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VIABILITY OF LACTIC ACID BACTERIA IN FROZEN YOGHURT PREPARED WITH LOW ENERGY CONTENT

Mehana, M. Y.
Dairy Dept., Fac. Agric., Mansoura Univ., Mansoura, Egypt.

ABSTRACT

Frozen yoghurt and yoghurt like ice-cream are becoming popular and preferable dairy food for consumption. Therefore, the results of the frozen yoghurt made with low fat and replacing 25% of its sucrose content with sorbitol as low energy content revealed that: non fat treatment recorded decreasing in titratable acidity, reduction in pH values, decreasing in melting down. But, highest increasing of overrun and lactic acid bacteria count were observed. Replacement of sucrose with 25% sorbitol increased greatly the count of lactic acid bacteria (LAB) and melting down, but decreased the acidity of frozen yoghurt. Storage of frozen yoghurt for 15 days led to greatest reduction of the count of LAB. Slight increasing of acidity and melting down were recorded during the storage period. Negligible increase in the organoleptic properties were found in the treatment contained 8% fat. The addition of sorbitol instead of sucrose decreased the individual scores as well as total scores of organoleptic properties of frozen yoghurt. The storage period (15 days) of frozen yoghurt decreased greatly all scores tested as well as total scores.
Finally, it might be concluded that all treatments containing fat and non-fat or containing low energy source could be recommended for the manufacture of frozen yoghurt.

Keywords: Frozen yoghurt, low fat content, lactic acid bacteria, organoleptic properties.

INTRODUCTION

Ice cream is the most widely consumed frozen desert by the public especially children. It composed of milk products, flavouring materials, stabilizers and sugar. So, it is highly delicious and nutritionally rich frozen product (Mohamed *et al.*, 1998). Frozen yoghurt is one preferably made from dairy products. It has many advantages, which gather the characteristics of yoghurt and ice cream together, it is a preferable dairy food for consumption because of its high nutritional attributes, as well as its refreshment, and a yoghurt as a fermented dairy product. In which the yoghurt culture produces certain metabolites during their growth, which allow the milk protein to be digested and inhibits some pathogens (Lopez *et al.*, 1998, Fathi, 1999 and Abo-Serea, 2002).

Frozen yoghurt may be made as soft-serve or hard variant and being low-fat, it may also be marketed as diet food or health food. Frozen yoghurt may be flavoured with a prepared base, including everything (fruit, flavour, colors, sweeteners and a cooking medium such as sugar or water) or a concentrated flavour or extract without processed or frozen fruit. The popularity of frozen yoghurt is attributed both to health-related properties, *i.e.*, lower energy and cholesterol content than ice cream and to taste and acceptable flavour (Tiezen & Baer, 1989; Fathi, 1999 and Roland *et al.*, 1999).

Cultured dairy products have been used as a medium to reintroduce a viable population into the gastrointestinal tract of children and adults to have the desired therapeutic effects, bifidobacteria and other lactic acid bacteria must be available in sufficient number in the food products. It has been suggested that, in order to avail therapeutic properties, a minimum of 10^5 cfu/g of viable cells of bifidobacteria should be present at the time of consumption. Such high number of viable cells of bifidobacteria can be incorporated as dietary adjuncts into dairy products (Dinakor & Mistry, 1994; Fathi, 1999; Davidson *et al.*, 2000; Abo-Serea, 2002 and Gooda *et al.*, 2002).

Therefore, this study was aimed to evaluate some properties of frozen yoghurt prepared with low fat content and replacers of sucrose with sorbitol as low energy content. Also, the viability of lactic acid bacteria under the above conditions was also evaluated.

MATERIALS AND METHODS

Frozen yoghurt preparations:

Commercial yoghurt cultures (*Lactobacillus delbreuckii* subsp. *bulgaricus* and *Streptococcus salivarius* subsp. *thermophilus* were used at ratio 1 :1 v/v). These cultures were obtained from Dairy Dept., Fac. Agric., Mansoura Univ., Mansoura, Egypt.

Ice-cream mixes were divided into four portions as follows:

Portion I: Contained zero fat + 100 sucrose.

Portion II: Contained 8% fat + 100 sucrose.

Portion III: Contained zero fat + 75% sucrose + 25% sorbitol.

Portion IV: Contained 8% fat + 75% sucrose + 25% sorbitol.

All portions contained 12% MSNF + 18% sugar and 0.5% emulsifier and stabilizer (Se 38 from Danisco ingredients, Brahrand, Denmark), then, the mix was heated at 85°C for 30 min, followed by a two-stage homogenization at 250 Kg/cm^2, then flavouring ingredients are added (vanillein), cooled to 45°C and inoculated with 3% yoghurt starter culture and incubated at 42°C for 4 hours. The mix was frozen by batch freezer system at –3 to –5°C. The producing soft frozen yoghurt was stored at –18°C for 15 days.

Analysis:

Fresh and stored frozen yoghurt were analyzed for acidity according to Ling (1963), and the pH of the sample was determined by using a glass electrode pH meter (Lutron pH – 206).

Melting resistance (Meltdown):

Melting rates were determined on samples collected from the continuous freezer in 120-ml Syro-Foam (Dow Chemical Co.).

Cups and the melted sample were weighted and recorded according to Garcia *et al.* (1995).

Overrun:

Overrun is measured by the amount of air in the product and is found from the following formula:

$$\text{Overrun} = \frac{\text{Wt.of mix} - \text{Wt.of product}}{\text{Wt. of product}}$$

The overrun was measured during the freezing process by determining the separate weights of the original mix and the product in a carefully filled baker (Abo-Serea, 2002).

Lactic acid bacteria count:

The count of lactic acid bacteria was carried out as prescribed method for yoghurt (APHA, 1978).

Organoleptic properties:

Frozen yoghurt samples were scored for organoleptic properties according to Kaul and Mathur (1982). 40 points were giving for body texture, 10 to melting down and 50 for flavour.

RESULTS AND DISCUSSION

Data presented in Table (1) showed some properties of frozen yoghurt. The data revealed that there were a slight differences in the titratable acidity values between different treatments containing low or non fat + 100% sucrose or 25% sorbitol + 75% sucrose as a sweeter material. The treatments containing 8% fat were containing slight more acidity than other one containing non fat.

Table (1): The effect of fat reduction on the properties of frozen yoghurt at zero time.

Treatments	pH	Acidity%	Melting down (g)	Overrun (%).	LAB
I	6.18	0.42	15	53	120×10^6
II	5.95	0.47	12	60	110×10^6
III	6.20	0.39	18	50	130×10^6
IV	6.03	0.40	14	59	118×10^6

I: zero fat + 100% sucrose, zero% sorbitol.
II: 8% fat + 100 sucrose, zero% sorbitol.
III: zero fat + 75% sucrose + 25% sorbitol.
IV: 8% fat + 75% sucrose + 25% sorbitol.
LAB = Lactic acid bacteria

Also, slight decrease in pH values in the treatment containing 8% fat were recorded compared with other one containing non fat. Similar observations were recorded with melting down, which, it was decreased in the treatment containing fat. But, overrun was highly increased in the treatment containing fat. This indicates that the increase of acidity is responsible for increasing of overrun. In the same line of overrun, count of lactic acid bacteria were recorded, but with lowest number in the treatment containing fat. The supplementation of sucrose with 25% sorbitol recorded higher numbers of lactic acid bacteria and decreased the overrun of frozen yoghurt at zero time. Also, these supplementation increased the meltdown, but, decreased the acidity. These results indicate that lactic acid bacteria were able to survive and grow in frozen yoghurt. This means that the

substitution of sucrose with sorbitol affected greatly on the properties of frozen yoghurt. Also, meltdown of the resultant frozen yoghurt tended to decrease as the acidity increased.

Results presented in Table (2) reveal that, titratable acidity was increased throughout the storage period of frozen yoghurt reached 15 days. At the same time, slight reduction of pH values of all treatments were also observed. Higher values of meltdown were found while, highest reduction of lactic acid bacteria count were recorded. These means that the storage of frozen yoghurt caused adverse effect on the survival of lactic acid bacteria, which greatly decreased it. These observations are similar to those reported by Garcia *et al.* (1995); Christiansen *et al.* (1996); Mohamed *et al.* (1998) and Abo-Serea, 2002).

Table (2): The effect of fat reduction on the properties of frozen yoghurt stored for 15 days.

Treatments	PH	Acidity (%)	Melting down (g)	LAB
I	6.08	0.45	19	90×10^6
II	5.93	0.46	14	50×10^6
III	6.12	0.40	22	47×10^6
IV	6.00	0.42	16	63×10^6

I: zero fat + 100% sucrose, zero % sorbitol.
II: 8% fat + 100 sucrose, zero % sorbitol.
III: zero fat + 75% sucrose + 25% sorbitol.
IV: 8% fat + 75% sucrose + 25% sorbitol.
LAB = Lactic acid bacteria

It is well known that sensory evaluation is an important indicator of consumer. Thus, the results presented in Table (3) show that, body texture, melting rate, flavour of frozen yoghurt at zero time. The results indicate that slight variations were recorded in body texture and other properties of frozen yoghurt. Flavour scores and body texture of frozen yoghurt were improved with the increasing of fat content. But, the substitution of sucrose with 25% sorbitole slightly decreased the body texture, melting down and flavour scores as well as total scores.

Table (3): The effect of fat reduction on the organoleptic properties of frozen yoghurt at zero time.

Treatments	Body & Texture	Melting down	Flavour	Total
	(40)	(10)	(50)	(100)
I	37	8	44	89
II	39	9	46	94
III	36	7	41	84
IV	38	8	43	89

I: zero fat + 100% sucrose, zero % sorbitol.
II: 8% fat + 100 sucrose, zero % sorbitol.
III: zero fat + 75% sucrose + 25% sorbitol.
IV: 8% fat + 75% sucrose + 25% sorbitol.
LAB = Lactic acid bacteria

In addition gradual decrease in all organoleptic properties were recorded with the storage of frozen yoghurt up to 15 days such in treatments containing fat or non fat treatments, containing sucrose or sucrose + sorbitole. This means that freezing affecting greatly which reduced the sensory scores, but it was acceptable product for all the judges. Similar observations were recorded by Mohamed *et al.* (1998); Roland *et al.* (1999); Abo-Serea (2002) and Gooda *et al.* (2002).

Table (4): The effect of fat reduction on the organoleptic properties of frozen yoghurt after for 15 days of storage.

Treatments	Body & Texture	Melting down	Flavour	Total
	40	10	50	100
I	34	6	40	88
II	38	9	45	92
III	33	5	39	77
IV	35	7	43	85

I: zero fat + 100% sucrose, zero % sorbitol.
II: 8% fat + 100 sucrose, zero % sorbitol.
III: zero fat + 75% sucrose + 25% sorbitol.
IV: 8% fat + 75% sucrose + 25% sorbitol.
LAB = Lactic acid bacteria

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حيوية بكتيريا حمض اللاكتيك فى الزبادى المجمد (شبيه الأيس كريم) المعد بمستوى منخفض من الطاقة

محمد يونس رياض مهنا

قسم الألبان – كلية الزراعة – جامعة المنصورة – المنصورة – مصر .

تعد المثلوجات اللبنية (المصنوعة من الزبادى) من أشهى المأكولات لدى الأطفال والكبار على حد سواء لما لها من قيمة غذائية عالية وطعم شهى ولما تحتويه من بكتيريات لها فوائد صحية وعلاجية جنباً إلى جنب مع الفوائد الغذائية لهذه المنتجات اللبنية ولذلك فقد هدف هذا البحث لإعداد زبادى مجمد منخفضة فى نسبة الدهن ومعد حيوياً ببكتيريا حمض اللاكتيك وقد أوضحت الدراسة النتائج التالية :

١. تناقصت الحموضة فى كل المعاملات التى لا تحتوى على الدهن كما تناقصت قيم الـ pH وكذلك تناقصت القابلية للإنصهار.

٢. تزايدات أعداد بكتيريا حمض اللاكتيك و overrun فى المعاملات التى لاتحتوى على الدهن إستبدال السوربيتول بنسبة ٢٥% من كمية السكروز المضافة كمادة محلية للبن المتخمر أدت إلى زيادة أعداد بكتيريا حمض اللاكتيك والقابلية للإنصهار بينما أدت إلى تناقص الحموضة فى المنتج .

٣. تخزين المثلوج اللبنى لمدة ١٥ يوم أدى إلى تناقص كبير فى أعداد بكتيريا حمض اللاكتيك بينما زادت الحموضة زيادة بسيطة وكذلك القابلية للإنصهار.

٤. حدثت زيادة ضئيلة فى الصفات الحسية وذلك للمعاملات المحتوية على ٨% دهن .

٥. إضافة السوربيتول للمثلوج اللبنى بدلاً من السكروز أدت إلى زيادة الخواص الحسية منفردة وكذلك فى مجموعها .

٦. أدى تخزين المثلوج اللبنى لمدة ١٥ يوم إلى تناقص كبير فى الخواص الحسية .

وفى النهاية توصى الدراسة بإمكانية تصنيع مثلوج لبنى متخمر منخفض فى نسبة الدهن والطاقة مقبول لدى المستهلكين .