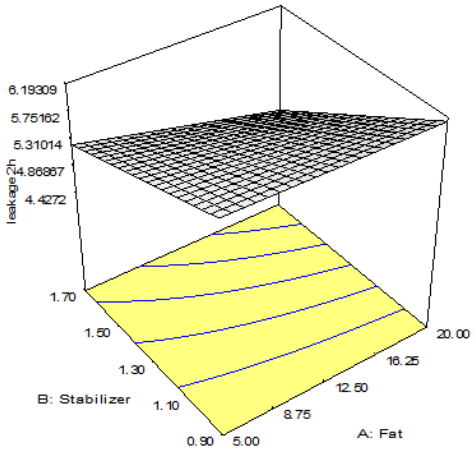

Figure 9- Fat and stabilizer percent response level versus cream leakage after two hours

According to variance analysis table, it is concluded that fat and stabilizer affect leakage after two hours individually. By analyzing the mean it becomes clear that by increasing fat and stabilizer percent the leakage is reduced after two hours. However, with increasing fat from 5 to 7.5 percent the leakage level is slightly increased and then reduced and the change of leakage after 2 hours by adding the stabilizer is higher than adding fat. These cases are presented in Figure 10.

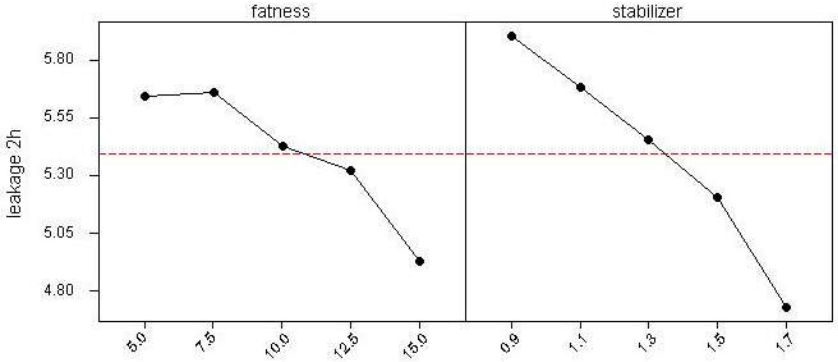

Figure 10 - The independent effect fat and stabilizer level on cream leakage after two hours

In a study conducted by Stanly [4] the fat content was reduced to 22%. But according to the authors the resulting cream lacked appropriate overrun and its firmness was low and required more time but these problems were resolved by stabilizers and the overrun, firmness and whipping was equal with the cream with 33-30% fat

In another study conducted by Shim *et al* [5] the properties of the cream the cholesterol of which was replaced by Beta-cyclodextrin was examined and it was concluded that there was no difference the treated samples compared to control samples and the results indicate that the process of cholesterol extraction by Beta-cyclodextrin had no harmful effect on the whipped cream properties.

The effect of fat and stabilizer percentage on sensory properties

The results of data analysis about sensory properties are shown in Fig. 11. Sensory analysis of the flavor showed that there were significant differences between different levels of fat ($p < 0.05$). The treatment with 15% fat had the highest effect on the flavor however this effect was not significantly different from the treatment with 12.5% fat but there was a significant difference between the treatments with 5 and 7.5% fat and other treatments. About the smell attribute it can be stated that the cream with 15, 12.5, 10 and 7.5% fat had higher smell than the treatment with 5% fat thus the smell of the treatments with 15, 12.5, 10 and 7.5% fat was significantly different with other treatments ($p < 0.05$). In case of texture attribute the cream with 15% fat had the highest firmness; however there was no significant difference between treatments with 12.5 and 10% fat but the treatments with 5 and 7.5% had significant difference with other treatments. In case of the overall acceptability the treatments with 15 and 12.5% fat had the highest acceptability among all treatments and only the treatments with 5 and 7.5% fat had significant difference with other treatments. The results also showed that although sensory attributes were increased by increasing stabilizer, this increase was significant at 15, 12.5 and10% fat contents and had no significant different in treatments with5 and 7.5% fat ($p < 0.05$).

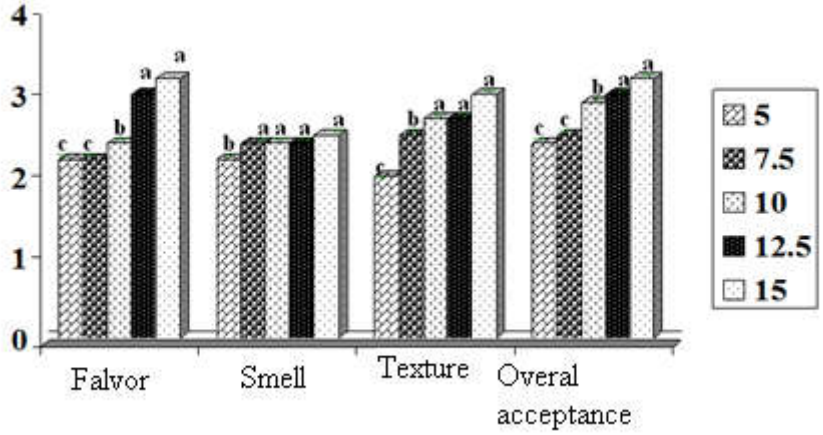

Figure 11.Evaluating the sensory properties of the low-fat whipped cream

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