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MICROBIOLOGICAL QUALITY OF EGYPTIAN ULTRA-HIGH-TEMPERATURE PROCESSED (UHT) MILK
(With 4 Tables)

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التقييم الميكروبيولوجي للبن المعقم بالطريقة السريعة والمنتج في مصر
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تم جمع ٢٠ عينة من اللبن المعقم بالطريقة السريعة من السوبرماركت في مدينة أسيوط ، وكذلك اخذت كمية من المصنع بعد التصنيع مباشرة ثم قسمت الى مجموعتين الأولى حفظت عند درجة حرارة التلاجة (٨ ± م°) ، أما الثانية حفظت عند درجة حرارة الحجرة (٢٥ م°) . وتم فحص هذه العينات ميكروبيولوجيا ووجد أن متوسط العدد الكلي للميكروبات ، الميكروبات المعوية ، الميكروبات القولونية وكذلك انباسبيلس سيربوس ، البكتيريا المحبة للبرودة ، والبكتيريا التي تعيش في درجات الحرارة العالية كانت على التوالي ١.٠×١١ ، ٥٠ ، ٦٢٨ ، ١.٠×١٢ ، ١.٠×١٧ ، ٢٧٢ مللي من العينات التي جمعت من السوبر ماركت . كذلك تم عزل عديد من الميكروبات المختلفة الممرضة والغير ممرضة والتي تؤدي الى فساد المنتج وتؤثر على صحة المستهلك . وقد تم مناقشة الأهمية الصحية لوجود هذه الميكروبات على الصحة العامة من ناحية وعلى فساد المنتج والخسارة الاقتصادية الناتجة من ناحية أخرى . وتناول البحث تأثير درجة حرارة التخزين على قيمة اللبن المعقم بالطريقة السريعة . وقد ناقش الباحث الخطوات الصحية التي يجب اتباعها عند تصنيع وتعبئة هذا المنتج حفاظا على صحة المستهلك وحفاظا على قيمته الغذائية .

SUMMARY

Thirty random samples of UHT-milk were collected from different supermarkets in Assiut City, as well as lot was taken from factory at the time of manufacture and stored at room and refrigerator temperatures for up to 11 weeks and examined for their microbiological quality. The obtained results revealed that the average counts of aerobic plate, enterococci, coliforms, B.cereus, psychrotrophic, thermophilic and thermotolerant bacteria in supermarkets samples were 44x10, 50, 62.2, 13.8x10, 17x10, 73.3 and 70/ml respectively. Furthermore, E.coli, klebsiella species, Enterobacter spp., citrobacter spp., Micrococcus spp., Staph. epidermidis and Anaerobic - spore formers could be isolated from the examined samples. Also the effect of storage temperature on the quality of UHT-milk was studied. The public health and economic significance of these findings are discussed.

INTRODUCTION

The term ultra-high-temperature processed (UHT) milk will refer to milk that has been heated to at least 130°C for not less than 1 sec., and then aseptically packaged. Milk sterilization has been practiced and studied for more than a century. Microbiological quality control for these products is a major problem (METHA, 1980) as the enzyme produced by psychrotrophic bacteria can hydrolyze milk proteins. The protease was quite active at normal and elevated room temperature and rapidly spoiled sterile milk with the development of bitter flavor, clearing or coagulation, and the

susceptibility of sterile milk to protease enzyme increased during storage of milk (SOMUELSON and HOLM, 1966).

In spite of the temperature attained in its preparation, UHT-milk may, at times, be responsible for transmitting some pathogenic organisms to consumers. Outbreaks of gastroenteritis traced to staphylococcal enterotoxin A have been associated with UHT-milk (GERINGER, 1983). KIM (1980) found that the viable bacterial counts of thermophilic, Psychrophilic and Coliform in packaged UHT-milk were 10-40/ml, 20/ml, 0-10/ml and Zero respectively. HUH and KIM (1983) could isolate 67 strains from UHT-milk, 41 were identified as *B.subtilis*, 8 as *B.megatherium* 5 as *B.circulans*, 4 each as *B.lichenformis* and *B.sphaericum*, 3 as *B.cereus* and 1 each of *B. larvae* and *B.coagulans*, and they mentioned that 170 of these isolates could grow at 7°C and vegetative cells of *B.subtilis* and *B.cereus* survived heating at 65°C for 40 min. Moreover LEE (1984) examined 37 samples of UHT-milk, and he isolated 40 strains, 13 were identified as *Bacillus* species. There were 6 *B.cereus*, 5 *B.lichenformis*, 1 *B.brevis* and 1 *B.pumilus*. The other 27 strains were identified as 5 yeast, 2 *pseudomonas* spp., 3 *streptococcus* spp., 12 *lactobacillus* spp., 1 *shigella* spp., 1 *Aeromonas* spp. and 3 *Micrococcus* spp.

The presence of coliform organisms in UHT-milk provides a useful index in determining the hygienic quality of the products. The presence of coliform bacteria in UHT-milk has been reported by HAHN (1984) he could isolate *Klebsiella oxytoca*, *Hafnia alvei*, *Citrobacter freundii*, *Enterobacter cloaca* and 5 strains of *E.coli* from contaminated UHT-milk. On other instances the contamination of UHT-milk by psychrophilic bacteria has been reported by BLANC, et al. (1984) and MOTTAR, et al. (1985). The presence of such organisms could serve in predicting the life of refrigerated foods. while ITO (1985) stated that UHT-milk may be kept for 1 day (opened carton) or 2 days (unopened carton) at 20°C and for about 10 days (opened carton) or 14 days (unopened carton) at 5°C. MOTTAR, et al. (1985) recommended that determination of psychrotrophic microorganisms is of importance for quality control of milk products in general and UHT-milk in particular as some psychrotrophs produce thermostable proteinases that limit the shelf life of UHT-milk.

As the microbial quality of UHT-milk reflects the care with which the milk was produced and the sanitary conditions prevailing during its processing and filling, therefore, this work was planned to secure information regarding the sanitary conditions of UHT-milk as well as the effect of storage temperature on its quality.

MATERIAL and METHODS

Part I: Microbiological quality of UHT-milk:

Collection and preparation of samples:

Thirty random samples of UHT-milk were collected from different supermarkets in Assiut City. The samples were prepared according to Standard Methods for the Examination of Dairy Products (MARTH, 1978) and were examined microbiologically for aerobic plate, enterococci, coliforms, *B.cereus*, psychrophilic, thermophilic and thermoduric counts.

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Part II: Effect of storage temperature on the quality of UHT-milk:

A total of UHT-milk (containing 24 cartons) was taken from factory at the time of manufacture, and divided into 2 groups, the first was stored at room temperature (25°C) and the second one at refrigerator temperature (7±2°C) the stored samples were prepared according to the standard Methods for the Examination of Dairy Products (MARTH, 1978) and were examined at time zero, then weekly upto 11 weeks for their microbiological quality.

- (1) Aerobic plate, psychophilic, thermophilic and thermoduric counts: were carried out according to the standard Methods for the Examination of Dairy products (MARTH, 1978).
- (2) Enterococcus count: Enterococcus Selective Differential (ESD) agar was used according to EFTHYMIU, *et al.* (1974).
- (3) Coliform count: Violet red bile agar was used as recommended by Standard Methods for the Examination of Dairy Products (MARTH, 1978).
- (4) Detection of anaerobic sporeformers (Stormy fermentation test): The technique adopted is that recommended by CRUICHSHANK, *et al.* (1969).
- (5) Detection of pathogenic microorganisms: The procedure used for isolation and identification of pathogenic microorganisms were carried out according to COWAN and STEEL (1970).

RESULTS

All results obtained from the examined samples of UHT-milk are recorded in tables 1-4.

DISCUSSION**Part I: Microbiological quality of UHT-milk:**

The results in Table 1. show the min., max. and average values for aerobic plate, enterococci, coliforms, *B.cereus*, psychrotrophic, thermophilic and thermoduric organisms recovered from the examined samples lower counts of total bacteria, thermophilic and psychrotrophic bacteria were recorded by KIM (1980) *B.cereus* was previously isolated from UHT-milk by HUH and KIM (1983) and LEE (1984). While the contamination of UHT-milk with psychrotrophic bacteria was previously studied by BLANC, *et al.* (1984) and MOTTAR, *et al.* (1985).

Data in Table (2) show the frequency distribution of isolated *E.coli*, klebsiella species, *Enterobacter* species, *Citrobacter* species, *Micrococcus* species, *Staph. epidermidis* and anaerobic spore-formers from examined samples. A higher incidence of *E.coli* was obtained by HAHN (1984). The findings for coliform organisms nearly go parallel with results recorded by HAHN (1984).

Part II: Effect of storage temperature on the quality of UHT-milk:

Table 3 reveals an increase in aerobic plate count in samples stored at room temperature, while Enterococci, coliforms and *B.cereus* decreased in population with increasing time of storage and not detectable after 5, 8 and 9 weeks respectively.

Psychrotrophic, thermophilic and thermoduric bacteria increased in number by the end of the 11th week. LEE (1984) suggested that *Bacillus* strains present in UHT-milk were mesophilic or thermophilic and some of them were also psychrophilic, and contamination by them occurred mainly during filling.

From the results in Table 4 it is evident that aerobic plate count in samples stored in refrigerator was initially 2×10^3 /ml, then decrease gradually till reach 9×10^2 /ml by the end of storage time. While Enterococci, coliforms and *B.cereus* were not detectable after 3, 4 and 4 weeks respectively. Psychrotrophic bacteria decreased in population at first, then increased till reach 8×10^2 /ml by the end of the 11th week. ADAMS, *et al.* (1975) stated that a milk sample that had a high population of psychrotrophic bacteria could have a reduced shelf-life. Concerning thermophilic and thermoduric counts it is clear that they decreased in numbers by the end of the 11th week of storage at refrigerator temperature. KIM (1980) mentioned that recontamination with psychrotrophic and thermophilic bacteria was experienced during packaging. ITO (1985) found that keeping UHT-milk in refrigerator increases its keeping quality than storage at room temperature.

Overall results indicated that improvements in the UHT-milk processing and filling operations are required, and storage of UHT-milk at refrigerator temperature will increase its keeping quality than storage at room temperature.

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Table (1)
Counts of some microorganisms recovered from UHT-milk samples

Types	Positive samples		Count/ml		
	N/30	%	Min.	Max.	Average
Aerobic Plate count	25	83.3	50	4×10^3	44×10
Enterococci	5	16.6	20	1×10^2	50.0
Coliforms	7	23.3	20	1×10^2	62.2
B.cereus	8	26.6	40	1×10^3	13.8×10
Psychrotrophs	12	40.0	30	1×10^2	17×10
Thermophilic	6	20.0	30	1×10^2	73.3
Thermoduric	3	10.0	30	1×10^2	70.0

Table (2)
Frequency distribution of isolates recovered from UHT-milk samples

Isolates	No. of isolates	%
E.coli	3	18.75
Klebsiella sp.	1	6.25
Enterobacter sp.	2	12.50
Citrobacter sp.	1	6.25
Micrococcus sp.	3	18.75
Staph. epidermidis	2	12.50
Staph. aureus	-	-
Anaerobic-sporeformers	4	25.00

Table (3)
Effect of storage at room temperature on the quality of UHT-milk

Time/week Type	APC	Enterococci	Coliforms	B.cereus	Psychrotrophic	Thermophilic	Thermoturic
Zero	2x10 ²	2x10 ²	1x10 ²	2x10	3x10 ²	4x10	1x10 ²
1	2x10 ²	1x10 ²	2x10 ²	3x10	6x10 ²	4x10	1x10 ²
2	2x10 ²	1x10 ²	3x10 ²	5x10	5x10 ²	7x10	1x10 ²
3	3x10 ²	1x10 ²	6x10 ²	9x10	2x10 ²	1x10 ²	2x10 ²
4	2x10 ²	7x10	5x10 ²	1x10	2x10 ²	1x10 ²	7x10 ²
5	5x10 ²	2x10	3x10 ²	8x10	2x10 ²	3x10 ²	9x10 ²
6	7x10 ²		1x10 ²	5x10	1x10 ²	8x10 ²	1x10 ²
7	7x10 ²		8x10	3x10	1x10 ²	6x10 ²	1x10 ²
8	6x10 ²		3x10	3x10	8x10	9x10 ²	1x10 ²
9	8x10 ²			1x10	7x10	3x10 ²	8x10 ²
10	9x10 ²				5x10	2x10 ²	7x10 ²
11	9x10 ²				3x10	2x10 ²	5x10 ²

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Table (4)
Effect of storage at refrigerator on the quality of UHT-milk

Time/week Type	APC	Enterococci	Coliforms	B.cereus	Psychrotrophs	Thermophilic	Thermoturic
Zero	2×10^2	2×10^2	1×10^2	2×10	3×10^2	4×10	1×10^2
1	8×10^2	1×10^2	6×10	2×10	3×10^2	3×10	9×10
2	5×10^2	7×10	3×10	2×10	3×10^2	1×10	1×10^2
3	2×10^2	1×10	3×10	1×10	2×10^2	1×10	1×10^2
4	2×10^2		1×10	1×10	4×10^2	5×10	8×10
5	3×10^2				7×10^2	4×10	1×10^2
6	5×10^2				6×10^2	9×10	2×10^2
7	6×10^2				7×10^2	1×10^2	8×10
8	5×10^2				1×10^2	1×10^2	9×10
9	8×10^2				1×10^2	3×10^2	5×10
10	7×10^2				9×10^2	1×10^2	3×10
11	9×10^2				8×10^2	7×10	