Assiut Vet. Med. J. Vol. 39 No 77, April 1998

Dept. of Food Hygiene,
Fac. of Vet. Med., Assiut Univ.,
Head of Dept. Prof. Dr. M.K. Moustafa.

MICROBIOLOGICAL QUALITY OF MOZZARELLA CHEESE

(With 6 Tables)

By

ENAS, EL-PRINCE and ***M.A. ISMAIL****

* Dept. of Botany, Fac. of Science, Assiut Univ.

التقييم الميكروبيولوجى للجبن الموزاريللا

إيناس البرنس ، ماضى إسماعيل

تعتبر الجبن الموزاريللا نوعاً جديداً فى الأسواق المصرية وتتميز عن مثيلاتها من أنواع الجبن الأخرى بخاصيتها المطاطية المرغوبة لاضفاء الطعم والشكل المطلوب فى عمل البيتزا ، لذلك أجريت هذه الدراسة لمعرفة مدى تلوثها بالعديد من الميكروبات ، ولهذا الغرض تم جمع ٤٠ عينة عشوائية من السوبر ماركت بمدينة أسيوط . وقد أسفرت النتائج على أن متوسط العدد الكلى لكل من البكتريا الهوائية ، والمحبة للبرودة،والقولونية ، والباسيللس سيريوس والمكور العنقودى الذهبى كان ٩ × ١٠^{٦} ، ٩×١٠^{٤} ، ٢ × ١٠^{٢} ، ٢ × ١٠ و ١ × ١٠^{٢} لكل جرام من الجبن على التوالى . أما البكتريا السبحية القولونية فلم توجد فى العينات المفحوصة ، بينما عزلت البكتريا اللاهوائية بنسبة ٦٢,٥٪ والميكروبات المعوية العصوية بنسبة ٦٠٪ ولم نتمكن من عزل الليستريا مونوسيتو جينس . ومن الفحص الميكولوجى أوضحت النتائج أن ٢٠ عينة (٥٠٪) ، ٢٣ عينة (٥٧,٥٪) من العينات تحتوى على mesophilic molds على كل من مستنبتى malt extract and dicloran agar على التوالى وذلك بمتوسط قدره ٥ × ١٠ ، ٥ × ١٠^{٢} بينما كان متوسط عدد psychrotrophic molds على dicloran agar ٣ × ١٠^{٢}/جم . وبتصنيف الفطريات المعزولة أمكن التوصل الى أن أكثر الفطريات وجوداً كانت Aspergillus, Penicillium, Cladosporium and Alternaria وذلك بالنسبة للفطريات التى تنمو فى درجة حرارة ٢٥°م أما الفطريات المحبة للبرودة كانت ممثلة فى Cladosporium, Aspergillus and Penicillium . وقد كان مستنبت dicloran malt extract أفضل من مستنبت فى عد وعزل الفطريات الموجودة . هذا وقد تم مناقشة الاشتراطات الصحية التى يجب أن تتبع لمنع تلوث الجبن الموزاريللا بالميكروبات المختلفة لما لها من خطورة على الصحة العامة وفساد المنتج، وكذلك الاقتراحات المطلوب توافرها لتحسين جودة المنتج.

SUMMARY

Fourty random samples of locally manufactured Mozzarella cheese were purchased from different supermarkets in Assiut Province and examined microbiologically to evaluate its quality. The obtained results revealed that the average counts of aerobic plate, psychrotrophes, coliforms, B. cereus and Staph. aureus were 9×10^6, 9×10^4, 2×10^2, 2×10 and 1×10^2 cfu/g, respectively. While, enterococci failed detection. Also, the incidence percentages of anaerobes, Enterobacteriaceae and Listeria monocytogenes were 62.5, 60.0 and 0.0%, respectively. The mycological examination of Mozzarella cheese showed that the average counts of mesophiles on malt extract agar and dicloran agar were 5×10 and 5×10^2 cfu/g, respectively, as well as, the psychrotrophic count on dicloran agar ranged from 1×10 to 1×10^3 cfu/g in a percentage of 17.5%. Moreover, various species of mesophilic molds were recovered from 20 examined samples on malt extract agar. Aspergillus was the most prevalent genus (55.0%), Penicillium was ranked secondly (32.5%), while Cladosporium spp., Emericella nidulans and Rhizopus stolonifer were infrequently encountered (2.5 - 5.0%). Furthermore, 184 species belonging to 16 genera of mesophilic molds were isolated on dicloran agar. Percentage of 25.57% of isolates were for Penicillium, 24.99% for Aspergillus, 20.11% for Cladosporium and 11.42% for Alternaria, while the other isolates existed in rare frequency of occurrence (0.54 - 5.44%). In addition, Cladosporium, Aspergillus and Penicillium species were found to be common psychrotrophic contaminants of examined cheese samples. Suggestive measures for improving the microbiological quality of Mozzarella cheese are discussed.

Keywords: *Microbiological quality, Mozzarella cheese.*

INTRODUCTION

Cheese is one of the most popular milk products all over the world. Recently, a new commodity of soft cheese has been introduced to the Egyptian supermarkets known as Mozzarella cheese. It is a soft, elastic perishable Italian cheese, having a brief commercial shelflife of 20-30 days according to the extent and degree of refrigerated storage.

Mozzarella cheese differs from other types in that, it is usually consumed in the melted state as in pizza (Kindstedt *et al.*, 1989).

Mozzarella cheese like any dairy product is subjected to the risk of microbial contamination by various microorganisms as psychrotrophes like Pseudomonas, Achromobacter, Acinetobacter, Citrobacter, Enterobacter, Escherichia and Serratia from its production until consumption (Rondinini and Garzaroli, 1990 and El-Shinawy *et al.*, 1994). Also, the product has been infrequently implicated as a vector in an outbreak of salmonellosis caused by Sal. javiana (Eckner *et al.*, 1990). While, Massa *et al.* (1992) found that Klebsiella pneumoniae was the most frequently isolated species from spoiled Mozzarella cheese. Moreover, yeast and mold could be isolated with varying percentages from cheeses which lead to musty off-flavors (El-Shinawy and Ragheb, 1995). The presence of these microorganisms affects the health of the consumers as they have been implicated as a causal agents of food borne infection or food poisoning. Furthermore, may be responsible for deterioration of Mozzarella cheese which dramatically affects its suitability as a pizza ingredient and rendering it unmarketable resulting in economic losses (Pilcher and Kindstedt, 1991 and Massa *et al.*, 1992). Additionally, manufacturing operation as well as the condition of raw ingredients may influence the keeping quality of the product.

According to the scanty information about the microbiological status of Mozzarella cheese produced in Egypt, the present investigation was undertaken to ascertain the level of microbial contamination.

MATERIAL and METHODS

I - Collection of samples:

Fourty random samples of locally manufactured Mozzarella cheese were purchased from different supermarkets in Assiut province. These samples were transferred directly to the laboratory without delay in their plastic bags to be examined microbiologically to evaluate their quality.

II - Preparation of samples:

Eleven grams of each sample were diluted in 99 ml of 2% sodium citrate solution in sterile plastic bags, then blended in Stomacher (Lab. blender Model 400) for 2 minutes. Decimal dilutions were then prepared from every sample for bacteriological and mycological analysis according to A.P.H.A. (1985).

III- Bacteriological examination:

The prepared samples were subjected to the following examination:

1 - Aerobic plate count (APC): using Standard plate agar (A.P.H.A., 1985).
2 - Psychrotrophic count: using Standard plate agar (A.P.H.A., 1985).
3 - Coliforms count: using violet red bile agar (A.P.H.A., 1985).
4 - Bacillus cereus count: using direct plating technique on Mannitol egg yolk polymyxin agar (MYP) (Lancette and Harmon, 1980).
5 - Staphylococcus aureus count: using Baird-Parker agar (Baird-Parker, 1962).
6 - Enterococci count: using Pfizer selective agar (PSA) (Geldreich, 1975).
7 - Anaerobes detection: by Stormy fermentation test (Schönberg, 1956).
8 - Isolation of Enterobacteriaceae: performed according to Speck (1985).
9 - Isolation of Listeria species: The warm enrichment procedures (McClain and Lee, 1988) was carried out. Subculture the broth onto McBride listeria agar (Biolife Code, 1602).

IV - Mycological examination:

The dilution-plate method was used for detection of viable mold propagules in examined Mozzarella cheese samples. Two types of media were used. Malt extract agar (Harrigan and McCance, 1976) was used for enumeration and identification of mesophilic molds at 25°C and dicloran-rose bengal medium (King *et al.*, 1979) was used for enumeration and identification of mesophiles at 25°C as well as psychrotrophes at 7°C. Triplicate plates for each medium were incubated for 7 - 10 days. Then molds were counted and identified according to Raper and Fennell (1965), Ellis (1976), Booth (1977), Pitt (1979), Samson and van Reeneh-Hoekstra (1988) and Kozakiewicz (1989).

RESULTS

The obtained results were recorded in Tables 1 - 6.

Table 1: Statistical analytical results of different microbial counts/g of examined Mozzarella cheese samples.

Types	Positive samples		**cfu / g		
	No. /40	%	Min.	Max.	Average
* APC	40	100.0%	1×10^4	5×10^7	9×10^6
Psychrotrophic count	22	55.0%	1×10^2	7×10^5	9×10^4
Coliforms count	13	32.5%	1 x 10	1×10^3	2×10^2
Bacillus cereus count	13	32.5%	1 x 10	5 x 10	2 x 10
Staphylococcus aureus count	12	30.0%	2 x 10	4×10^2	1×10^2
Enterococci count	-	-	-	-	-

* APC : Aerobic plate count.
** cfu : Colony forming unit.

Table 2: Incidence of some microorganisms recovered from examined Mozzarella cheese samples.

Isolated microorganisms	Positive samples	
	No. / 40	%
- Anaerobes	25	62.5%
- Enterobacteriaceae		
Lactose fermenters	13	32.5%
Non-lactose fermenters	11	27.5%
- Listeria species	-	-

Table 3: Statistical analytical results of total molds recovered from examined Mozzarella cheese samples.

Molds / Media	Positive samples		cfu / g		
	No./ 40	%	Min.	Max.	Average
Mesophiles on malt extract agar	20	50.0%	1 x 10	3×10^2	5 x 10
Mesophiles on dicloran agar	23	57.5%	1×10^2	3×10^3	5×10^2
Psychrophiles on dicloran agar	7	17.5%	1 x 10	1×10^3	3×10^2

Table 4: Frequency distribution of mesophilic molds recovered from examined Mozzarella cheese samples on malt extract agar at 25°C.

Mold species		Isolated molds	
		No. of cases	%
Aspergillus flavus	Link	6	15.0
A. fumigatus	Fres.	1	2.5
A. niger	van Tieghem	15	37.5
Cladosporium cladosporioides	(Fres.) de Vries	1	2.5
C. sphaerospermum	Penzig	2	5.0
Emericella nidulans	(Eidam) Vuillemin	1	2.5
Penicillium aurantiogriseum	Dierckx	3	7.5
P. chrysogenum	Thom	3	7.5
P. citrinum	Thom	2	5.0
P. restrictum		3	7.5
P. viridicatum	Westling	2	5.0
Rhizopus stolonifer	(Ehrenb.) Lind.	1	2.5
Total		**40**	**100.00%**

Table 5: Frequency distribution of mesophilic molds recovered from examined Mozzarella cheese samples on dicloran agar at 25°C.

Mold species	Isolated molds	
	No. of cases	%
Acremonium strictum W. Gams	4	2.17
Alternaria alternata (Fres.) Keissler	7	3.80
A. chlamydospora Mouchacca	9	4.89
A. egyptiacus	2	1.09
A. tenuissima (Kunze : Pers) Wiltshire	3	1.64
Aspergillus flavus Link	13	7.07
A. glaucus	1	0.54
A. niger van Tieghem	26	14.13
A. Parasiticus Speare	1	0.54
A. Sydowii (Bainier & Sartory) Thom & Church.	4	2.17
A. terreus Thom	1	0.54
Cladosporium cladosporioides (Fres.) de Vries	9	4.89
C. sphaerospermum Penzig	28	15.22
Emericella nidulans (Eidam) Vuillemin	1	0.54
E. quadrilineata (Thom & Raper): Benjamin	3	1.64
Fusarium moniliforme Sheldon	4	2.17
Geotrichum candidum Link ex leman	10	5.44
Mucor racemosum Fres.	1	0.54
Paecilomyces variotii Bainier	2	1.09
Penicillium aurantiogriseum Dierckx	5	2.72
P. chrysogenum Thom	18	9.79
P. duclauxii Delacroix	3	1.64
P. funiculosum Thom	2	1.09
P. roquefortii Thom	19	10.33
Rhizopus stolonifer (Ehrenb.) Lind	1	0.54
Scopulariopsis brumptii	1	0.54
S. candida (Gueguen) Vuill	1	0.54
Stachybotrys chartarum (Ehrenb.: Lind) Hughes	2	1.09
Stemphylium spp.	1	0.54
Torula herborum	1	0.54
Trichosporon cutaneum	1	0.54
Total	**184**	**100.00%**

Table 6: Frequency distribution of psychrotrophic molds recovered from examined Mozzarella cheese samples on dicloran agar at 7°C.

Mold species		Isolated molds	
		No. of cases	%
Acremonium strictum	W. Gams	8	4.88
Alternaria alternata	(Fres.) Keissler	3	1.84
A. chlamydospora	Mouchacca	5	3.05
A. egyptiacus		1	0.60
Aspergillus glaucus		1	0.60
A. flavus	Link	7	4.27
A. niger	van Tieghem	16	9.76
A. sydowii	Thom & Church (Bainier & Sartory)	7	4.27
A. versicolor	(Vuill.) Tiraboschi	1	0.60
Botryotrichum piluliferum	Saccardo & Marchal	3	1.84
Chaetomium globosum		1	0.60
Cladosporium cladosporioides	(Fres.) de Vries	13	7.93
C. sphaerospermum	Penzig	21	12.80
Emericella nidulans	(Eidam) Vuillemin	1	0.60
E. variecolor	Berk. & Br.	1	0.60
Fusarium moniliforme	Sheldon	2	1.22
Geotrichum candidum	Link ex leman	9	5.49
Hypomyces chrysosporium		2	1.22
Paecilomyces variotii	Bainier	3	1.84
Penicillium chrysogenum	Thom	5	3.05
P. citrinum	Thom	1	0.60
P. duclauxii	Delacroix	3	1.84
P. roquefortii	Thom	18	10.98
P. spinulosum	Thom	2	1.22
Rhizopus stolonifer	(Ehrenb.) Lind.	3	1.84
Scolecobasidium spp.		2	1.22
Scopulariopsis candida	(Gueguen) Vuill.	2	1.22
Trichosporon cutaneum		2	1.22
Torula spp.		1	0.60
Yeast spp.		20	12.20
Total		**164**	**100.00**

DISCUSSION

The results recorded in Table 1 show the min., max. and average values of aerobic plate, psychrotrophic, coliforms, B. cereus, Staph. aureus and Enterococci counts. The total aerobic plate count/g ranged from 1×10^4 to 5×10^7 with an average value of 9×10^6 cfu/g. The obtained results substantiate what were stated by Cortesi et al.. (1997) in which APC was 2.3×10^5 cfu/g of Mozzarella cheese after 7 days storage at 6°C in brine solution. Psychrotrophes were detected in 55% of the examined samples with an average count of 9×10^4 cfu/g. Somewhat, higher count was found by Rondinini and Garzaroli (1990), Massa et al. (1992), El-Shinawy et al. (1994) and Nazem and El-Hawary (1997). The contamination of Mozzarella cheese with psychrotrophes induces undesirable changes which rendering the product unmarketable resulting in a serious economic losses during extended periods of cold storage (Rondinini and Garzaroli, 1990 and Massa et al., 1992). Nowadays, psychrotrophic food borne organisms have new concerns in the safety of refrigerated foods (Cousin *et al.*, 1992). Coliforms and B. cereus have been estimated but in lower counts than that of Idris and Ibrahim (1995), Cortesi et al. (1997) and Silva *et al.* (1997). The presence of coliforms may be implicated in food borne illness and gives an indication about the unhygienic measures during manufacturing, handling and storage of the product. Moreover, B. cereus was associated with food poisoning and has the ability to cause various infections which documented by Gilbert et al. (1974) and Turnbull et al. (1979). As regarding Staph. aureus count, it was noticed that these results were lower than that reported by Idris and Ibrahim (1995), Nazem and El-Hawary (1997) and Silva et al. (1997), on the other hand, Staph. aureus never detected by Cortesi et al. (1997) in Mozzarella cheese after 7 days storage at 6°C in brine. Staph. aureus is still among the microorganisms commonly involved in dairy products food poisoning. In the absence of proper cooling, the growth of Staph. aureus in cheese produces thermostable enterotoxins resulting in serious manifestations (Hekneby and Gondrosen, 1981). Lastly, in Table 1, Enterococci failed detection in the examined samples, however, Cortesi et al. (1997) recorded an average count of 1.8×10^4/g recovered from Mozzarella cheese samples. The presence

of enterococci reflects the unhygienic measures during handling and processing (Varnam and Evans, 1991).

It is obvious from the results presented in Table 2, that the incidence percentages of Anaerobes, Enterobacteriaceae and Listeria species were 62.5, 60.0 and 0%, respectively. Cortesi et al. (1997) stated that sulfite-reducing Clostridia were detected in Mozzarella cheese after 7 days storage at 6°C. The findings for Enterobacteriaceae organisms go parallel with the results recorded by Nazem and El-Hawary (1997). Also, Cortesi et al. (1997) and Silva et al. (1997) could isolate Salmonellae from the examined Mozzarella cheese samples. The prevalence of Enterobacteriaceae in milk and milk products is properly taken as an index of faecal pollution (Thatcher and Clark, 1978), also, it has been implicated in human infections and food poisoning outbreaks. In addition to the previous results, Listeria species could not be isolated from the examined samples. Similar findings were achieved by Silva et al. (1997).

Table 3 explains that the average counts of mesophilic molds at 25°C were 5 x 10 and 5 x 10^2 cfu/g on malt extract agar and dicloran agar, respectively, as well as the average value of psychrotrophic molds at 7°C on dicloran agar was 3 x 10^2 cfu/g of the examined Mozzarella cheese. These results revealed that, dicloran rose bengal medium allows the isolation of the highest number of different species and genera of molds. The high effectiveness of dicloran rose bengal agar is confirmed by King et al. (1979), Saad and Hemida (1995) and Weidenbörner *et al.* (1995) who recommended this medium for isolation of molds from food. In addition, higher mold counts were recovered from different products as processed cheese, pizza and cream cheese-like products by El-Shinawy and Ragheb (1994), Idris and Ibrahim (1995) and Nazem and El-Hawary (1997), respectively. The high counts of mycoflora in cheese may be contributed to the unhygienic measures during handling by attendants or failure to sterilize processing equipments (Aran and Eke, 1987).

Inspection of results in Table 4, declared that various species of mesophilic molds were recovered from 20 examined samples of Mozzarella cheese (50%) on malt extract agar. Aspergillus was the most prevalent genus encountered in the examined samples comprising 55.0% of total molds.

The genus is represented mainly by A. niger (37.5%) and A. flavus (15.0%), while, A. fumigatus was recorded in rare frequency of occurrence (2.5%). Similar results were reported by Saad and Hemida (1995), while, El-Shinawy and Ragheb (1994) demonstrated higher incidence of Aspergilli. Penicillium was represented by 5 species, P. aurantiogriseum, P. chrysogenum, P. citrinum, P. restrictum and P. viridicatum and ranked second in the percentage of isolation constituting 32.5% of total molds. Penicillium species were the most prevalent in Egyptian (Abdel-Rahman and El-Bassiony, 1984 and Ibrahim, 1987), Swiss (Bullerman, 1976 and 1980), Australian (King et al., 1981), Greece (Zerfiridis, 1985), Turkish (Aran and Eke, 1987) and Poland cheeses (Weidenbörner et al., 1995). Moreover, Cladosporium cladosporioides, C. sphaerospermum, Emericella nidulans and Rhizopus stolonifer were infrequently encountered (2.5 - 5.0%).

It is apparent from the results in Table 5 that, 184 species belonging to 16 genera were presented in samples of Mozzarella cheese. Percentage of 25.57% of the isolates were for Penicillium, 24.99% for Aspergillus, 20.11% for Cladosporium and 11.42% for Alternaria. While the other isolates existed in rare frequency of occurrence (0.54 - 5.44%). Similar findings were estimated by El-Sayed (1981). It was reported that, 82.2% of molds found on refrigerated chedder cheese were belonged to Penicillium spp., 6.6% to Aspergillus spp. and 1.1% to Fusarium spp. Furthermore, some species of these genera are mycotoxin producing molds which posses potential hazards to food safety and human health (Van Walbeek, 1973 and Bullerman and Olivigni, 1974).

Cladosporium, Aspergillus and Penicillium species were found to be common psychrotrophic contaminants of Mozzarella samples in percentages of 20.73, 19.50 and 17.69%, respectively (Table 6). Moreover, yeast species comprising 12.20% and both Alternaria spp. and Geotrichum candidum were encountered in 5.49% of total isolates. The incidence and species of molds isolated from cheese samples were reported in the same trends by several investigators as Bullerman (1981), Fadd et al. (1989), Kivance (1990). In fact, the importance of mold lies in that cheese may be contaminated by some toxigenic fungal strains either directly or indirectly during ripening, curing as well as during refrigeratd storage. Therefore, the hazard for

natural occurrence of mycotoxins in Mozzarella cheese is real (Tricksess and Page, 1986).

From the above achieved results, it is noted that Mozzarella cheese is liable to contamination by some pathogenic microorganisms. Moreover, many species of molds encountered are known to be mycotoxin - producers which threaten the consumers health.

Therefore, to safe guard consumers from being infected and to obtain a finished product of good keeping quality, strict hygienic measures should be adopted during manufacturing and storage. This requires the use of fresh raw ingredients, sterilized utensils and personal hygiene of the individuals. Also, it is very important to keep Mozzarella cheese under deep freezing (-18°C) at all times.

REFERENCES

Abdel-Rahman, H.A. and El-Bassiony, T. (1984): Psychrotrophic molds in some food products. First Sci. Congress, Fac. Vet. Med., Assiut Univ., 17-19 Nov.

A.P.H.A. (1985): Standard methods for the examination of dairy products. 15th ed. American Public Health Association, Washington, D.C., USA.

Aran, N. and Eke, D. (1987): Mold mycoflora of Kasar cheese at the stage of consumption. Food Microbiol., 4: 101-104.

Baird-Parker, A.C. (1962): An improved diagnostic and selective medium for isolating coagulase - positive Staphylococci. J. Appl. Bact., 25 (1): 12-19.

Booth, C. (1977): The genus Fusarium: Laboratory guide to identification of the major species. Common Wealth Mycological Institute, Kew, Surrey, England, 1-58.

Bullerman, L.B. (1976): Examination of Swiss cheese for incidence of mycotoxin producing molds. J. Food Sci., 41: 24.

Bullerman, L.B. (1980): Incidence of mycotoxic molds in domestic and imported cheeses. J. Food Safety, 2 (1): 47-58.

Bullerman, L.B. (1981): Public health significance of mold and mycotoxins in fermented dairy products. J. Dairy Sci., 64: 2439.

Bullerman, L.B. and Olivigni, F.J. (1974): Mycotoxins producing potential of molds isolated from cheese. J. Food Sci., 39 (6): 1166.

Cortesi, M.L.; Citro, A.; Sarli, T.; Santoro, A.; Murru, N.; Pepe, T. and Dell'orfano, G. (1997): Behaviour of Salmonella senftenberg during manufacture of buffalo Mozzarella cheese: Preliminary researchs. 5th World Buffalo Congress, Royal Palace, Caserta, Italy, October 13-16: 266-271.

Cousin, M.A.; Jay, J.M. and Vasavada, P.C. (1992): Psychrotrophic microorganisms. In: Compendium of methods for the microbiological examination of food. 3rd ed., American Public Health Association, Washington, D.C. USA.

Eckner, K.F.; Roberts, R.F.; Strantz, A.A. and Zottola, E.A. (1990): Characterization and behavior of Salmonella javiana during manufacture of Mozzarella - type cheese. J. Food Prot., 53 (6): 461-464.

Ellis, M.B. (1976): More Dematiaceous Hyphomycetes. Common Wealth Mycological Institute, Kew, Surrey, England, 1-507.

El-Sayed, S. (1981): Studies on the sanitary condition of processed cheese in Egypt. Ph.D. Thesis, Fac. Vet. Med., Cairo Unvi.

El-Shinawy, S.H. and Ragheb, R.R. (1995): Fungal contamination of processed cheese. J. Egypt. Vet. Med. Assoc., 55 (1, 2): 187-192.

El-Shinawy, S.H.; Hafiz, N.M. and Hassan, S.A. (1994): Prevalence of psychrotrophic bacteria in Mozzarella cheese. Vet. Med. J., Giza, 42 (1): 111-112.

Fadd, M.E.; Plasm, F.; Coenlino, S. and Caglans, R. (1989): Evaluation of microbial contamination of dairy products. Lgiene Moderna, 92 (3): 408-417. (Dairy Sci. Abst. 1991, 53 (8): 727).

Geldreich, E.E. (1975): Handbook for evaluating water bacteriological laboratories. 2nd ed., U.S. environmental protection Agency Cinicinata, OHIO 45268.

Gilbert, R.G.; Stringer, M.F. and Peace, T.C. (1974): The survival and growth of B. cereus in boiled and fried rice in relation to outbreaks of food poisoning. J. Hyg. Cam., 73: 433.

Harrigan, W.F. and McCance, M.E. (1976): Laboratory methods in food and dairy microbiology. Academic Press, London, New York and San Francisco.

Hekneby, A. and Gondrosen, B. (1981): Food poisoning due to Staphylococcus aureus after consumption of "Fjellost" cheese. Norsk. Vet., 93 (12): B43 (Dairy Sci. Abst. 1982, 44: 524).

Ibrahim, E.K. (1987): Yeasts and molds in locally manufactured cheese in Assiut. M.V.Sc. Thesis, Fac. Vet. Med., Assiut Univ.

Idris, A.M. and Ibrahim, M.H. (1995): Microbial profile of ready-to-eat pizza. Alex. J. Vet. Sci., 11 (3): 355-359.

Kindstedt, P.S.; Rippe, J.K. and Duthie, C.M. (1989): Measurement of Mozzarella cheese melting properties by helical viscometry. J. Dairy Sci., 72 (12): 3117-3122.

King, A.D.; Hocking, A.D. and Pitt, J.I. (1979): Dichloran-rose bengal medium for the enumeration and isolation of molds from foods. Appl. & Environ. Microbiol., 37: 959-964.

King, A.D.; Hocking, A.D. and Pitt, J.I. (1981): The mycoflora of some Australian foods. Food Technol. Australia, 33: 55-60.

Kivance, M. (1990): Mould growth and presence of aflatoxin in some Turkish cheese. J. Food Safety. 10: 289-294.

Kozakiewicz, Z. (1989): Aspergillus species on stored products. C.A.B. International Mycological Institute, Mycological Paper, No. 161, pp. 188.

Lancette, G.A. and Harmon, M. (1980): Enumeration and confirmation of Bacillus cereus in foods. J. Assoc. Off. Anal. Chem., 63: 581-586.

Massa, S.; Gardini, F.; Sinigaglia, M. and Guerzoni, M.E. (1992): Klebsiella pneumoniae as a spoilage organism in Mozzarella cheese. J. Dairy Sci., 75 (6): 1411-1414.

McClain, D. and Lee, W.H. (1988): Development of USDA-FSIS method for isolation of Listeria monocytogenes from raw meat and poultry. J. Assoc. Off. Anal. Chem. 71: 660-664.

Nazem, A.M. and El-Hawary, I.I. (1997): Microbial monitoring of locally manufactured cream cheese-like product. Alex. J. Vet. Sci., 13 (2): 149-158.

Pilcher, S.W. and Kindstedt, P.S. (1991): Survey of Mozzarella cheese at restaurant end use. J. Dairy Sci., 73: 1644.

Pitt, J.I. (1979): The genus Penicillium and its teleomorphic states Eupenicillium and Talaromyces. Academic Press, London, 1-398.

Raper, K.B. and Fennell, D.J. (1965): The genus Aspergillus. Williams and Wilkins, Baltimore, USA., 1-878.

Rondinini, G. and Garzaroli, C. (1990): Microbiological aspects and spoilage of Mozzarella cheese processed via citric acid acidification. Industrie Alimentari, 29 (281): 329-334. (Dairy Sci. Abst. 1990, 52 (10) 7518).

Saad, N.M. and Hemida, S.K. (1995): Isolation and identification of molds present as contaminants in roquefort cheese. Assiut Vet. Med. J., 33 (65): 116-122.

Sallam, S.S. (1979): Microbiological investigations on powdered and condensed milks. M.V.Sc., Thesis, Fac. of Vet. Med., Cairo Univ.

Samson, R.A. and van Reeneh-Hoekstra, E.S. (1988): Introduction to foodborne fungi. Centraalbureau voor Schimmel cultures, Baarn, The Netherlands, pp. 299.

Schönberg, F. (1956): Milchkunde and Milchhygiene, 7 Auflage, Verlag M. & H. Schoeber, Hannover. (Cited after Sallam, 1979).

Silva, E.O.T.R.; Panetta, J.C. and Ferreira, F. (1997): Non-automated production of buffalo Mozzarella from raw milk. Study of the microbiological contamination related to the manual and partially mechanized manufacture, Sao Paulo, Brazil. 5th World Buffalo Congress, Royal Palace, Caserta, Italy, October 13-16: 259-265.

Speck, M.L. (ed) (1985): Compendium of methods for the microbiological examination of foods. 2nd ed. American Public Health Association, Washington, D.C., USA.

Thatcher, F.S. and Clark, D.S. (1978): Microorganisms in foods. 2nd ed., Toronto Buffalo, London.

Tricksess, M.W. and Page, S.W. (1986): Examination of imported cheeses for aflatoxin M. J. Food Prot., 49 (8): 632-633.

Turnbull, P.C.P.; Kramer, J.M.; Jorgensen, K.; Gilbert, R.J. and Melling, J. (1979): Properties and production characteristics of vomitting, diarrhea with Virology and Immunology, 2nd ed., MIR Publisher, Moscow.

Van Walbeek, W. (1973): Fungal toxins in foods. Can. Ins. Food Sci. Technol. J.: 96.

Varnam, A.H. and Evans, M.G. (1991): Food pathogens. An illustrated text, Wolf Publishing, Book house, 2-16 Torrington place, London, England.

Weidenbörner, M.; Wieczorek, C. and Kunz, B. (1995): Mold spectra of various foods in relation to plating medium. J. Food Prot., 58 (6): 661-665.

Zerfiridis, G.K. (1985): Potential aflatoxin hazards to human health from direct mold growth on teleme cheese. J. Dairy Sci., 68: 2184-2188.