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ASSOCIATED MYCOBIOTA OF SOME TYPES OF CHEESE AND COOKING BUTTER

(With 5 Tables)

By

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الفطريات والخمائر العالقة ببعض أنواع الجبن وزبد الطهي

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أجريت هذه الدراسة للتعرف على مدى تواجد الفطريات والخمائر في بعض أنواع الجبن وزبد الطهي. لذلك تم جمع ١١٩ عينة عشوائية (٩٨ عينة من الجبن الطري "الدمياطي والقريش - محليا" ، الجاف ، المطبوخ المستورد والمحلى ، ٢١ عينة من زبد الطهي) من بعض أماكن البيع وكذلك أماكن التصنيع المختلفة لهذه المنتجات بمحافظة أسيوط. وقد أسفرت النتائج عن تواجد هذه الفطريات والخمائر بمتوسط عدد كلى يتراوح من ٤×١٠^{٣} إلى $١,٣\times١٠^{٤}$ مستعمرة/جم في الجبن الدمياطي والجاف المستورد على التوالي ، أما في حالة زبد الطهي فقد كان متوسط العدد الكلى $١,٤\times١٠^{٥}$ مستعمرة/ جم. وكذلك تم عزل السلالات الآتية : الاسبرجلس ، البنسليوم، الكانديدا، الكلادوسبورم، الميكوسفيريلا ، الريزوبس والجيوتركم من كل العينات المفحوصة. وكانت سلالات الكانديدا باراسيلوزس ، البنسليوم روكفورتى ، الاسبرجلس نيجر ثم بعد ذلك الجيوتيركم كانديدم ، الكلادوسبورم سفيروسبرمم والميكوسفيريلا تسيانا والريزوبس ستولينفر هى السلالات السائدة المتواجدة في الجبن الطرى بنوعيه ، أما في الجبن الجاف فقد كانت السلالات السائدة هى الكانديدا باراسيلوزس ، البنسليوم روكفورتي، والاسبرجلس نيجر ، وقد كانت السلالات السائدة في الجبن المطبوخ هى البنسليوم والاسبرجلس ، أما في حالة زبد الطهي فقد تم عزل الجيوتيركم كانديدم بنسبة ٧٨% والكانديدا باراسيلوزس بنسبة ١٢,٨% أما باقى السلالات فكانت متواجدة بنسب قليلة. وعموماً يتضح من النتائج أن عينات الجبن المختلفة وزبد الطهى ملوثة بالعديد من الفطريات والخمائر التى بعضها يؤثر على جودة المنتج والبعض على صحة المستهلك ، لهذا تم مناقشة الاشتراطات الصحية التي يجب إتباعها لمنع تلوث الالبان ومنتجاتها بهذه الميكروبات.

SUMMARY

119 random samples of different kinds of cheese (98) and locally produced cooking butter (21) were collected from different localities in Assiut Governorate and subjected to mycological examination for associated mycobiota. All samples were found to be contaminated by a wide variety of spoilage molds and yeasts at levels ranging, in case of cheeses, from 4 x 10^3 (the least recorded in Damietta cheese) to 1.3 x 10^4 (the highest in imported hard cheese) to 1.4 x 10^5 propagules/g in case of cooking butter. The high level of contamination of cooking butter is due to the highest incidence and count of *Geotrichum candidum* (78% of the total propagules encountered). *Aspergillus, Penicillium, Candida, Cladosporium, Mycosphaerella, Rhizopus* and *Geotrichum* were the most dominant genera on all substrates investigated, however, they may differ in their incidences and counts from a kind to another. In case of soft cheeses, the most prevalent species on both imported and locally produced were: *Candida parapsilosis, Penicillium roquefortii* and *Aspergillus niger* followed by *Geotrichum candidum, Cladosporium sphaerospermum, Mycosphaerella tassiana* and *Rhizopus stolonifer*. However, some other species were more common either on imported *(P. chrysogenum, P.aurantiogriseum & A. flavus)* or on locally produced Kareish *(P.viridicatum & P. chrysogenum). The dominant* species on hard cheeses were *C. parapsilosis, P. roquefortii* and *A. niger*, however, *P.aurantiogriseum* and *P. viridicatum* were more common on the imported type and *M. tassiana* and *G. candidum* on the local one. On the other hand, the highly frequent species on both local and imported processed cheeses were *P. aurantiogriseum, P. chrysogenum, P.roquefortii, A. niger* and *A. flavus*, however, others were more common either on imported *(C. parapsilosis & P. verrucosum)* or local type *(M.tassiana, C. sphaerospermum* and *R. stolonifer)*. With respect to cooking butter, the highly encountered species were *G. candidum* (78%) and *C. parapsilosis* (12.8%) but *P. aurantiogriseum, A. flavus, P.roquefortii, M. tassiana and A. niger* were a significant proportion (7.8%) of the spoilage fungi. Public health implications of these findings are discussed.

Keywords: *Molds, Yeasts, Cheeses, Soft Cheeses, Hard Cheeses, Processed cheeses & Cooking butter.*

INTRODUCTION

Fresh milk, a liquid of neutral pH, is highly susceptible to bacterial spoilage, and hence fungi are rarely a problem. When, milk is processed to cottage cheese or butter, the growth of lactic acid bacteria will cause the pH to fall, favouring the growth of spoilage molds and yeasts (Pitt and Hocking, 1997). Such molds and yeasts can cause gas and off flavor in cheese and rancidity or other flavor defects in butter due to their lipolytic and proteolytic activities and the production of bitter compounds from lactose (Walker & Ayres, 1970 and Viljoen & Greyling, 1995). Mold contamination not only causes deterioration of foods but also adversly affect the health of humans & animals, since they produce toxic metabolites called mycotoxins (Sweeney and Dobson, 1998), which could be regarded as potential health hazard. Also, they are responsible for many serious diseases of liver, kidney, blood, circulation system and blood forming organs (Cole and Cox, 1981) as well as carcinogenic effect (Mossel, 1982).

Bodini et al. (1969) found *Mucor, Penicillium and Aspergillus* to be the most prevalent genera from soft cheeses. *Also, Penicillium, Aspergillus and Fusarium of* which some species are capable of mycotoxin production were the most common from refrigerated cheddar cheese (Bullerman & Olivigni, 1974). In Egypt, El-Sayed (1981) isolated 14 fungal genera from processed cheese of which *Aspergillus and Penicillium* were the most common species. In Australia and New Zealand cheeses, Hocking (1994) found that *Penicillium commune* and *P.requefortii* were the most common spoilage species, but other penicillia *(P. chrysogenum, P. expansum, P. solitum, P. viridicatum and P.brevicompactum)* were a significant proportion of the spoilage mycoflora. In packaged cheeses in Europe, *P. commune* was also the most common spoilage species (Lund et al., 1995), with *P. verrucosum, P.solitum, P. roquefortii* and *P. nalgiovense* also significant; while species other than *Penicillium* were rarely encountered.

On the other hand, solid perishable dairy products such as butter and margarine are susceptible to the growth of spoilage fungi. Muys et al. (1966) concluded that *G. candidum, Moniliella suaveolens* and the yeast *Yarrowia lipolytica* could cause spoilage of margarine by their lipolytic action. However, Hocking (1994) found that the most common spoilage fungi on margarine are *Penicillium* species, particularly *P. glabrum,*

P.expansum, P. chrysogenum and *Cladosporium* species, with *C.cladosporioides* by far the most common.

Aman (1985) recorded an average yeast and mold count of 99.0 x 10^5/g cooking butter, while a mean count of 2.5 x 10^5/g cooking butter was reported by Ahmed et al. (1987). Mohamed et al. (1982 & 1983) detected a mean yeast count of 41.87 x 10^2/g and a mean mold count of 55.2 x 10^2/g cooking butter, respectively. While, Tasnim et al. (1993) and Patir et al. (1995) recorded mean counts of 3.84 x 10^2/g and 9.0 x 10^5/ g table butter for yeasts & molds, respectively. Candida spp., Torulopsis spp., Debaromyces spp., Saccharomyces spp. and Rhodotorula spp. were isolated from salted and unsalted butter (Mohamed et al., 1982 & 1983; Aman, 1985; Nazem, 1991 and Rajaraman et al., 1994).

Therefore, this study was undertaken to emunerate and identify spoilage fungal species contaminating different kinds of cheeses either imported or locally manufactured in Egypt, as well as, Egyptian cooking butter.

MATERIALS and METHODS

Collection of samples:

A total of 119 samples of either imported or locally manufactured (Damietta and Kareish) soft (31), hard (22), processed cheeses (45) and cooking butter (21) at the stage of consumption were randomly collected from different localities in Assiut, Egypt. Details about the number of samples in each case are recorded in Table 1. The samples once collected were transferred to the laboratory and kept in a refrigerator at 3 - 5°C till fungal analysis.

Detection and enumeration of spoilage mycobiota:

The dilution plate technique was used for the isolation and enumeration of viable fungal propagules. Dilutions were prepared by shaking samples in diluents containing 0.1% (V/V) tween 80 and 85% (w/v) NaCl (Hartog and Notermans, 1988). Serial ten-fold dilutions were prepared and 1ml aliquots of the appropriate dilution was placed in sterile Petri-dishes. Malt extract agar as an isolation medium (Harrigan and McCance, 1976) was used (5 plates for each sample). The plates were incubated at 25°C for 7 - 10 days and the growing fungal colonies were counted, isolated and identified.

Identification of the isolated strains:

Identification was based on macro and microscopic characteristics using the taxonomic methods of Raper and Fennell (1965); Booth (1971); Ellis (1971 & 1976); Pitt (1979); Sivanesan (1984); Samson and van

Reenen - Hoekstra (1988); Moubasher (1993) and Pitt and Hocking (1997).

RESULTS

The obtained results were recorded in Tables 1 - 5.

DISCUSSION

From the results illustrated in Table 1, it could be shown that all samples analyzed (119) either of cheeses (98) or cooking butter (21) were found to be contaminated by molds and yeasts at different levels ranging from 4 x 10^3 to 1.3 x 10^4 in case of cheeses to 1.4 x 10^5 fungal propagules/g in case of butter.

Of the imported cheeses, only hard cheese samples were heavily contaminated (1.3 x 10^4 propagules/g) approximately twice compared to that locally produced hard cheese (6.9 x 10^3). Nearly similar results (5.3 x 10^3) were recorded by Abouzeid et al. (1996). On the other hand, in case of soft cheeses, the least contamination level (4.0 x 10^3/g) was detected in locally produced Damietta cheese, while for those imported and Kareish cheese samples were nearly similar (9.6 x 10^3). Abouzeid et al. (1996) detected slightly higher level of approximately 1.1 x 10^4 in Kareish cheese. However, in case of processed cheeses, the local samples were slightly more contaminated than imported ones (8.9 x 10^3 and 7.5 x 10^3 cfu/g, respectively).

Concerning the Egyptian cooking butter, the contamination level by spoilage fungi was much higher than that of cheeses and this is due to the high incidence and count of *Geotrichum candidum* which accounted approximately 78% of the total counts of spoilage fungi.

I. Spoilage Fungi Recovered from Soft Cheeses:

All samples of soft cheeses either imported or locally manufactured were found to be contaminated by a wide variety of spoilage species of which *Candida* (2 species) and *Penicillium* (10 species) were isolated from the three types. *Candida* was recovered from 50, 60 and 91%, while *Penicillium* from 80,60 and 73% of the imported, Damietta and Kareish cheese samples, respectively. *Candida* accounted approximately 77.3, 32.5 and 44.9%, while *Penicillium* 15.3, 52.2 and 9.9% of the total fungi in the three substrates. Only *C. parapsilosis* and *P. roquefortii* were the most frequent spoilage species, from the three substrates (Table 2). *P.*

roquefortii was reported from French, Italian, German, English and Danish blue cheeses (Samson et al., 1977). *P. chrysogenum* was isolated moderately from both imported and Kareish, while rarely from Damietta cheese. *P. aurantiogriseum* was moderately isolated from imported soft cheese, while in low frequency from Damietta. *P. viridicatum* was recovered moderately from Kareish, while rarely in Damietta samples. *P. oxalicum* was isolated only and in low frequency from imported cheese. The remainder 5 *Penicillium* species and *C. guilliermondii* were rarely encountered and each only from one substrate (Table 2). Abdel- Sater et al. (1995) and Abouzeid et al. (1996) found that yeasts were the most commonly encountered from the Egyptian soft cheeses. Also, Penicillia were found to be prevalent in Egyptian (Abdel-Rahman and El-Bassiony, 1984; Ibrahim, 1987; Abdel-Sater et al., 1995; Saad and Hemida, 1995; Abouzeid et al., 1996 and Saleh, 1997), Swiss (Bullerman, 1976 & 1980), Australian (King et al., 1981), Greece (Zerfiridis, 1985) and Turkish cheeses (Aran and Eke, 1987). Also, The following *Penicillium* species were reported either from Damietta: *P. chrysogenum, P. citrinum* and *P. oxalicum* (Abdel-Sater et al., 1995) or from Kareish: *P. chrysogenum, P. citrinum, P. duclauxii, P. cyclopium, P. brevicompactum, P. commune, P. viridicatum* and *P. urticae* (Abdel-Sater et al., 1995 and Saleh, 1997).

Aspergillus (7 species) was also common and isolated in high frequency from imported and Damietta while moderately from Kareish cheese. It accounted about 2.6, 1.9 and 0.3% of the total propagules in the three substrates, respectively. In agreement with the findings of Abdel-Sater et al. (1995) and Saleh (1997). Only *A. niger* being the most common species, was found to be parallel in its frequency and counts to that of the genus. *A. flavus* the aflatoxigenic species, was isolated in low frequency from imported cheese and rarely from Kareish. This species was encountered from Damietta and Kareish cheeses, but in different incidences (Abdel-Sater et al., 1995 and Abouzeid et al., 1996). Galvano et al. (1996) stated that the occurrence of aflatoxin M_1 in milk and milk products is widespread, although contamination levels do not seem to be a serious health hazard. The remaining 5 Aspergilli were rarely encountered from either Kareish (*A. alutaceus & A. carbonarius*), Damietta (*A.restrictus & A. terreus*) or imported and Damietta cheese (*A. sydowii*). In previous studies, *A. ochraceus (= A. alutaceus), A. parasiticus, A. sydowii, A. tamarii* and *A. terreus* were encountered from either Damietta or Kareish cheese (Abdel-Sater et al., 1995 and Abouzeid et al., 1996).

Geotrichum (G. candidum) was isolated either in high (from all Kareish samples), moderate (30% of Damietta) or rare frequency (10% of imported). Its count was also much higher in case of Kareish (44.4% of the total fungi) compared to that of Damietta (5.18%) or imported cheese (1.6 %). In agreement with Abouzeid et al. (1996). This species was also reported from Kareish cheese in high incidence and counts.

Cladosporium (C. cladosporioides and *C. sphaerospermum)* was isolated in moderate frequency from both imported (40%) and Damietta (30%) while rarely from Kareish cheese samples (9%). Abouzeid et al. (1996) recorded *Cladosporium* spp. from Kareish cheese to be less common, while Abdel- Sater et al. (1995) isolated both species rarely but only from Damietta cheese. On the other hand, *Mycosphaerella tassiana* (anamorph: *Cladosporium herbarum)* was isolated in high frequency only from Damietta cheese samples (60%), while in low frequency from both Kareish (18%) and imported cheese (20%). This species accounted approximately 0.8, 0.1 and 0.7% of the total propagules, respectively.

The remaining fungi were isolated either in low or rare frequencies from the three substrates *(Rhizopus stolonifer),* both imported and Damietta (*Emericella nidulans* and *Moniliella suaveolens),* imported and Kareish *(Rhodotorula mucilaginosa),* Kareish and Damietta *(Mucor racemosus)* or only from imported *(Cochliobolus spicifer, Gibberella fujikuroi* and *Paecilomyces variotii),* Damietta *(Acremonium strictum, Nectria haematococca* and *Neurospora crassa),* and Kareish cheese *(Fusarium oxysporum* and *Mucor hiemalis).* Most of the above species were encountered from either Damietta, Kareish or both (Abdel-Sater et al., 1995; Abouzeid et al., 1996 and Saleh, 1997), or from other milk products (Bullerman and Olivigni, 1974; Sutic et al., 1979; Ismail, 1993 and Ismail and Saad, 1997).

II. Spoilage Fungi Recovered from Hard Cheeses:

A total of 11 and 8 spoilage fungal species were isolated from imported and locally manufactured hard cheeses, respectively. However, the local cheese was found much less contaminated than the imported one (Tables 1&3). The genera *Candida* and *Penicillium* followed by *Aspergillus* were the most dominant on the imported, while *Candida, Geotrichum, Mycosphaerella* and *Penicillium* on the Egyptian type (Table 3). In previous studies, *Aspergillus, Penicillium, Scopulariopsis, Rhizopus, Mucor, Cladosporium, Geotrichum, Candida* and other yeasts were isolated from the Egyptian hard cheese (Abouzeid et al., 1996 and Saleh, 1997).

Only *Penicillium* (6 species) and *Candida (C. parapsilosis)* were highly encountered from both substrates. They accounted approximately in 14.9 & 0.8% and 84.6 & 89.0% of the total propagules encountered from imported and Egyptian hard cheese, respectively. *P. roquefortii* was dominant on both substrates (40% and 67% of the samples, accounting 12.9% and 0.7% of the total propagules, respectively), however, *P. aurantiogriseum* and *P. viridicatum* were also common and isolated moderately but only from imported type. The other 3 Penicillia were less frequent either on imported *(P. duclauxii & P. oxalicum)* or on Egyptian cheese (*P. citrinum).* Saleh (1997) isolated the following *Penicillium* species from the Egyptian hard cheese with the most common being *P. urticae, P. viridicatum & P. commune* and the least being *P. brevicompactum, P. chrysogenum* and *P. cyclopium.*

Mycosphaerella tassiana was isolated in high frequency from the local type, while in low frequency from the imported, however, accounted nearly the same percentage from both (0.25% of the total propagules).

Aspergillus (3 species) was recovered moderately (40% of the samples) from the imported cheese, while in low frequency (17%) from the local. The count and frequency of *A. niger* were parallel to those of the genus. *A. flavus* and *A. terreus* were isolated in low frequency, however the former only from the Egyptian and the latter from the imported. Both of *A. flavus* and *A.niger* have been reported to be commonly encountered from the Egyptian hard cheese (Saleh, 1997). Also, *A. ochraceus, A. niger, A. parasiticus* and *A. wentii,* followed by *A. flavus* and A. *glaucus* were detected from the Egyptian hard cheese by Abouzeid et al. (1996).

Two species were isolated only from one substrate not from the other: *Geotrichum candidum* (in high incidence) and *Rhodotorula mucilaginosa* (in low incidence) from only the Egyptian cheese, while *Cladosporium sphaerospermun* and *Rhizopus stolonifer* (low) from the imported type (Table 3). *Geotrichum, Rhizopus* and *Cladosporium* were also encountered previously from hard cheeses (El-Bassiony et al., 1980; Northolt et al., 1980; Hocking and Faedo, 1992; Kivance, 1992 and Abouzeid et al., 1996).

III. Spoilage Fungi Recovered from Processed Cheeses:

The level of contamination by fungi of the local processed cheese is slightly higher (8.9×10^3) than that of the imported (7.5×10^3 propagules/g), (Tables 1 & 4).

A total of 18 genera and 37 species were recovered from both Egyptian (17 and 33) and imported cheese (10 and 23) of which *Aspergillus* and *Penicillium* were the most predominant genera (Table 4).

Penicillium (11 species) was the commonest fungus with respect to its count (56.9% and 59.3% of the total propagules on imported and Egyptian cheese, respectively), and frequency (77% and 81%). A lower percentage count (9.5%) and frequency (16.7%) for *Penicillium* was obtained from the Egyptian processed cheese by Abdel-Sater et al. (1995). *P. aurantiogriseum* (24.1% and 11.6% of the total propagules), *P.chrysogenum* (15.2% and 6.2%) and *P. roquefortii*(15.2% and 38.8%) were the most prevalent species on both types of cheeses. The rest of Penicillia were less commonly encountered either from imported *(P.camembertii & P. citrinum),* Egyptian *(P. duclauxii, P. glabrum & P.purpurogenum)* or both cheeses (*P. oxalicum, P. verrucosum* and *P.viridicatum)* (Table 4). Only two *Penicillium* species have been encountered and rarely *(P. chrysogenum* and *P. citrinum)* from the Egyptian type by Abdel-Sater et al. (1995).

Aspergillus (9 species) came behind *Penicillium* in its frequency and isolated from 69% and 78% of the imported and Egyptian samples, respectively. It accounted to 5.7% and 2.0% of the total propagules. Contrariwise to our finding, a much higher count of *Aspergillus* (31%) was obtained from the Egyptian processed cheese by Abdel-Sater et al. (1995). The most prevalent Aspergilli were *A. niger* and *A. flavus*. The other 7 species were less commonly encountered either from imported (*A.versicolor),* Egyptian (*A. parasiticus* and *A. tamarii*) or both cheeses (*A.fumigatus, A. penicilloides, A. sydowii* and *A. terreus). A. niger* was encountered frequently, while *A. flavus, A. sydowii, A. tamarii* and *A.terreus* were less common on the Egyptian processed cheese (Abdel-Sater et al., 1995). It is worth to mention that sterigmatocystin produced by *A. versicolor* (which is rarely encountered herein from imported processed cheese) was detected in the surface layer of hard cheeses in the Netherlands (Northolt et al., 1980).

Mycosphaerella tassiana was highly encountered from the Egyptian processed cheese (53% of the samples), while rarely from the imported type (8%). It accounted to 1.1% and 0.2% of the total propagules, respectively.

Candida parapsilosis, Cladosporium sphaerospermum and *Rhizopus stolonifer* were encountered moderately from one type of cheese, while in low frequency from the other (Table 4). They accounted to 36.3%

and 35.5%; 0.1% and 0.5%; and 0.2% and 0.2% of the total propagules, respectively. Yeasts were highly encountered, representing 52.7% of the total count, while *Rhizopus stolonifer* was rarely recovered and accounted to 1.4% from the Egyptian processed cheese (Abdel-Sater et al., 1995).

The remainder of species were isolated in low or rare frequencies either from imported *(Geotrichum candidum)*, local *(Acremonium strictum, Alternaria chlamydospora, Alternaria tenuissima, Cochliobolus lunatus, Epicoccum nigrum, Gibberella fujikuroi, Scytalidium lignicola, Sporidesmium densum* and *Ulocladium chartarum)* or both cheeses *(Emericella nidulans, Nectria haematococca* and *Paecilomyces variotii)* (Table 4).

The level of mold & yeast contamination in the Egyptian Damietta, Egyptian hard and processed cheese is generally low. In processed cheese, this could be attributed to the fact that processed cheese is prepared in small packages for retial markets and each piece of cheese is wrapped in aluminum foil which lower the possibility of contamination unless the foil is injured. These results disagree with these recorded by Taniwaki and Dender (1992), as they could not isolate molds from processed cheese. In addition the low count in Egyptian Damietta & hard cheeses may be due to high salt content as stated by Shehata et al. (1978).

IV. Spoilage Fungi Recovered from the Egyptian Cooking Butter:

Much higher level of contamination was detected in butter as compared to all kinds of cheeses investigated (Tables 1 & 5). Twelve genera represented by 20 species of which *Aspergillus, Geotrichum, Mycosphaerella* and *Penicillium* were the most predominant on butter (Table 5). However, Saleh (1997) found only *Aspergilli, Penicillia, Rhizopus* and *Scopulariopsis* to be the contaminants of butter.

Geotrichum candidum was the most dominant spoilage species, contaminating all butter samples and accounting to 78.1% of the total propagules.

Aspergillus (6 species), *Penicillium* (4) and *Mycosphaerella* (1) were found in high incidences being isolated from 71%, 67% and 52% of the samples, accounting approximately 2.8%, 3.9% and 1.4% of the total propagules, respectively. Of these genera, *A. flavus, A. niger, P.aurantiogriseum* and *M. tassiana* were the most dominant spoilage species. The remaining Aspergilli *(A. carbonarius, A. fumigatus, A.parasiticus* and *A. versicolor)* and Penicillia *(P. chrysogenum, P.funiculosum* and *P. roquefortii)* were less common. Saleh (1997) recorded *A. niger, P. cyclopium, P. brevicompactum, P. commune* and

P.viridicatum from the Egyptian butter samples, but in different incidences.

Candida (C. parapsilosis) came after *Geotrichum* in its count (12.8%) but came behind *Aspergillus, Penicillium* and *Mycosphaerella* in its frequency (29%).

Alternaria alternata, Cladosporium sphaerospermum, Mucor hiemalis and *Rhizopus stolonifer* were isolated in low frequencies (14-24% of the samples), accounting collectively a minor proportion of the total propagules (0.66%). Of the above, only *R. stolonifer* was recorded in 20% of butter samples examined by Saleh (1997). On the other hand, *Emericella nidulans, Moniliella suaveolens* and *Paecilomyces variotii* were rarely encountered (Table 5).

Most of the above fungi were reported as contaminants of different milk products allover the world (Bullerman, 1980; King et al., 1981; Zerfiridis, 1985; Aran and Eke, 1987; Ismail, 1993; Hocking, 1994; Abdel-Sater et al., 1995; Saad and Hemida, 1995; Abouzeid et al., 1996; Ismail and Saad, 1997 and Salch, 1997).

From the a fore-mentioned results it could be concluded that the occurrence of fungi reported in this study indicates to what extent cheeses & cooking butter are exposed to contamination. The contamination by mold could be resulted from different sources including the milk used, air, water and equipments, as well as, during manufacturing process or handling of the product. The invading organisms may find the opportunity to grow and multiply in the product, producing undesirable changes, and render the product unmarketable.

Yeasts and molds that spoil dairy products could be isolated from the processing plant, packing equipment, the air, salt brine, manufacturing equipment, and from the general environment (floors, walls, ventilation, ducts., etc.). Control efforts must be taken to limit the exposure of pasteurized products to these sources (Doyle and Marth, 1975). If the initial contamination level is limited, strategies to inhibit growth are more likely to succeed. These strategies include packaging to reduce oxygen, cold storage and the use of antimycotic chemicals such as sorbate, propionate and natamycin (Hocking and Faedo, 1992).

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Table 1. Showed the number of samples analyzed (NSA), number of contaminated samples (NCS), number of isolated genera (NG) and species (NS) and counts of fungi of the investigated cheeses and butter samples.

Substrate	NSA	NCS	NG	NS	Counts of Fungi/g		
					Min.	Max.	Average
Soft cheese:							
Imported	10	10	13	21	$2.6x10^2$	$5.0x10^4$	$9.6x10^3$
Egyptian Damietta	10	10	13	21	$1.8x10^2$	$1.8x10^4$	$4.0x10^3$
Egyptian Kareish	11	11	10	18	$4.0x10^3$	$1.9x10^4$	$9.6x10^3$
Hard cheese:							
Imported	10	10	6	11	$5.0x10^2$	$4.2x10^4$	$1.3x10^4$
Egyptian	12	12	6	8	$6.0x10^1$	$3.0x10^4$	$6.9x10^3$
Processed cheese:							
Imported	13	13	10	23	$1.6x10^2$	$3.1x10^4$	$7.5x10^3$
Egyptian	32	32	17	33	$1.0x10^2$	$6.2x10^4$	$8.9x10^3$
Egyptian cooking butter	21	21	12	20	$1.2x10^4$	$2.9x10^5$	$1.4x10^5$

Table 2. Mycobiota recovered from soft cheese.

Taxon	Imported					Egyptian Damietta					Kareish				
	ATC	%C	NCS	%F	0	ATC	%C	NCS	%F	0	ATC	%C	NCS	%F	0
Acremonium strictum						6	0.15	1	10	R					
Aspergillus	244	2.55	8	80	H	76	1.9	6	60	H	26	0.25	5	45.5	M
A. alutaceus											6	0.06	1	9.1	R
A. carbonarius											4	0.04	1	9.1	R
A. flavus	34	0.36	2	20	L						2	0.02	1	9.1	R
A. niger	208	2.18	7	70	H	68	1.7	5	50	H	14	0.13	3	27.3	M
A. restrictus						4	0.1	1	10	R					
A. sydowii	2	0.02	1	10	R	2	0.05	1	10	R					
A. terreus						2	0.05	1	10	R					
Candida	7390	77.33	5	50	H	1304	32.51	6	60	H	4760	44.86	10	90.9	H
C. parapsilosis	7378	77.21	5	50	H	1304	32.51	6	60	H	4760	44.86	10	90.9	H
C. guilliermondii	12	0.13	1	10	R										
Cladosporium	24	0.25	4	40	M	184	4.59	3	30	M	8	0.08	1	9.1	R
C. cladosporioides						4	0.1	1	10	R					
C. sphaerospermum	24	0.25	4	40	M	180	4.49	2	20	L	8	0.08	1	9.1	R
Cochliobolus spicifer	6	0.06	1	10	R										
Dematiaceous hyphomycete											12	0.11	2	18.2	L
Emericella nidulans	2	0.02	1	10	R	6	0.15	1	10	R					
Fusarium oxysporum											6	0.06	1	9.1	R
Geotrichum candidum	152	1.6	1	10	R	208	5.18	3	30	M	4712	44.4	11	100	H
Gibberella fujikuroi	40	0.42	1	10	R										
Moniliella suaveolens	6	0.06	1	10	R	82	2.05	1	10	R					
Mucor						2	0.05	1	10	R	12	0.11	2	18.2	L
M. hiemalis											2	0.02	1	9.1	R
M. racemosus						2	0.05	1	10	R	10	0.09	1	9.1	R
Mycosphaerella tassiana	68	0.71	2	20	L	32	0.8	6	60	H	12	0.11	2	18.2	L
Nectria haematococca						4	0.1	1	10	R					
Neurospora crassa						2	0.05	1	10	R					

Taxon	Imported					Egyptian Damietta					Kareish				
	ATC	%C	NCS	%F	0	ATC	%C	NCS	%F	0	ATC	%C	NCS	%F	0
Paecilomyces variotii	130	1.36	1	10	R										
Penicillium	1464	15.32	8	80	H	2094	52.22	6	60	H	1050	9.89	8	72.7	H
P. aurantiogriseum	1034	10.82	4	40	M	152	3.79	2	20	L					
P. brevicompactum											4	0.04	1	9.1	R
P. chrysogenum	68	0.71	4	40	M	40	1	1	10	R	34	0.32	3	27.3	M
P. duclauxii											2	0.02	1	9.1	R
P. glabrum	60	0.63	1	10	R										
P. oxalicum	198	2.07	2	20	L										
P. purpurogenum	2	0.02	1	10	R										
P. roquefortii	102	1.07	4	40	M	1242	30.97	6	60	H	958	9.03	7	63.6	H
P. spinulosum						600	14.96	1	10	R					
P. viridicatum						60	1.5	1	10	R	52	0.49	3	27.3	M
Rhizopus stolonifer	18	0.19	2	20	L	10	0.25	2	20	L	12	0.11	2	18.2	L
Rhodotorula mucilaginosa	12	0.13	2	20	L						2	0.02	1	9.1	R
Total	**9556**	**100**	**10**	**100**	**H**	**4010**	**100**	**10**	**100**	**H**	**10612**	**100**	**11**	**100**	**H**

ATC, average total count in all samples analyzed (calculated per g cheese). Values of ATC are multiplied with 10; %C, percentage counts (calculated per total fungal counts); NCS, number of contaminated samples (out of the total); %F, percentage frequency; 0, occurrence: H = High 50-100%, M = Moderate 25-49%, L = Low 12.5-24%, R = Rare less than 12.5%.

Table 3. Mycobiota recovered from hard cheese*.

Taxon	Imported					Egyptian				
	ATC	%C	NCS	%F	0	ATC	%C	NCS	%F	0
Aspergillus	28	0.22	4	40	M	20	0.24	2	16.7	L
A. flavus						4	0.05	2	16.7	L
A. niger	24	0.19	4	40	M	16	0.19	2	16.7	L
A. terreus	4	0.03	2	20	L					
Candida parapsilosis	10800	84.59	6	60	H	7372	88.99	9	75.0	H
Cladosporium sphaerospermum	4	0.03	2	20	L					
Geotrichum candidum						796	9.61	6	50	H
Mycosphaerella tassiana	32	0.25	2	20	L	20	0.24	6	50	H
Penicillium	1900	14.88	8	80	H	64	0.77	8	66.7	H
P. aurantiogriseum	116	0.91	4	40	M					
P. citrinum						4	0.05	2	16.7	L
P. duclauxii	8	0.06	1	10	R					
P. oxalicum	24	0.19	2	20	L					
P. roquefortii	1640	12.85	4	40	M	60	0.72	8	66.7	H
P. viridicatum	112	0.88	3	30	M					
Rhizopus stolonifer	4	0.03	2	20	L					
Rhodotorula mucilaginosa						12	0.15	2	16.7	L
Total	**12768**	**100**	**10**	**100**	**H**	**8284**	**100**	**12**	**100**	**H**

* As the same in Table 2.

Table 4. Mycobiota recovered from processed cheese*.

Taxon	Imported					Egyptian				
	ATC	%C	NCS	%F	O	ATC	%C	NCS	%F	O
Acremonium strictum						24	0.09	1	3.1	R
Alternaria						22	0.08	4	12.5	L
A. chlamydospora						2	0.01	1	3.1	R
A. tenuissima						20	0.07	3	9.4	R
Aspergillus	558	5.69	9	69.2	H	564	1.99	25	78.1	H
A. flavus	224	2.28	3	23.1	L	260	0.92	13	40.6	M
A. fumigatus	162	1.65	3	23.1	L	12	0.04	1	3.1	R
A. niger	154	1.57	6	46.2	M	248	0.87	18	56.3	H
A. parasiticus						22	0.08	2	6.3	R
A. penicillioides	2	0.02	1	7.7	R	10	0.04	2	6.3	R
A. sydowii	8	0.08	2	15.4	L	2	0.01	1	3.1	R
A. tamarii						6	0.02	1	3.1	R
A. terreus	2	0.02	1	7.7	R	4	0.01	2	6.3	R
A. versicolor	6	0.06	1	7.7	R					
Candida parapsilosis	3560	36.27	4	30.8	M	10082	35.50	5	15.6	L
Cladosporium sphaerospermum	14	0.14	2	15.4	L	144	0.51	9	28.1	M
Cochliobolus lunatus						10	0.04	1	3.1	R
Emericella nidulans	2	0.02	1	7.7	R	20	0.07	1	3.1	R
Epicoccum nigrum						10	0.04	1	3.1	R
Geotrichum candidum	22	0.22	1	7.7	R					
Gibberella fujikuroi						4	0.01	2	6.3	R
Mycosphaerella tassiana	18	0.18	1	7.7	R	308	1.08	17	53.1	H
Nectria haematococca	34	0.35	2	15.4	L	58	0.20	4	12.5	L
Paecilomyces variotii	6	0.06	1	7.7	R	58	0.20	5	15.6	L
Penicillium	5582	56.87	10	76.9	H	16840	59.29	26	81.3	H
P. aurantiogriseum	2364	24.08	6	46.2	M	3302	11.63	13	40.6	M
P. camembertii	10	0.10	1	7.7	R					
P. chrysogenum	1496	15.24	6	46.2	M	1750	6.16	18	56.3	H
P. citrinum	2	0.02	1	7.7	R					
P. duclauxii						20	0.07	2	6.3	R
P. glabrum						32	0.11	1	3.1	R
P. oxalicum	6	0.06	1	7.7	R	186	0.66	3	9.4	R

Taxon	Imported					Egyptian				
	ATC	%C	NCS	%F	O	ATC	%C	NCS	%F	O
P. purpurogenum	1490	15.18	9	69.2	H	326	1.15	4	12.5	L
P. roquefortii	194	1.98	4	30.8	M	11018	38.79	14	43.8	M
P. verrucosum	20	0.20	1	7.7	R	62	0.22	3	9.4	R
P. viridicatum	20	0.20	3	23.1	L	144	0.51	2	6.3	R
Rhizopus stolonifer						50	0.18	10	31.3	M
Scytalidium lignicola						6	0.02	1	3.1	R
Sporidesmium densum						148	0.52	4	12.5	L
Ulocladium chartarum						54	0.19	2	6.3	R
Total	**9816**	**100**	**13**	**100**	**H**	**28402**	**100**	**32**	**100**	**H**

* As the same in Table 2.

Table 5. Mycobiota recovered from the Egyptian cooking butter*.

Taxon	ATC	%C	NCS	%F	O
Alternaria alternata	26	0.08	5	23.8	L
Aspergillus	862	2.84	15	71.4	H
A. carbonarius	8	0.03	2	9.5	R
A. flavus	480	1.58	9	42.9	M
A. fumigatus	84	0.28	3	14.3	L
A. niger	286	0.94	13	61.9	H
A. parasiticus	2	0.01	1	4.8	R
A. versicolor	2	0.01	1	4.8	R
Candida parapsilosis	3886	12.8	6	28.6	M
Cladosporium sphaerospermum	50	0.17	3	14.3	L
Emericella nidulans	60	0.2	1	4.8	R
Geotrichum candidum	23692	78.08	21	100	H
Moniliella suaveolens	16	0.05	1	4.8	R
Mucor hiemalis	102	0.34	3	14.3	L
Mycosphaerella tassiana	436	1.44	11	52.4	H
Paecilomyces variotii	4	0.01	2	9.5	R
Penicillium	1188	3.92	14	66.7	H
P. aurantiogriseum	716	2.36	9	42.9	M
P. chrysogenum	16	0.05	1	4.8	R
P. funiculosum	4	0.01	1	4.8	R
P. roquefortii	452	1.49	5	23.8	L
Rhizopus stolonifer	20	0.07	4	19.1	L
Total	**30342**	**100**	**21**	**100**	**H**

* As the same in Table 2, except for the values of ATC are multiplied with 10^2.