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USE OF FENUGREEK GUM IN MANUFACTURE OF ICE CREAM

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ABSTRACT

Fresh buffaloes' milk was standardized to give 8% fat, 12%MSNF, then 16%sugar was added to the mix base. Five portions of mix base were prepared; in the fresh portion 0.4% ice gel 156 (Emulsifier and Stabilizer) was added and used as control. For the other four portions 0.25, 0.5, 0.75 and 1% of fenugreek seed was added as a new stabilizer instead of ice gel 156. Specific gravity and weight per gallon were decreased while the viscosity of mix was increased as the fenugreek amount was increased. Addition of the fenugreek led to decrease the acidity %, increase the pH values and low in freezing point. The overrun of the resulting ice cream was increased by increasing fenugreek up to 0.5% when it compared with control. The total bacterial counts and spore forming were slightly higher in control than other treatments, while moulds and yeast and other groups of pathogenic bacteria were not detected. The present work showed that ice cream which contained 0.5% fenugreek seed gained the highest scores and was highly accepted.

INTRODUCTION

The nutritional and therapeutic values of food are a key characteristic in the development of value – added products that are manufactured for health – conscious consumers (Fernandez – Garcia et al., 1998). Ice cream is a frozen dairy product that is widely consumed throughout the world. Sweeteners have a great impact on the acceptance of ice cream as affect not only the taste but also the quality of the product (Udabage and Augustin, 2003).Fenugreek has primarily been described as an antihyperglycemic herb in humans and in laboratory animals (Bordia et al., 1997). Its cholesterol reducing effect is also shown an overall stimulatory effect on the specific as

well as non-specific immune functions mice (Bin-Hafez et al., 2003). The main chemical constituents of fenugreek are fibers flavonoids polysaccharides and saponins (Yoshikawa et al., 1997). Some of these constituents also possess antioxidant properties and they may induce the immune-stimulant effects (Devasagayam and Sainis, 2002). Both pro-oxidant and antioxidant effects of flavonoids have previously been identified (Shen et al., 2004). However, very little is known about fenugreek as emulsifying and stabilizer effect. The objective of this study was to evaluate fenugreek gum as emulsifying and stabilizer in manufacture of ice cream.

MATERIALS AND METHODS

Materials:

The following materials were used in making ice cream

Fenugreek seeds (*Trigonella foenum-graecum)*: were obtained from the field crops Research Institute, Agriculture Research Center, Giza. The seeds were washed, dried at 50°C and grinded. The chemical composition of fenugreek seed are summarized in Table (1)

Buffaloes' milk and cream: were obtained from Faculty of Agriculture, Cairo University, Egypt.

MSNF (Ecoval N.V., Paris, France)

Sucrose (Egyptian Sugar and Distilleries Company, El-Hawamdia, Egypt)

Ice gel 156 (Emulsifier and Stabilizer)**:** was purchased from the Egyptian Company for Milk Products and Additives

Vanilla: was obtained from local market

Methods:

Preparation of ice cream:

Table (2) revealed the five ice cream mixes (2 kg each), each of three replicates, were prepared with the addition of 0.25%, 0.5%, 0.75% and 1% fenugreek gum as a stabilizer as T1,T2,T3 and T4 respectively, while the control contained 0.4% ice gel 156. All mixes were standardized to contain 8% fat, 12% MSNF, 16% sugar and 0.001% vanilla. In each treatment, mix ingredients were homogenized together as described by Arbuckle (1986) and then heated at 80°C for 30 seconds as suggested by Rothwell (1976). All mixes were cooled to 5°C and aged at the same temperature for 24 hours prior to freezing. After aging, the amount of vanilla was added, and then each batch was

frozen in an experimental ice cream freezing machine (Taylor, Model 103 Italy). The resulting product was filled into PVC cups (120 ml each), covered and hardened in a deep freezer at -18°C for 24 hours before analysis.

Analytical methods:

Ice cream mix:

All ice cream mix treatments were examined for: titratable acidity and pH (Rishardson, 1986), specific gravity at 20°C using pycenometer (Winton and Winton, 1958), weight per gallon (Burke, 1947), viscosity (Baurne, 1982) and freezing point (FAO, 1977).

Table 1: Component chemical analysis of fenugreek seed.

Component	Percent (%)
Dietary fiber	45.4
- insoluble	32.1
- soluble	13.3
Protein	36
Oil	6
Ash	3.2
Starch	1.6
Sugar	0.4
Mositure	7.4

Table 2: Formula of ice cream made by addition different levels of fenugreek.

Fenugreek% / Ingredients (%wt/wt)	Treatments				
	(Control)	T1	T2	T3	T4
	0	0.25	0.5	0.75	1
Fresh cream(40% fat)	20	20	20	20	20
Sucrose	16.00	16.00	16.00	16.00	16.00
Stabilizer/emulsion	0.4	0.25	0.5	0.75	1
Skimmed milk	12	12	12	12	12
Total solids	36.4	36.25	36.5	36.75	37
Water	15.2	15.5	15.0	14.5	14

Ice cream:

All ice cream treatments were examined for: pH (Rishardson, 1986), specific gravity (Winton and Winton, 1958), weight per gallon (Burke, 1947), overrun (Sommer, 1951), melting resistance (Reid and Painter, 1993), total bacterial count (Houghtby et al., 1993), coliforms count (James et al., 1992), detection of *salmonella spp*. (Russell et al., 1992), *staphylococci* count (Galye and Tatini, 1992) and psychrotrophic bacterial count(Cousin,1982) Moreover, flavor (50 points), body and texture (40 points) and appearance (10 points) were evaluated as outlined by Becker (1974).

Statistical analysis:

Data were expressed as mean ± SD, and analyzed statistically by student t test and Chi square. Significant effects were declared at $P < 0.05$ (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Mix properties:

From results in Table (3) it could be observed that the addition of fenugreek gum level had a little effect in the acidity and pH values of the ice cream mix. Using fenugreek slightly decreased the acidity and little increase in the pH than control. These results are in agreement with that of Al-Atawy et al.,(2001). Table (3) also indicates that specific gravity and weight /gallon show that the decrease in the level fenugreek caused a slight increase. It also indicated that the mix viscosity increased proportional by increasing the fenugreek added. This may be due to water hydration or emulsifying and stabilizing ability caused by the fenugreek. These results are in agreement with that reported by El-Nasri and El-Tinay (2007). This increase of viscosity could be attributed to the higher content of fibers and proteins which is characterized by its high water hydration capacity (Vani and Zayas, 1995). Baer and Baldwin (1984) showed that soluble constituents with high molecular weights will cause the least lowing of freezing point.

Properties of resultant ice cream:

From the results presented in Table (4), it could be observed that specific gravity and Wt/gallon were decreased as the level of fenugreek gum increased. Also it could be noticed that T2 gave the

Table 3: properties of ice cream mix containing different levels of fenugreek

Properties	Treatments				
	Control	T1	T2	T3	T4
Titratable acidity	0.25±0.02	0.23±0.03	0.22±0.02	0.22±.05	0.21±0.06
pH	6.33±0.05	6.35±0.04	6.37±0.06	6.38±0.04	6.40±0.04
Specific gravity	1.145±0.03	1.126±0.02	1.123±0.01	1.116±0.04	1.112±0.02
Weight/gallon	9.75±0.05	9.37±0.02	9.22±0.05	9.21±0.01	9.19±0.02
Viscosity	30.83±0.2	31.23±0.1	34.55*±0.3	36.45*±0.2	37.80**±0.3
Freezing point	-2.15±0.001	-2.3±0.001	-2.35±0.001	-2.5±0.001	-2.6±0.001

* P < 0.05, ** P < 0.01

Table 4: Properties of ice cream containing different levels of fenugreek

Properties	Treatments				
	Control	T1	T2	T3	T4
Specific gravity	0.75±0.5	0.70±0.6	0.68±0.7	0.73±0.4	0.71±0.5
Weight/gallon	6.3±0.04	6.3±0.02	6.3±0.05	6.3±0.04	6.3±0.06
Overrun %	55.9±1.5	58.3±2.2	62.4*±2.5	50.2±1.1	45.4±2.8
pH	6.4±0.01	6. 4±0.04	6.4±0.02	6.4±0.04	6.4±0.05
Viscosity	110±3	113±3	126*±4	130*±4	154.**±5
Melting resistance					
- 15 min	15.6±2.2	13.4±3.2	11.2±1.3	9.5*±2.0	7.6*±1.8
- 30 min	93.2±4.5	88.8±2.9	82.2±3.5	75*±4.6	68.4*±3.5
- 45 min	122±4.1	112±5.8	105±4.7	99*±3.6	90.5*±5.8
- 60 min	143±3.6	134±4.6	129±5.6	121*±5.5	115.5*±5.1

* P < 0.05, ** P < 0.01

lowest specific gravity and Wt/gallon compared with control and other treatments. These results are agreement with El Sayed et al., (1992). Also the overrun was increased when 0.5% fenugreek gum was used and had the highest percentage of overrun. The effect of different added fenugreek on the rate of melting in finished ice cream can be observed in Table (4). From this data it is cleared that using fenugreek gum increased the melting resistance of ice cream which proportional

to the amount of fenugreek gum used. This increase could be attributed to the high water hydration capacity of fenugreek seed protein. The control ice cream showed lower melting resistance than the rest ice cream treatments.

Data in Table (5) show that the total viable count and spore forming count were decreased as the fenugreek level increased , this observation give the impression that fenugreek gum may have antimicrobial effect. These findings are in agreement with Omoloso et al., (2001) who screened Fenugreek against 26 pathogens and exhibited broad-spectrum anti-bacterial activity.

On the other hand, coliform, salmonellae, staphylococcus and psychrotrophic bacteria were not detected in all formulas; these may be due to the heat treatment, the hygienic quality and precautions applied during the manufacture process and anti-bacterial activity of fenugreek.

Table 5: Microbiological properties of ice cream enriched with fenugreek

Properties	Treatments				
	Control	T1	T2	T3	T4
Total bacterial count $x10^3$	35.75	33.50	30.25	28.67	25.00
Spore forming $x10^1$	25.00	22.25	20.76	15.30	14.66
Coliform count $x10^1$	N.D.	N.D.	N.D.	N.D.	N.D.
Salmonella $x10^1$	N.D.	N.D.	N.D.	N.D.	N.D.
Staphylococci $x10^1$	N.D.	N.D.	N.D.	N.D.	N.D.
Psychrotrophic $x10^1$	N.D.	N.D.	N.D.	N.D.	N.D.

N.D.: Not detected

Table 6: Organoleptic properties of ice cream enriched with different levels of fenugreek

Treatments	Properties			
	Flavor (50)	Body and texture (40)	Appearance (10)	Total (100)
Control	45.20	39.45	8.76	93.41
T1	44.75	37.65	8.50	90.90
T2	44.86	38.75	8.56	92.17
T3	42.00	35.33	8.44	85.77
T4	40.55	33.25	8.00	81.80

Organoleptic properties:

Sensory evaluation data of ice cream supplemented with different levels of fenugreek gum are depicted in Table (6). Addition of fenugreek caused decrease in the organoleptic properties with the increase of percent replacement from fenugreek. These results are in agreement with Sharma and Chauhan, (2002).The best results were noticed at 0.5% which had the highest score followed by 0.25% in comparison with the control treatment. The ice cream with 1% fenugreek gum got the lowest score; this may be due to the bitter taste of fenugreek. These results are in agreement with Abd El-Baki et al., (2008)**.**

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أستخدام الحلبة في صناعة المثلوجات القشدية

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معهد بحوث تكنولوجيا الأغذية –مركز البحوث الزراعية-الجيزة

تم في هذا البحث دراسة أستخدام بذور الحلبة كبديل جزئي للمواد الرابطة في صناعة المثلوجات القشدية و ذلك باضافتها بنسب ٠,٢٥٪ و٠,٥ ٪ و ٠,٧٥٪ و ١٠٠٪ و لقد أختبرت المخاليط و كذلك المثلوجات الناتجة من حيث خواصها الكيمائية و الطبيعية و الميكروبيلوجية والريولوجية و كذلك الخواص الحسية مع اجراء التحليل الأحصائي للنتائج و أشارت النتائج أن أضافة بذور الحلبة المطحونة أدت الى أختلافات في قيم الكثافة النوعية و الوزن بالجالون و اللزوجة لكل من المخاليط و المثلوجات الناتجة و بناء عليه كان هناك اختلاف معنوي في الريع الناتج . كما أظهرت مخاليط المثلوجات أنخفاض في القابلية للخفق و الحموضة مع أرتفاع في نقطة تجمدها و زادت قيم اللزوجة زيادة معنوية مع زيادة نسبة الأستبدال و مقاومة المنتج للأنصهار و أصبحت المثلوجات أكثر نعومة و أكثر تفضيلا لدى المحكمين مع الأستبدال حتى نسبة ٥٠٪ مع ملاحظة أن أضافة بذور الحلبة أدى الي خفض التكلفة الأقتصادية بدرجة ملحوظة مع الحصول على منتج عالي الجودة و له فوائد صحية كثيرة.