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EVALUATION OF THE QUALITY AND HYGIENE PRACTICES IN SMALL DAIRY PROCESSING PLANTS IN GIZA.

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ABSTRACT

The aim of the present work was to evaluate the quality and hygiene practices in small dairy processing plants in Giza. Samples of raw milk and finished product (soft cheese) were collected randomly from small plants representing 7 areas. A total of 69 raw milk samples and 65 soft cheese (fresh and pickled) were collected and analysed for the presence of preservatives (formalin, bicarbonate and H_2O_2), and microbiological quality. Hydrogen peroxide was detected in all raw milk samples. Wide variations were found in the total bacterial, counts and coliform and yeasts & moulds were found in raw milk and cheese samples of the different areas. *Salmonella spp* were not found in all of the milk samples, but were detected in 4-7% samples from 2 areas, while *Staphylococcus areus* was detected in 15-38% of milk samples from 5 areas and 3-39% of samples from 6 areas. Also, the hygiene practices in the cheese plants were evaluated using a questionnaire formate and critical points were identified. The obtained data can be used to develop and apply the HACCP system in the small cheese plants.

Keywords: Raw milk, soft cheese, small scale plants, preservatives, microbiological quality, hazard analysis

INTRODUCTION

Dairy industry is considered one of the of the main food industries as it provides consumers with nutritious and health promoting and diversified products e.g fresh and fermented milks , cheese , cream, butter and ice cream. Form the nutritional point of view milk and milk products contain many constituents of importance for the growth and vitality of consumers .

Manufacture and consumption of raw milk and raw milk products still existed in some parts of the world including Egypt. However, many bacteria, including spoilage and pathogenic bacteria are constituting potential and hazard contaminants in raw milk and milk products. Generally ,microflora of milk arises from several sources including the natural flora mostly bacteria harbored teat canal or from contamination of milk handling and processing stages (Gruetzmacher and Bradley ,1999 ; Hayes et al .,2001).

Milk and dairy products have been frequently implicated in the main human diseases such as tuberculosis because milk has always been considered one of the most perishable food items (ICMSF, 1996) . Results of the WHO surveillance program (WHO, 1992) indicate that the number of causative agent of food –borne diseases continues to increase . Testing the end product has been for decades the most widely used tool to ensure food safety. However there is a growing awareness that the end product testing cannot by itself ensure the safety of food (Heeschen , 1996). Quality assurance programmers are now considered as effective ways to achieve disease reduction. One of these programmers is the Hazard Analysis Critical Control point (HACCP) from production to consumption of dairy products

(Roberts *et al.*, 1995). The concept of Critical Control Points is a preventive , structured , systematic and documented approach to ensure food safety (Buchanan,1990, Motarjemi , *et al.*,1996) . It is generally recognized that the production of cheese with desirable organoleptic characteristics and, in the mean time, to ensure its safety can be achieved through the implementation of HAACP system.

The present study aimed to evaluate the hygiene status in small cheese production plants in Giza and to identify the critical control points in the plants as a base for the implementation of HAACP system in these plants.

MATERIALS AND METHODS

Samples of raw buffalo milk designed as buffalo milk were collected from milk delivered to small cheese plants in 7 areas in Giza. The milk was delivered mainly in utensils, and few in small tanks. Also, samples of fresh and pickled soft cheese were obtained from the same plants. A total of 69 samples of raw buffalo milk and 65 samples of soft & pickled cheese samples were obtained. Samples were delivered to the laboratory in a cool box and tested within 24 hr.

The presence of formalin and bicarbonate in milk samples was tested according to Kotterer and Muench (1978) and detection of H_2O_2 was carried out according to Pien *et al* (1953).

For examining the microbiological quality of raw milk and raw soft cheese, for each sample, 25g were weighed out and transferred to a sterile blender with 225 ml of 0.1 % peptone and mixed thoroughly for 2 min to prepare the milk or cheese homogenate. These were then checked for the total bacterial count, coliform count and the presence of mold and yeasts, staphylococci and salmonella ,as well as the spore forming bacteria .The count of aerobic spore forming bacteria was carried out as described by Luck (1981)

Coliform bacteria were enumerated according to (APHA,1992) using Violet Red Bile Agar (VRBA) . The plates were incubated at 37ºc for 48 hr. Molds & Yeasts were determined according to the Standard Methods for the Examination of Dairy Products (APHA,1992) *Staphylococcus aureus and Salmonella spp* were detected according to methods recommended by the(ICMSF) International Commission on Microbiological Specification for Foods (1996)

RESULTS AND DISCUSSION

All the 69 samples of raw milk delivered to the cheese plants in the different areas were free of formalin and bicarbonate, and only one of these samples was found positive. However, H_2O_2 was detected in all of the samples analysed. This indicate that the addition of H_2O_2 is generally accepted practically by the raw milk supplier to suppress the development of

acidity and spoilage of milk before reaching the factory. According to(the Egyptian Standards of raw milk, 2005) no additive is allowed in raw milk.

Table (1) revealed that the highest total bacterial counts (TBC) of the examined raw milk samples was found in zone (F) with a mean value of 6.69 log cfu/ml , while the lowest TBC was found zone (C) with a mean value of 3.59 log cfu/ ml. Nearly similar counts were reported by Ayad *et al* (2009) in Alexandria, Sharaf *et al,* (1989) in Fayoum city, and Abd El-Ghani (1993) in Giza market.

Table (1): Total Bacteria Count (log cfu/ml) of raw milk received in the cheese plants

Zone	TBC			
	No. of sample	Minimum	Maximum	Mean
A	9	5.36	5.85	5.6
B	10	4.69	5.61	5.03
C	7	3.96	3.11	3.59
D	12	5.76	6.56	6.32
E	13	6.21	6.96	6.57
F	7	6.34	6.89	6.69
G	11	5.91	6.79	6.19

The results summarized in Table (2) showed that the coliform bacteria counts ranged widely between different zones, but generally high counts were found in most of the examined raw milk samples which exceeded the permitted level for the presence of coliforms in the Egyptian standard for raw milk 154-1-2005). The obtained coliform counts in the present study were higher than that reported by Ayad *et al,* (2009), which reflects the poor hygienic conditions of production and handling of raw milk.

Table (2):Coliform Count (log cfu/ml) in raw milk received in the cheese plants

Zone	Coliform Count			
	No. of sample	Minimum	Maximum	Mean
A	9	3.47	4.71	4.25
B	10	2.67	2.95	2.81
C	7	-	-	-
D	12	4.82	4.94	4.86
E	13	5.12	5.79	5.35
F	7	5.07	4.83	4.92
G	11	3.46	4.1	3.74

It is evident from Table (3) that the presence of high mould & yeast counts in raw milk from different zones with a maximum mean value of 4.72 log cfu/ml at zone (F) and minimum mean value of 2.12 at zone (C). The obtained results are additional marker of the poor hygienic quality of received raw milk, which could lead to technological problems during processing as reported by Skrinjar *et al.*, (1983) and Saubios *et al.*, (1991).

Table (3):Mould &Yeast Count (log cfu/ml) in raw milk sample received in the cheese plants

Zone	Mould &Yeast Count			
	No. of sample	Minimum	Maximum	Mean
A	9	2.38	3.66	2.84
B	10	2.17	2.86	2.54
C	7	2.07	2.14	2.12
D	12	3.68	4.85	4.31
E	13	4.54	4.82	4.65
F	7	4.54	4.96	4.72
G	11	2.34	3.78	3.28

From Table (4) *Staphylococcus spp* were detected in 0 to 38% of the examined raw milk samples in different zone being highest in zone F. High Staphylococci count was considered a good indication of udder infection (Deinhofer & Pernthaner ,1993) as one of the important causes of mastitis. *Staphylococcus* & *Micrococcus* strains were reported to be responsible for mastitis in about 95% of infected animals(Tzanetaki, 1993). Ayad *et al* (2009) reported an average *Staph.*spp of 5.5 x $10^3 ml^{-1}$in agreement with present results. All the samples tested were negative for Salmonella and spore forming bacteria in agreement with Abo-Elnaga *et al.* (1985), while Ayad *et al* (2009) detected sallmonella in 16% of raw milk samples.

Table (4): Detection of Pathogenic bacteria in raw milk sample received in the cheese plants

Zone	% Positive samples			
	No. of examined sample	Staphylococcus	Salmonella	Spore forming
A	9	17%	0%	0%
B	10	0%	0%	0%
C	7	0%	0%	0%
D	12	23%	0%	0%
E	13	33%	0%	0%
F	7	38%	0%	0%
G	11	15%	0%	0%

It could be seen from the foregoing results, that the microbiological quality of raw milk received in cheese plants varied between the different zones, but generally it had poor bacteriological quality which did not satisfy the standard specification of raw milk (2005).

Table 5 shows that soft cheese from the different zones had high total bacterial count with the highest average value of 5.38 cfu/g in zone F, while the lowest average was found in zone C ; namely 2.46 cfu/g. Pickled cheeses (Table 9) showed less TBC than the fresh cheeses from the same zone. Thus the highest (4.57 cfu/g) and lowest (2.23 cfu/g) averages were found in zone F and C respectively. During storage in pickle, the developed acidity and decrease in the lactose content can be considered as the main factors responsible for the lower TBC of pickled cheeses as compared to the

fresh ones. Higher TBC of soft cheese were reported in Alexandria (Ayad *et al,* 2009).

Table (5):Total bacterial Count (log cfu/ g) in fresh cheese sample received in the cheese plants

Zone	TBC			
	No. of sample	Minimum	Maximum	Mean
A	9	4.43	5.56	4.91
B	10	3.74	4.04	3.86
C	7	2.42	2.51	2.46
D	12	4.74	4.9 8	4.81
E	13	4.90	5.64	5.38
F	7	4.86	5.77	5.19
G	11	3.94	4.83	4.67

Both fresh and pickled soft cheeses contained generally high coliform count (Table 6 and 10 respectively). The present results suggest that most of the examined samples did not comply to the Egyptian Standard requirements of soft cheese (2005). The high coliform may result in the early blowing defect in cheese made from raw milk due to gas formation by Coliform (Hamed *et al.*, 1992 ; Elein *et al.*, 1999 ; Moatsou *et al.*, 2001). Aman *et al.* (1998) found that coliform count in Domiati cheese to range from log 2 to log 6/g, while Ayad *et al.,*(2009) reported the presence of coliform in 70% of Domiati cheese samples in Alexandria.

Table (6):Coliform Count (log cfu/ml) in fresh cheese samples received in the cheese plants

Zone	Coliform Count			
	No. of sample	Minimum	Maximum	Mean
A	9	2.66	3.44	2.98
B	10	2.24	2.97	1.59
C	7	1.01	1.23	1.11
D	12	2.85	3.97	3.53
E	13	3.91	4.61	4.05
F	7	3.72	4.78	3.88
G	11	3.17	3.87	3.58

Tables 7 and 11 show that the highest average of total mould & yeast counts were 4.27 and 4.28 log cfu/g in soft and pickled cheese, respectively, in zone F while the lowest averages were 1.29 and 2.38 respectively in zone C. It is obvious from these results that the mould and yeast count tended to increase during pickling. This suggests the occurrence of salt tolerant, mould and yeasts were , and can grow in the acid environment of the pickled cheese. The high counts of mould and yeasts indicated the poor hygienic conditions of cheese manufacture, in addition to the poor quality of milk. The total mold and yeast count were reported to be higher in cheese made from unpasteurized milk cheese as compared to

cheese from pasteurized milk (Aly and Galal , 2002). This might explain the present finding with respect to moulds and yeasts count in cheese.

Table (7): Mould &Yeast Count (log cfu/ml) in fresh cheese samples received in the cheese plants

Zone	Mould &Yeast Count			
	No. of sample	Minimum	Maximum	Mean
A	9	2.76	3.89	3.11
B	10	2.25	2.80	2.56
C	7	1.19	1.42	1.29
D	12	3.49	3.98	3.58
E	13	3.81	4.25	4.05
F	7	3.74	4.54	4.27
G	11	2.54	3.91	3.25

Tables 8 and 12 show that soft and pickled cheese were free of *Salmonella* and sporeforming bacteria in agreement with Ayad *et al,*(2009). However, *Stephylococcus spp* were found in cheese samples from all zones except zone C, which was free from this pathogen. *Staphylococcus spp* were found in 43 and 39% of fresh and pickled cheeses respectively. This indicates that these pathogens can withstand the high salt and acid condition of pickled cheese. Ayad *et al,* (2009) stated the presence of average *Staphylococcus spp* count in Domiati cheese samples in Alexandria of log 2.8/g. Nearly similar finding were reported by (Rashed *et al.*, 1992; Zottola and Smith ,1993) .

Table (8): Detection of Pathogenic bacteria in fresh cheese sample received in the cheese plants

Zone	% Positive samples			
	No. of examined sample	Staphylococcus	Salmonella	Spore form
A	9	24%	0%	0%
B	10	9%	0%	0%
C	7	0%	0%	0%
D	12	31%	0%	0%
E	13	39%	4%	0%
F	7	43%	7%	0%
G	11	10%	0%	0%

Table (9):Total Bacteria Count (log cfu/g) in pickled cheese sample received in the cheese plants

Zone	TBC			
	No. of examined sample	Minimum	Maximum	Mean
A	9	3.77	4.41	4.10
B	10	3.49	3.67	3.52
C	7	2.34	2.71	2.49
D	12	4.69	4.82	4.57
E	13	3.65	4.79	4.13
F	7	3.69	4.10	3.91
G	11	3.41	3.65	3.53

Table (10):Coliform Count (log cfu/ml) in pickled cheese sample received in the cheese plants

Zone	Coliform Count			
	No. of examined sample	Minimum	Maximum	Mean
A	9	2.95	3.41	3.08
B	10	1.81	2.57	
C	7	1.01	1.21	
D	12	2.38	3.88	3.29
E	13	2.72	2.86	2.78
F	7	2.38	2.72	2.49
G	11	2.34	2.78	2.54

Table (11):Mould& yeast Count (log cfu/ml) in pickled cheese sample received in the cheese plants

Zone	Mould& yeast Count			
	No. of sample	Minimum	Maximum	Mean
A	9	2.47	3.94	3.07
B	10	2.53	2.95	2.74
C	7	2.07	2.78	2.38
D	12	3.64	3.94	3.53
E	13	3.67	3.98	3.85
F	7	3.92	4.72	4.08
G	11	2.78	3.67	3.31

Table (12): Detection of Pathogenic bacteria in pickled cheese sample received in the cheese plants

Zone	% Positive samples			
	No. of examined sample	Staphylococcus	Salmonella	Spore form
A	9	19%	0%	0%
B	10	6%	0%	0%
C	7	0%	0%	0%
D	12	24%	0%	0%
E	13	27%	2%	0%
F	7	39%	6%	0%
G	11	5%	0%	0%

The hygienic conditions of the selected cheese plants in the study were assessed using a questionnaire based on the HACCP system. Generally, all the plants in this study were not applying Good Manufacture Practice (GMP) ,which explains the presence of many critical control points as evident from the analysis of the obtained results and presented in Tables (13-18).

Raw milk was received from different sources (Giza , Fayoum) in utensils poorly designed tanks. Transportation of milk usually took more than 1-2 hours at temperature sometimes exceeding 10ºC . In addition , utensils and tanks were nor properly cleaned after the reception of milk.. The

transportation and handling of tanks and utensils were considered as a major critical point for GMP in the cheese plants.

Table(13): Prevailed hazards from the plant location, and surroundings.

Item	Present %	Not present %
Disposal of Lab Wastes (refuse)	26.7	73.3
Garbage	58.8	29.4
Adequate drainage and sewage disposal	76.5	23.5
Protection against scarp metal, pests , birds and animals	97.1	2.9
Location ,environmental polluted areas and industry contamination	12.7	87.3

Table (14): Prevailed hazards from the plant design .

Item	Applied %	Not Applied %
Good storage of packaging materials	88.2	11.8
Cleaning of walls and ceiling	35.3	64.7
Air purification	5.9	94.1
Resistant glass windows	11.8	88.2
Good storage of raw materials	92.3	7.7
Good lighting	85.3	14.7
Suitable distance bet. Pips and walls	29.4	70.6
Suitable paths	44.1	55.9
Suitable floor drainage	73.5	26.5
Soft walls	44.1	55.9
Available hygiene records	32.4	67.6
Pest control records		73.5
Special place for eating and smoking	55.9	44.1

Source: Data of the questionnaire

Table (15): Prevailed hazards from the operating conditions in the plant

Item	Applied%	Not Applied %
Plan for equipment maintenance	14.7	85.3
Cooling system and instruments of temperature	5.9	94.1
Program for water analyses	2.9	97.1

Table (16): Hazards from personnel in the cheese plants

Item	Applied%	Not Applied %
Hand washing before and after bath room	64.7	35.3
Cleaning of the uniform	82.4	17.6
Wearing of gloves and head caps	61.8	32.2
Wearing of glories	11.8	88.2
Following the infection and wounds of laborers	44.1	55.9
Sufficient and adequate lockers (one per person)	92.6	7.4

Table (17): Application of quality control measurements

Item	Applied%	Not Applied %
Quality control of raw materials	20.6	79.4
Presence of quality control plan	23.5	76.5
System follow up	5.9	94.1
Quality control of end product	8.8	91.2

Source: Data of the questionnaire

Table(18):Awareness of the GMP in the cheese plants.

Item	Applied%	Not Applied %
Good storage of raw and intermediate materials	47.1	52.9
Records for amount and kind of wastes generated inside the lab	11.8	88.2
Following air disseminated out of the plant	8.8	91.2
Getting rid of wastes near lines of production	82.4	17.6
Aware of new legislation about environment protection	2.9	97.1
Electrical UV-light insect control units suspended in food handling areas in any stage of production, must be of safety type and protected to prevent contamination of food in case of breakage.	13.4	86.6
Equipment must be positioned at least 50 cm. away from the wall and off the floor	26.7	73.3
Easy to clean surface, which does not pose a foreign hazard e.g. Walls should be finished with a continuous, bonded surface and protected from damage. Corners, joints between cladding sheets or ceramic tiles must be sealed with a suitable impervious sealing	7.2	92.8

Source: Data of the questionnaire

The location of the cheese plants can be considered a critical point as 87.3% of the plants were located in environmentally polluted areas which pose the hazards of industrial contamination. Also, several critical points were apparent from the plant design, the most prevalent ones were the absence of air filtration (94.1%) absence of resistant glass windows (88.2%), machinery layout (70.6%) and records keeping (67.6 and 73.5%). The absence of protective maintenance of equipment (85.3%) and controlling the cooling system (94.1%) and water analysis (97.1%) characterize most of the studied plants. In nearly all plants (88.2%) wearing of glories was not practiced and inspection of workers for visible injuries and infection was not practiced in 55.9% of the plants. Generally the quality control of raw material and processing steps and end products were not practiced in 79.4 and 76.5% and 91.2% respectively of the plants. High percentages of the plant personnel were not aware with several points related to GMP and legislation (Table 18) which are necessary information for workers in the field.

It is apparent from the obtained results that several critical points were found in the small cheese plants in Giza, which can be used to develop an HACCP system which a should be adopted in order to improve the quality and hygiene of produced cheeses.

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تقييم لجودةالألبان والممارسات الصحية في مصانع الألبان الصغيرة في محافظة الجيزة.

علية على الجندى ، عبير فؤاد زيان و أمانى رفعت البيلى
معهد بحوث تكنولوجيا الأغذية

يهدف البحث لتقييم جودة الألبان الخام و الجبن الطرى (الطازج و الخزين) والممارسات الصحية في مصانع الألبان الصغيرة من خلال 7 مناطق في محافظة الجيزة. تم تجميع عينات من الحليب الخام والمنتج النهائي (الجبن الطري) بطريقة عشوائيا من المصانع الصغيرة (معامل الألبان). وقد تم جمع 69 عينة من الحليب الخام و 65 الجبن الطري (الطازجة والمخزنة) وتحليلها للكشف عن وجود المواد الحافظة (الفورمالين ، بيكربونات , H_2O_2) والجودة الميكروبيولوجية. تم الكشف عن وجود فوق أكسيد الهيدروجين في جميع عينات الحليب الخام. تم العثور على اختلافات واسعة في العدد الكلى للبكتيريا ، وجدت ميكروبوبات القولون والخمائر والفطريات في عينات الحليب الخام والجبن من مناطق مختلفة. لم يتم العثور على ميكروب السالمونيلا في جميع عينات الحليب ، ولكن تم الكشف عن 4-7 ٪ في عينات من مناطق 2 بينما تم الكشف عن المكورات العنقودية areus في 15-38 ٪ من عينات الحليب من 5 مناطق و3-39 ٪ من العينات من 6 مناطق. وقد تم اجراء تقييم للممارسات الصحية وتطبيق نظام تحليل المخاطر و النقاط الحرجة في مصانع الجبن التى أجرى عليها الدراسة وذلك باستخدام أستمارات الاستبيان. ويمكن استخدام البيانات التي تم الحصول عليها لوضع الأشتراطات الصحية وتطبيق نظام تحليل المخاطر في معامل الألبان أو المصانع الصغيرة .

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