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UTILIZATION OF VEGETABLE PROTEINS IN THE ICE CREAM LIKE PRODUCT MAKING

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ABSTRACT

This study aimed to study the effect of substituting two levels of rice gluten meal of UF-milk retentate on the quality of ice-cream either when fresh or after 30 and 60 days of storage at freezing conditions. Three treatments were processed first is control 100% UF-milk retentate having 27%T.S. (M0), 5 and 10% of rice gluten were replaced by UF-milk retentate namely (M1) and (M2). The resultant ice cream products were examined for the chemical, physical, bacteriological, and organoleptic characteristics. Results indicated that titrable acidity increased and pH value decreased in M1 and M2, comparing with M0. also total solids, total nitrogen, non protein nitrogen , soluble nitrogen and total volatile fatty acids increased, while fat decreased in M1 and M2 comparing with M0. Moreover, relative viscosity, specific gravity, weight/gallon, melting resistance and overrun increased in M1 and M2 comparing with Mo.On the other hand, total viable bacterial count increased while psychrotrophic bacteria decreased in M1 and M2 comparing with M0, but moulds and yeasts were present in the three blends (M0, M1 and M2) during the first 30 days of storage and disappeared after 60 days. No coliform and staphylococcus aureus were detected in the three blends. M0 (control without rice glutein) recorded the highest total scoring points comparing with M1 and M2 (5 and 10% rice gluten flour). However, the addition of 10% strawberry juice improved the organoleptic characters of the ice-cream mixes manufacture either from UF-milk retentate or partially replaced by rice gluten flour.

INTRODUCTION

Ice-cream is a very popular dairy products in Egypt. It is production and consumption is growing continuously due to its therapeutic properties. Moreover, its high nutritive value. In addition , the production of ice-cream has recently increased in Egypt. Rice is an important source of protein, supplying more than 50% of total protein consumed in some countries. The rice protein is considered the most importat component that has the highest nutritive value among all of the cereal proteins. The high protein quality of rice is due to its high gluten to prolamine ratio (Huebner et al., 1990). Rice proteins contain relatively high levels of essential amino acids lysine and methionine, compared with the other common cereal grains. However, glutamic acid is very low in rice protein (Dharmaputra, 1997).

The aim of the present work is to study the possibility of using rice gluten flour mixed with UF milk retentate in ice cream manufacturing.

MATERIAL AND METHODS

UF-milk retentates were obtained from the dairy industry unit, Misr Company of Dairy and Food Products Mansoura, Egypt. Rice Gluten meal was purchased from the Rice Research and Training Center located in Sakha at Kafr El-Sheikh Governorate. Sucrose, emulsifier/ stabilizer formula palsgaard 5926 (Denmark) and. natural vanilla produced by Guvison Co.

(Switzerland), were purchased fromt the local market in Mansoura, as well Strawberry

Chemical analysis of ice cream:

The resultant ice cream samples were analyzed for pH values, titratable acidity as precent of lactic acid and fat content according to Ling (1963). Total solids (TS) content was measured according to the American PH Association, (1978). Total nitrogen (TN), non-protein nitrogen (NPN) and soluble nitrogen (SN) as described by Ling (1963). Total volatile fatty acids (TVFA) was determined according to Kosikowiski, (1978).

Physical properties of ice cream:

Relative viscosity were determined according to methods of Arbuckle, (1986) by Ostwald Viscometer. Specific gravity (Winton, 1958). Weight per gallon (Burke, 1947). Melting resistance (Garcia, et al., 1995). Overrun (Sommar, 1951).

Microbiological Analysis:

Total viable bacterial count of ice cream mix was determined according to the American PH Association (1978) by plating suitable dilution in duplicates using nutrient agar medium (Difco Manual, 1966). The coliform bacteria count as described in oxoid manual, (1982). The staphylococci count by (Difco, 1974).

The molds and yeasts as described by the Oxoid Manual, (1962).

The psychrotrophic bateria were enumerated according to Maria (1998).

Sensory evaluation:

The parameters evaluated were flavour (50 points), body & texture (40 points), and melting quality (10 points) according to the score card suggested by Fathi and Fatma (1999).

Strawberry Juice:

Strawberry juice was produced as mentioned by Arbuckle (1977), from fresh fruit as follows: the fruit was washed and mixed with sugar in the ratio of 3:1 fruit to can sugar by weight and held at about 5°C for 12 hours to combine large part of the juice and flavour with the sugar by osmotic action to form a fruit syrup, then it was stored in the deep freezer (-18°C) until usage, ten percent strawberry juice was added at the end of freezing.

Statistical analysis:-

Data were statistically analyzed using the general liner model of SAS (Statistical analysis system, 1994 Cary, N.C., USA) at 5% level of significance.

RESULTS AND DISCUSSION

Table (1) shows the chemical composition of rice gluten and ultrafiltrated milk retentate as follows:

Ingredient formulas of ice cream mixes:

The control ice cream mix (M0) contained UF milk retentate (27% TS), 10% sucrose, 0.5% palsgaard and 0.08 vanillia, while the other two ice cream mixes M1 and M2 were substituted in UF milk retentate by rice gluten meal at the levels of 5% and 10%, respectively as shown in table (2).

Table (1): Chemical composition of the rice gluten meal and UF- milk retentate:

Constituent %	Rice gluten meal	uf milk retentate
Moisture	16.11	73.0
Total fat	4.0	11.80
Total proteins	17.34	8.80
Ash	8.85	1.90
Crud fiber	4.35	--
Carbohydrates	46.39	4.50
Total solid	83.89	27.0

Table (2): Ingredient for different treatments:-

Treatments	UF-milk retentate	Rice gluten flour
Control(M0)	100%	----
(M1)	95%	5%
(M2)	90%	10%

The resultant ice cream products were examined for the chemical, physical, bacteriological and organoleptic characteristics.

Chemical properties:

pH value and titratable acidity (TA):

It could be seen from Table (3) that substituting UF milk rententate by rice gluten meal at levels of 5% and 10% highly significant decreased pH value but titratable acidity highly significant increased of ice cream compared with the control treatment, when it was fresh or during storage. This is due to the highest protein content (17.34%) of rice gluten meal.

Table (3): Chemical Properties (pH , T.A ,T.S and F% Content for mixes.(U.F)

Treatments		pH	T.A%	T.S%	F%
Fresh	Control (M0)	6.60	0.225	37.50	11.86
	M1	6.55	0.240	38.60	10.65
	M2	6.50	0.260	39.80	7.32
30 days	Control (M0)	6.55	0.260	37.66	11.92
	M1	6.50	0.310	38.71	10.71
	M2	6.40	0.330	39.92	7.38
60 days	Control (M0)	6.44	0.270	37.74	11.96
	M1	6.42	0.320	38.80	10.78
	M2	6.33	0.338	39.99	7.42
F test		**	**	**	**
LSD 5%		0.007	0.005	0.008	0.008

(M0) contained UF milk retentate (27% TS), 10% sucrose, 0.5% palsgaard and 0.08 vanillia, while the other two ice cream mixes. (M1 and M2) were substituted in UF milk retentate by rice gluten meal at the levels of 5% and 10%, respectively

It is clear from tables (3 &4), that replacing 5 or 10% UF milk retentate by rice glutin flour high significantly increased the T.S., T.N., N.P.N., S.N and T.V.F.A. of resultant ice-cream, while led to lowering the fat content

of the blends as compared with control (100%UF-milk retentate).On the other hand, slight increases was detected for the above components as the storage period.These increases in T,S. and T.N. is due to the higher T.S. (83.39%) and (T.P. 17.34%) of rice glutin flour.While the decrease in fat content is owing to the low fat content (4%) of the of rice glutin flour. These results could be attributed to the loss of some free water during storage which accordingly leads to concentrating the ice cream solids. These results are in agreement with Gomma, (1987) and Garcia, et al., (1995).

Table (4): Chemical Properties (TN, NPN, SN and TVFA) for treatment mixes.

Treatments		TN %	NPN%	SN%	TVFA%
Fresh	Control (M0)	1.160	0.147	0.140	1.60
	M1	1.260	0.154	0.224	2.80
	M2	1.400	0.161	0.245	3.60
30 days	Control (M0)	1.190	0.196	0.238	3.20
	M1	1.330	0.189	0.245	3.60
	M2	1.470	0.175	0.252	5.20
60 days	Control (M0)	1.210	0.203	0.245	4.00
	M1	1.360	0.196	0.252	4.80
	M2	1.510	0.182	0.256	5.60
F test		**	**	**	**
LSD 5%		0.002	0.003	0.001	0.007

Physical properties:

As it is illustrated in Table 5 increasing the substitution level of UF milk retentate from 5% to 10% by rice gluten flour resulted in increasing both the relative viscosity, specific gravity, weight per gallon, melting resistance and overrun as compared with the control treatment, whether in the fresh or stored ice cream samples.

Table (5): Effect of replacing rice glutin of UFretentate on physical properties (relative viscosity specific gravity, weight/gallon, melting resistance, and overrun) for mixes during stoage.

Treatments		Relative viscosity %	Specific Gravity %	Weight/ gallon %	Melting drip %	Overrun %
Fresh	Control (M0)	14.00	0.8393	7.00	40.04	36.35
	M1	14.42	0.8991	7.501	9.53	41.95
	M2	14.95	0.9053	7.551	5.30	43.82
30 days	Control (M0)	14.51	0.8404	7.013	41.0	
	M1	14.91	0.9169	7.652	10.0	
	M2	15.25	0.9252	7.721	6.0	
60 days	Control (M0)	14.55	0.8445	7.047	43.0	
	M1	14.94	0.9339	7.793	11.0	
	M2	15.29	0.9361	7.811	7.5	

(M0) contained UF milk retentate (27% TS), 10% sucrose, 0.5% palsgaard and 0.08 vanillia, while the other two ice cream mixes. (M1 and M2) were substituted in UF milk retentate by rice gluten meal at the levels of 5% and 10%, respectively.

This could be due to the higher protein and solids not fat content in rice gluten flour compared with UF milk retentate. On the other hand, it is well known that proteins have the ability to adsorp free water and increase viscosity. Also, the overrun values increased gradually upon increasing the solids not fat of different treatments; Abou Dawoad, (1999) had similar results.

Microbiological properties:

Data in Table 6 indicate that the lowest total viable bacterial count or molds and yeasts were found in ice cream (M0) from UF milk retentate. Meanwhile, it could be noticed from the same table that the total viable bacterial counts of M1 and M2 were higher than that M0 mix. On the other hand, it's noticed that the molds and yeasts could not be detected in all treatments after 60 days of storage under freezing condition.

Table (6): Microbiological properties (total bacteria count, cliform bacteria, staphylococcus group, molud and yeast and psychrophic bacterial) for mixes.

Treatments		T.C $(10)^6$	Coliform bacteria $(10)^3$	Staphylo coccus. $(10)^3$	M/Y $(10)^2$	Psychrophic bacteria $(10)^3$
Fresh	Control (M0)	4.5	ND	ND	2.5	4.0
	M1	5.5	ND	ND	3.0	2.5
	M2	7.0	ND	ND	4.0	1.5
30 days	Control (M0)	3.5	ND	ND	0.5	3.0
	M1	4.0	ND	ND	1.0	2.0
	M2	5.0	ND	ND	1.5	1.0
60 days	Control (M0)	2.0	ND	ND	ND	1.5
	M1	2.5	ND	ND	ND	1.0
	M2	3.0	ND	ND	ND	0.5

(M0) contained UF milk retentate (27% TS), 10% sucrose, 0.5% palsgaard and 0.08 vanillia, while the other two ice cream mixes. (M1 and M2) were substituted in UF milk retentate by rice gluten meal at the levels of 5% and 10%, respectively.

All treatments M0, M1 and M2 had no detectable coliform organisms or staphylococcus aureus, whether in fresh or stored ice cream up to 30 and 60 days. This indicates that the manufacturing process was conducted under hygienic practices. On the other hand, the number of psychrotrophic bactera decreased in M1, and M2 of ice cream mix compared with M0. also, the TVBC or psychrotrophic bacterial count decreased during the storage period after 30 and 60 days in all treatments. These decreases may be owing to the effect of freezing conditions on the viability of some bacteria.

Organoleptic properties:

Results in Table (7 & 8) exhibit that M0 mix had higher points scored for the organoleptic characters compared with M1 and M2 mixes. This was a result of the low flavour of rice gluten flour therefore, an attempt was made to improve the flavour of rice glutin flour by the addition of 10% strawberry juice. On the other hand, rice glutein flour can be used as an economic substitute for milk protein in the preparation of ice cream which improved in the same time the melting resistance and overrun. However, ice cream storage resulted in highly significant lowered total score for control (M0) and treatments M1

and M2 ice cream storage decreased the points recorded for flavour and body texture, but the melting quality were non significantly increased after 30 and 60 days.

Table (7): Organo leptic properties of the mixes (flavour, Body texture, and melting).

Treatments		Flavour (50 d.)	Body texture (40 d.)	Melting (10 d.)	Total score (100 d.)
Fresh	Control (M0)	43.00	35.00	7.00	85.00
	M1	40.00	33.01	7.50	80.50
	M2	36.00	32.00	8.00	76.00
30 days	Control (M0)	42.00	35.00	7.10	84.10
	M1	38.00	32.00	7.65	77.66
	M2	32.00	31.00	8.15	71.15
60 days	Control (M0)	41.00	34.00	7.10	82.10
	M1	35.00	31.00	7.70	73.70
	M2	30.00	30.00	8.25	68.25
F test		**	**	ns	**
LSD 5%		0.104	0.109	—	0.266

Table (8): Organoleptic scoring points of ice cream mixes containing 10% strawberry juice

Treatments		Flavour (50 d.)	Body texture (40 d.)	Meting (10 d.)	Total score (100 d.)
Fresh	Control (M0)	46.00	35.50	7.00	88.50
	M1	43.00	32.50	7.50	83.00
	M2	40.00	32.00	8.50	80.00
30 days	Control (M0)	45.00	35.20	7.00	87.20
	M1	42.00	31.50	7.60	81.10
	M2	37.00	31.00	8.55	76.55
60 days	Control (M0)	44.00	35.00	7.10	86.10
	M1	40.00	31.00	7.70	78.70
	M2	34.00	30.00	8.60	72.60

Control (M0) = Uf milk rotentate (27% TS) + 10% sucrose + 0.5% palsgaard + 0.08% vanilla.
M1 = Uf milk rotentate (27% TS) + 5% rice gluten + 10% sucrose + 0.5% palsgaard + 0.08 % vanilla.
M2 = Uf milk rotentate (27% TS) + 10% rice gluten + 10% sucrose + 0.5% palsgaard + 0.08 % vanilla.

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استخدام البروتينات النباتية في تصنيع الآيس كريم

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يهدف هذا البحث إلى دراسةاستبدال ١٠،٥ % من اللبن المركز الناتج بالترشيح الفائق بدقيق جنين حبة الأرز كمصدر للبروتينات النباتية في تصنيع الآيس كريم وأثره علي الخواص الكيميائية والطبيعية والميكروبية والحسية علي الناتج النهائي. وان إضافة دقيق جنين حبة الارزالي مخاليط المثلوجات اللبنية يتوقع رفع قيمتها الغذائية لاحتوائه علي نسبة عالية من البروتينات (١٧،٣٤%) وكذلك المواد الصلبة (٨٣،٣٩ %) وعلاوة علي ذلك فان بروتين دقيق حبة الأرز به نسبة عالية من بعض الأحماض الامينية الأساسية .

ولقد تم تصنيع ثلاث خلطات من المثلوجات هي ١٠٠% لبن مركز بالترشيح الفائق (كنترول M0) والثانية استبدال ٥% من اللبن المركز بدقيق جنين حبة الأرز (M1) ؛ والثالثة استبدال ١٠% من اللبن المركز بدقيق جنين حبة الأرز(M2), وتم تخزين الناتج علي درجة حرارة التجميد (– ١٨ درجة مئوية) لمدة ٦٠ يوم وتم تحليل العينات وهي طازجة وبعد ٣٠ , ٦٠ يوم علي التوالي

وقد أظهرت النتائج ما يأتي :

- زيادة قيمة الحموضة وانخفاض قيمة الـ pH بزيادة استبدال اللبن المركز بجنين حبة الأرز.
- يقل الدهن بينما يزداد الجوامد الكلية والنيتروجين الكلي والنيتروجين الغير بروتيني والنيتروجين الذائب والأحماض الدهنية الطيارة بزيادة الاستبدال.
- زيادة اللزوجة النسبية والوزن النوعي والوزن لكل جالون والمقاومة للإنصهار بزيادة نسبة الاستبدال.
- يزداد العد الكلي البكتيري ويقل عدد البكتريا المحبة للبرودة بينما ظهرت الفطريات والخمائر في المخاليط الطازجة والمخزنة لمدة ٣٠ يوم فقط ولكنها لم تظهر بعد ٦٠ يوم، وكذلك لم تظهر بكتريا القولون والإستافيللوكوكس في جميع مراحل التخزين.

سجل المخلوط المصنع من اللبن المركز بالترشيح الفائق أعلى الدرجات في التعقيم الحسى مقارنة بالمخاليط المحتوية على جنين حبة الأرز ولذلك تم إضافة ١٠ عصير فراولة لتحسين الطعم بتلك المخاليط.