J. Food and Dairy Sci., Mansoura Univ., Vol. 8 (9): 387 - 390 , 2017

Functional Properties of Whipped Cream as Affected by Addition of B-Lactoglobulin and A-Lactalbumin

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ABSTRACT

Effect of adding whey protein concentrate (WPC), β-Lactoglobulin (β-LG) and alfalactalbumin (α-LA) on the functional properties of Whipped cream was examined. Obtained results showed unchangeable values of pH, the highest pH was found when skim milk powder was used compared with other treatments. Higher overrun (%) was also found when β-Lactoglobulin (β-LG) and alfalactalbumin (α-LA) were incorporated in whipped cream than whey protein concentrate (WPC). Samples showed changeable values of whipping time .The sensory evaluation showed that treatment with alfalactalbumin (α-LA)was of the most acceptable flavor body & texture and appearance, as compared with other treatments .

Keywords:whipped cream,whey protein concentrate(WPC),β-Lactoglobulin(β-LG)and alfalactalbumin(α-LA),functional properties.

INTRODUCTION

Whey protein is of a wide range of nutritional and biological attributes. It is of many imbortant uses. β-Lactoglobulin (β-LG) and α-lactalbumin (α-LA) constitute of about 70-80% of total whey protein. Hydration, gelling and surface active properties (emulsifying and foaming properties) are influenced by whey protein constituents. They are also of importance for their therapeutic properties and in lowing calorie diets.The effect of adding whey protein concentrate (WPC) to Whipped cream could be the possible use of ultrafiltered bovine milk in making whipped cream. Similar rheological properties as 40% cream standardized with milk. Hence an acceptable cream with more protein and less fat could be produced ,potentially providing both nutritional and economic benefits to the producer and consumer. The effect of skim milk powder, whey protein concentrate to improve the whipping cream quality. Whipped cream could be made by partial replacement (10%) of milk fat with different combinations of lupine and whey protein concentrate (WPC) (Abd El-Salam *et al.,*1993, Salem and Zeidan , 1993, Chatterton *et al., and* 2006 Shalaby *et al.,*2013).

Smaller size of native whey protein causing the ability to diffuse to the interfaces is higher than aggregates. As a result, native proteins have higher foaming properties (leads to higher overrun) than aggregates. In the case of whipped cream, milk proteins play an important role in the formation of foam, and partially crystallized fat globules stabilize the formed foam (Sajed *et al.,*2014).

Therfore, the aim of the present study is to elucidate the functional properties of whipped cream encriched with WPC, β-LG and α-LA**.**

MATERIALS AND METHODS

Fresh buffalo's skim milk and Fresh sweet buffloe's cream (50% fat), which was standardized with fresh buffaloe's skim milk to 35 %fat. The milk is obtained from the herd of faculty of agriculture, Cairo University. Skim milk powder(SMP) was obtained from the local market. Whey protein concentrate, α-lactalbumin and β-Lactoglobulin were produced by Davisco Foods International, Inc., USA. Commercial grade sugar, was obtained from local market. the stabilizer (CMC) was obtained from local market.

Table 1. Chemical composition of whey protein fractions and Skim milk powder .

Whey protein products	Chemical composition (%)			
	Moisture	Fat	Protein	Ash
Whey protein concentrate	5.0	5.8	78.0	2.4
β-lactoglobulin	4.9	0.1	93.1	1.7
α-lactalbumin	4.9	0.1	92.8	20
Skim milk powder	3.7	0.8	33.4	7.9

Whipped cream was prepared according to Banks *et al.,*(1989) from fresh buffaloe's sweet cream, the fat content of cream was standardized to 35 % using skim milk from the same milk used in the preparation of cream. sugar 8 % sugar W/W, carboxy methyl cellulose (CMC) as a stabilizer (0.1%)and skim milk powder were used in preparing the whipped cream. Whey protein concentrate (WPC), α-lactalbumin(α-La) and β-lactoglobulin (β-Lg) were used as improvers (2%).The fresh cream was heated to 80ºC for 10 min in boiling water bath and then rapidly cooled to 5ºC .Cream was cooled to 5ºC and stored at the same degree for 16 hr.Home egg mixer was used in whipping of the cream. The bowl and the cream was kept at 5ºC during whipping using an ice bath. Whipping was stopped when a stiff whipp was obtained.

The method of Scurlock (1987) was followed in determining the overrun at 8ºC. The overrun was calculated from the following equation:

$$\text{Overrun} = \frac{(M) - (M1)}{M1} \times 100$$

Where: M was the weight of unwhipped cream and M1 was the weight of whipped cream.

The specific gravity of the un-whipped cream was described by(Winton 1958) at 20°C, while whipped cream a cool cup (with known weight and volume) was filled and weighted. Specific gravity was obtained by dividing the weight of the f whipped cream by the cup volume. The weight / gallon of whipped cream was calculated according to Kessler(1981).

$$\text{Density} = \frac{\text{Weight of whipped cream}}{\text{Original volume}} \text{ g/cm}^3$$

$$\text{Specific gravity} = \frac{\text{Density of whipped cream}}{\text{Density of water}}$$

The serum leakage is an index of the whipped cream stability. It was determined following the method described which method. A known volume (50 ml) of whipped cream was transferred to whatman No. 54 filter paper and placed over a measuring cylinder. The whole assembly was placed at 20 ºC for 2hrs, and the volume of drained solution was recorded. The percentage of serum leakage was calculated form the following equation:-

$$\text{Serum leakage \%} = \frac{\text{(Volume of drained solution)}}{\text{Volume of whipped cream}} \text{X } 100$$

Texture profile analysis test of samples was done using a Universal Testing Machine (TMS-Pro) equipped with (250 lbf) load cell and connected to a computer programmed with Texture Pro^{TM} texture analysis software (program, DEV TPA with hold). A flat rod probe (49.95 mm in diameter) was used to uniaxial compress the samples to 50% of their original height. The texture profile analysis test set condition was adjusted to a test speed 50 mm/sec, trigger force 1N, deformation 40% and holding 2 sec between cycles).

Each sample was subjected to two subsequent cycles (bites) of compression - decompression. Calculation described by (Bourne 1978) was used to obtain the texture profile parameters.

Sensory evaluation of whipped cream samples were judged by staff members of the Departmeant of Dairy Science ,Faculty of Agriculture,Cairo and staff members of the Food Technology and Research Institute. Dairy Department.According to (Nelson and Trout 1964) for flavor (45points), body and texture (40 points) and General appearance (15)

RESULTS AND DISCUSSION

a. Physical properties of whipped cream

Physical properties of whipped cream as affected by adding of WPC, β-LG and α-LA as an improver are presented in Table (2).

Table 2. Physical properties of whipped cream with different whey protein fractions.

Treatments	pH Value	Overrun (%)	whipping time (sec.)	Serum leakage
T_1	6.67	51.6	292	0
T_2	6.64	20.4	194	0
T_3	6.64	33.0	230	0
T_4	6.65	25.9	310	0

T_1 : Control (2% skim milk powder)
T_2 : 2% WPC
T_3 : 2% β-LG
T_4 : 2% α-LA

pH values of manufactured whipped cream samples showed unchangeable values being 6.64 – 6.67. The highest pH value with skim milk powder than other treatments .These results are in agreement with those found by (Abd El-Salam *et al.,*1993) , (Salem and Zeidan 1993) and (Shalaby *et al.,*2013)

Tabulated data show that the highest value of overrun (%) was found in the presence of skim milk powder in whipped cream (51.6%), copmpared with all of other treatments, which recorded (20.4%)with whey protein concentrate ,(33.0%) with (β-LG) and (25.9%) with(α-LA) treatment . These results are in agreement of those reported by (Shalaby *et al.,*2013 and Abd El–Salam *et al*.,1993).

Concerning the whipping time of manufactured whipped cream samples, It could be noticed unchangeable values of 292,194, 230,310 sec. for skim milk powder ,WPC , α-LA and β-LG treatments, respectively.

Serum leakage could be considered as a result of weak whipped cream body owing to stabilizer agent used. The values of serum leakage for all treatment were zero .

Texture profile analysis is used for texture evaluation of food products. Texture of whipped cream is related to physical properties which influenced by size of fat globules, distribution of air cells and properties of protein-emulsifier film absorbed on the fat globule.

Table 3 .Textural profile analysis (TPA) of whipped cream with different whey protein fractions.

Property	Treatment No.			
	T1 (Control)	T2	T3	T4
Hardness (N)	3.6	3.1	3.3	4.0
Springingess (mm)	5.0	4.97	4.48	4.7
Cohesiveness (ratio)	0.45	0.45	0.48	0.50
Chewiness (m.j)	8.75	7.81	7.08	5.78
Adhesiveness(m.j)	10.22	7.26	9.32	6.47

Hardness is the force required to penetrate the sample . It's a parameter describe the product quality (soft, firm, hard) related to the strength of whipped cream structure under compression .Data presented in Table (3) showed that whipped cream samples had hardness values of 3.6, 3.1, 3.3 and 4.0 (N) for control, WPC , β-LG and α-LA treatments, respectively.

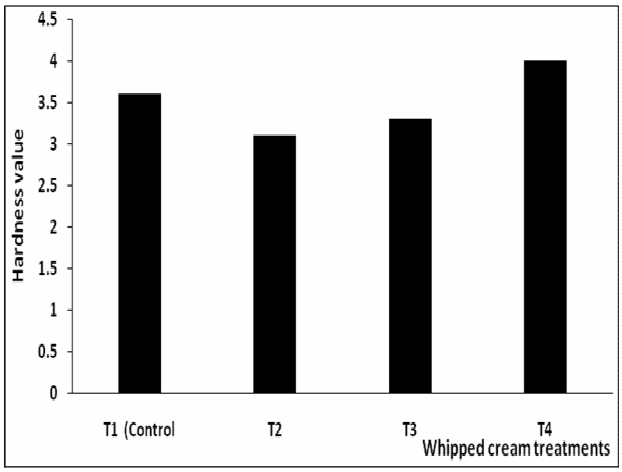

Fig. 1. Hardness values of whipped cream with Whey protein concentrate, α-lactalbumin and β-lactoglobulin

As with the springiness of the resultant whipped cream, it could be observed a perception of ice cream "rubber" in the mouth, and is a measure of how much the ice cream structure is recovered after the initial compression. Whipped cream had Springiness values 5.0, 4.97 , 4.48 and 4.7 (mm) for control, WPC , β-LG

and α-LA treatments respectively. It's clear that all treatment had low value than the control .

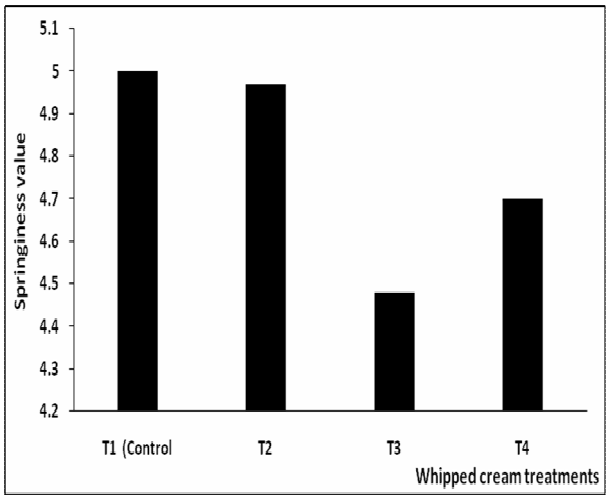

Fig. 2. Springiness values of whipped cream with Whey protein concentrate,α-lactalbumin and β-lactoglobulin

Cohesiveness defined as the strength of internal bonds making up the body of the product, it is the ratio of the positive area during the second compression to that of the first peak during the first compression .Whipped cream had Cohesiveness values of 0.45, 0.45, 0.48 and 0.50 for control, WPC , β-LG and α-LA treatments respectively.

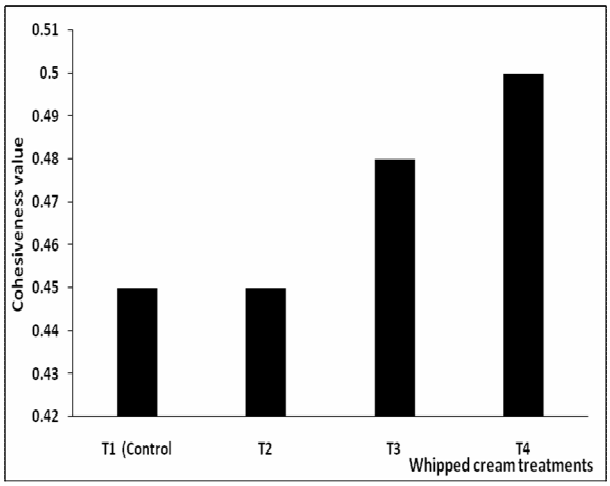

Fig. 3. Cohesiveness values of whipped cream with Whey protein concentrate,α-lactalbumin and β-lactoglobulin

The obtained data also showed that Whipped cream had Chewiness values of 8.75, 7.81, 7.08 and 5.78 (m.j) for control, WPC , β-LG and α-LA treatments, respectively.

Adhesiveness is recognized as the work required to overcome the attractive forces between surface of the ice milk and surface of other materials with which the whipped cream contacts which had adhesiveness values of 10.22 for control ,7.26, 9.32 and 6.47 (m.j) for WPC , β-LG and α-LA treatments respectively.

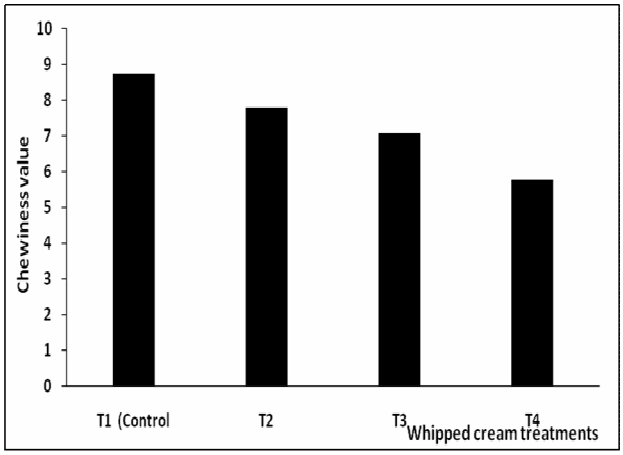

Fig. 4. Chewiness values of whipped cream with Whey protein concentrate,α-lactalbumin and β-lactoglobulin

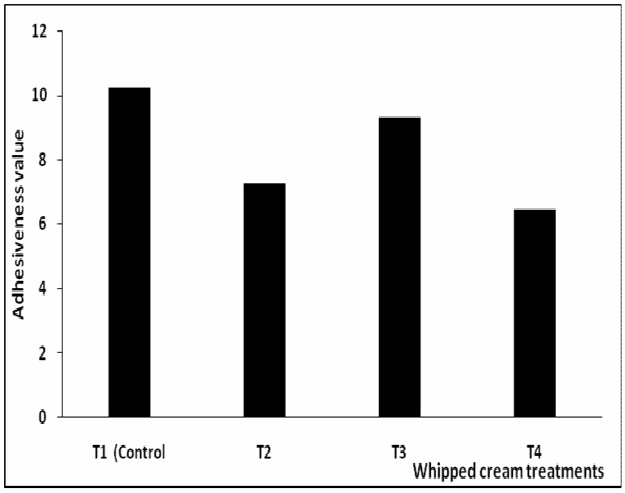

Fig. 5. Adhesiveness values of whipped cream with Whey protein concentrate,α-lactalbumin and β-lactoglobulin

Sensory evaluation is the key for gaining knowledge about whether consumers and panelists perceive differences in a final product .

Table 4. Organoleptic characterestics of of whipped cream with different whey protein fractions.

Properties	Treatments			
	T1 (Control)	T2	T3	T4
Flavor (45)	41.5	41.7	41.8	42.4
Body & Texture (40)	36.0	35.9	35.7	36.9
Appearance(15)	12.6	12.8	13.0	13.4
Total (100)	90.1	90.4	90.5	92.7

The results of the scores for sensory evaluation of whipped cream with different whey protein fractions show that treatment (4) was the most acceptable flavor body & texture and appearance as compared with other treatments so treatment (4) gained the highest scoring points 92.7 followed by treatment (3), treatment (2) then (control)

CONCLUSION

Incorporating β-Lactoglobulin fraction or alfa-lactalbumin fraction improved the whipped cream which increase the overrun as compared with whey protein

concentrate. sensory properties show that treatment with alfalactalbumin (α-LA)was the most acceptable flavor body & texture and appearance followed by β-Lactoglobulin . It could be recommended that the whipped cream can be produced with good functional properties by β-Lactoglobulin fraction or alfa-lactalbumin fraction .

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الخواص الوظيفية للقشدة المخفوقة و تأثرها بإضافة البيتالاكتوجلوبيولين والالفا لاكتاألبيومين

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أُجريت الدراسة بهدف دراسة تأثير أستخدام شقوق بروتينات الشرش خاصة بيتالاكتوجلوبيولين والفا لاكتاألبيومين علي القشدة المخفوقة كمحسن لخواصها الوظيفية و تقييم الخواص الفيزيائية والريولوجية وكذلك صفات الجودة الحسية .وقد وجد أن قيمة الريع في القشدة المخفوقة أرتفعت نتيجة أستخدام اللبن الفرز المجفف عن المعاملات الأخرى يليه أستخدام ببيتالاكتوجلوبيولين . كما أستغرقت المعاملة بألفا لاكتاألبيومين وقت أطول لعملية الخفق يليه إستخدام اللبن الفرز المجفف يليه أستخدام ببيتالاكتوجلوبيولين ومركز بروتينات الشرش الذي أستغرق أقل زمن للخفق.

الكلمات الدالة: مركز بروتينات الشرش، بيتالاكتوجلوبيولين ، الفا لاكتاألبيومين ، الخواص الوظيفية ، القشدة المخفوقة