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STUDIES ON THE MYCOLOGICAL QUALITY OF MILK POWDER

(With 5 Tables)

By

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دراسات عن الحاله الميكولوجيه لألبان المجففه

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فى هذه الدراسه تم جمع ٥٠ عينه عشوائيه من الألبان المجففه من الصيدليات بمدينة أسيوط لمعرفة مدى تلوثها بالفطريات المختلفه .

وقد أوضحت النتائج أن ٤٤ عينه (٨٨٪) ، ٢٨ عينه (٥٦٪) من العينات تحتوى على mesophilic molds على كل من مستنبتى dicloran and malt extract agar على التوالى وذلك بمتوسط قدره ٨٨ ر٣٤ X ١٠^{٣} ، ٩ X ١٠^{٣} / جم بينما كان متوسط عدد thermophilic molds على dicloran agar ٤ X ١٠ / جم وقد كان مستنبت dicloran أفضل من malt extract agar وذلك لعد الفطريات الموجوده .

وبتصنيف الفطريات المعزوله أمكن التوصل الى وجود ٣٩ نوع تعزو الى ١٧ جنس ووجد أن أكثر الفطريات وجوداً كانت Alternaria, Aspergillus, Emericella and Penicillium وان فطر A. niger موجود فى جميع العينات .

هذا وقد تم مناقشة الاشتراطات الصحيه التى يجب أن تتبع لمنع تلوث الألبان ومنتجاتها بالفطريات لما لها من خطوره على صحة المستهلك ولما لها من تأثير على جودة المنتج .

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SUMMARY

Fifty random samples of milk powder representing 7 brands (A,B,C,D,E,F, and G) were collected from different pharmacies in Assiut province. Every sample was examined mycologically to evaluate its mycological quality. From the mycological analysis, it Could be noted that 44(88%) and 28(56%) of milk powder samples were positive for mesophilic molds on dicloran and malt extract agar, respectively, with average counts of 34.88 x 10^2/g. and 9X10^2/g. While the thermophilic molds which recovered on dicloran agar had an average count of 4 x 10/g. These findings revealed that dicloran agar is more reliable for enumeration of molds than malt extract agar. 39 species and 1 variety belonging to 17 genera of fungi were identified. The most contaminated samples were found to belonging to brands A, C and D while the least were F and G brands. The most frequent genera were *Alternaria, Aspergillus, Emericella and Penicillium. Aspergillus niger* was the only fungus found to contaminate all brands (72% of the total samples). *A. flavus* was recovered only from D (50% of samples tested) and G (37.5%) brands. *Alternaria alternata, Emericella nidulans, Fusarium oxysporum, Penicillium aurantiogriseum, P. chrysogenum and P. citrinum* were prevalent in some brands of milk powder. Public health implications of these findings are discussed.

Keywords: Studies, mycological quality, milk powder.

INTRODUCTION

World attention had been focused in the last two decades on the toxicity of molds, because of considerable hazards to health associated with liver damage and carcinogenicity (MOSSEL, 1982). Contamination of food with such molds causes also considerable economic losses through spoilage and discoloration of foods.

Nowadays, the growing use of milk powder for infants has made its microbial quality of primary concern due to susceptibility of children to food-borne diseases. Molds gain entrance to milk powder either from the milk used, air contamination or utensils. Therefore, presence of molds in milk

powder is indicative of unsatisfactory sanitation during processing and handling of the product. *JESENSKA and HRDINOVA (1982)* found that molds were present in 53% of examined milk powder samples for infants, while *MOUSTAFA* et al. *(1984)* tested 30 samples of dried baby foods with milk base and they found that molds were present in 28 samples. Contamination of infant's milk powder was also recorded by *SABREEN (1986)*.

As the mycological quality of milk powder reflects the care with which the milk was produced and the identification of the contaminating mycoflora will also help to estiamte the probable types of mycotoxins which might be produced, therefore, this research was done for enumeration and identification of molds that may be present in milk powder.

MATERIALS and METHODS

Collection of samples:

Fifty random samples of milk powder at the stage of consumption were collected from different pharmacies in Assiut City. These samples were belonging to seven brands. A, B, C, D, E, F and G. Brand A is locally packaged.

Mycological analysis:

The dilution-plate method was used for detection of viable mold propagules in milk powder samples. Two types of media, malt extract agar *(HARRIGAN and McCANCE, 1976)* and dicloran-rose bengal medium *(KING* et al., *1979)* were used for the enumeration of mesophiles at 25°C. Thermophiles were enumerated only on dicloran agar at 55°C. Triplicate plates for each medium were incubated for 7-10 days and molds were counted and identified according to *(COONEY and EMERSON, 1964; RAPER and FENNELL, 1965; ELLIS, 1971; BOOTH, 1977; PITT, 1979; SAMSON and van REENEH-HOEKSTRA, 1988 and KOZAKIEWICZ, 1989)*.

RESULTS

The obtained results were recorded in Tables (1-5).

DISCUSSION

From the results given in Table (1) it is clear that mold counts were ranged from 10 to 21 x 10^3 , 10 to 7 X 10^3 and to 4.3 x 10^2/g of the examined milk powder samples on dicloran, malt agar at 25°C and dicloran agar at 55°C, respectively.

Mesophilic molds recovered at 25°C:

Molds recovered on dicloran agar: 44 milk powder samples (88%) were found to be contaminated by molds. 10 genera and 28 species were recovered on dicloran agar at 25°C. The most common genera were being *Aspergillus* (9 species) and *(Penicillium* (8 species). These two genera were found in 80 & 44% of the samples and accounted 68.8 & 20.5% of total molds, respectively. *SUTIC* et al. *(1979)* found that *Aspergillus and Penicillium* comprised 3.2% and 59.1% of the total molds obtained from milk and milk products. The most contaminated samples were brands A and D followed by C, while brands F and G were the least as recorded in table (3). *Aspergillus niger* was the only mold found to contaminate all brands of milk powder samples. Many reports on dairy products recorded that *Aspergillus niger* was of high incidence *(BULLERMAN, 1980; EL-BASSIONY* et al., *1980 and IBRAHIM, 1987).* The second most frequent species was *Penicillium chrysogenum.* It was recovered from all brands except brand A. *Aspergillus flavus* was recovered from all brands except brands A. *Aspergillus flavus* was recovered only from brand D and G. *A flavus* and *P. chrysogenum* were previously isolated from various dairy products *(BULLERMAN, 1980; ARAN and EKE, 1987 and IBRAHIM, 1987).* The other *Aspergilli and Penicillia* were recovered infrequently and with low counts in one or two brands (Tables 2 & 3). The other fungal genera and species were also recovered infrequently from the examined samples (Table 3). Most of the encountered molds were reported previously from milk and other dairy products *(SEHAM* et al., *1983; ABDEL-SATER and ISMAIL, 1983 and ISMAIL, 1993).*

Molds recovered on malt agar: Only 28 out of the 50 of the examined samples on malt agar were found to be contaminated with molds. *SABREEN (1986)* could detected mold in 70, 50 and 65% of examined samples (E, F and G) of infant's milk powder. Twenty-one mold species belonging to 14 genera were collected on malt agar plates at 25°C (Table 2 & 4). The counts in all samples were relatively low (25250 colonies/g) compared with that recovered on dicloran agar (153496.5). Brands C and B were the most contaminated ones. *Aspergillus* (24% of the samples) and *Penicillium (42%)* were the prevalent genera. *A. niger, P. chrysogenum and P. citrinum* were the most frequent species.

Alternaria (A. alternata) and *Fusarium (F. oxysporum)* were the second most frequent genera. Nearly similar results were obtained by *SUTIC* et al. *(1979).* The other mold genera and species were infrequently isolated from only one, two or three brands of milk powder (Tables 2, 4). Contamination of infant's

foods was previously detected by several investigators (*ROSA* et al., *1979 and MOUSTAFA* et al., *1984*).

Thermophilic molds recovered on dicloran agar: The average count of thermophilic molds was 40 colonies/g with a minimum of 10 and a maximum of 4.3×10^2 (Table 1). Only 19(38%) samples were found to be contaminated with molds. Five species and one variety belonging to four genera were identified of which *Aspergillus* and *Emericella* were the most frequent. *Aspergillus* was represented by *A. fumigatus var. albus, A. niger, A. terreus and Emericella* by *E.nidulans. Malbranchea sp.* and *Rhizomucor pusillus* were isolated each from one sample of brands F and A, respectively (Table 5).

In conclusion it was noted that many of the encountered molds are known to be mycotoxin-producers, notably *Aspergillus flavus* (Aflatoxins), *A. niger* (nigragillin, malformins, naphthoquinones and oxalic acid), *Emericella nidulans* (Kojic acid and stregmatocystin), *Penicillium sp.* (penicillic acid, citrinin, patulin, cyclopiazonic acid and mycophenolic acid) and *Alternaria alternata* (tenuazonic acid) *(KING and SCHADE, 1984; MORTHOLT and SOENTORO, 1988 and FRISVAD, 1988).* The consumption of moldy and mycotoxin-contaminated foods, particularly by children, can threaten human health *(AUSTWICK, 1984; BULLERMAN, 1986 and LACEY, 1988).* Therefore to safe-guard consumers from being infected and to safe a lot of the products from being deteriorated, strict hygienic measures and regulations should be imposed during preparation, packaging, preservation and transportation of milk powder as well as other foodstuffs.

REFERENCES

Abdel-Sater, M.A. and Ismail, M.A. (1993): Ecological and enzymatic studies on fungi associated with biscuits in Egypt. International Biodeterioration and Biodegradation 31: 277-292.

Aran, N. and Eke, D. (1987): Mould mycoflora of kasar cheese at the stage of consumption. food Microbiology 4: 101-104.

Austwick, P.K.C. (1984): Human mycotoxicosis, past, present and future. Chemistry and Industry 6: 547-551.

Booth, C. (1977): Fusarium: laboratory guide to the identification of the major species. Commonwealth Mycological Institute, Kew, Surrey, UK.

Bullerman, L.B. (1980): Incidence of mycotoxic molds indomestic and imported cheeses. J. Food Safety 2(1): 47-48.

Bullerman, L.B. (1986): Mycotoxins and food safety. Food Technol. Aust. 40(7): 59-85.

Cooney, D.G. and Emerson, R. (1964): Thermophilic fungi. W.H. Freeman and Co., Sanfrancisco & London.

El-Bassiony, T.A., Atia, M. and Aboul-khier, F. (1980): Search for thepredominance of fungi species in cheese. Assiut Vet. Med. J. 7(13&14): 175.

Ellis, M.B. (1971): Dematiaceous Hyphomycetes. Commonwealth Mycological Institute, Kew, Surrey, UK.

Frisvad, J.C. (1988): Fungal species and their specific production of mycotoxins. In Introduction to Foodborne Fungi, eds. R.A. Samson & E.S. van Reenen-Hoekstra. Centraalbureau voor chimmelcultures, Baarn, The Netherlands, pp. 239-249.

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

Ibrahim, E.K. (1987): Yeasts and moulds in locally manufactured cheese in Assiut. M.V.Sc. Thesis, Faculty of Veterinary Medicine, Assiut Univ., Assiut, Egypt.

Ismail, M.A. (1993): Degradative enzymes and fungal flora associated with the Egyptian foodstuff kishk. International Biodeterioration and Biodegradation 31: 143-157.

Jesenska, Z. and Hndinova, I. (1982): Moulds in foods in Czechoslovakia. Schimmelpilze in Lebenmitteln der Tschechoslowakei. Zeitschrift fur Lebensmittel-Unbtersuchung und-Forschung. 137(1): 16-20.

King, A.D. and Schade, J.E. (1984): Alternariaa toxins and their importance. J. of Food Protection 47: 886-901.

King, A.D.; Hocking, A>D> and Pitt, J.I. (1979): Dichloran-roe bengal medium for the enumeration and isolation of molds from foods. Applied and Environmental Microbiology 37: 959-964.

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

Lacey, J. (1988): The microbiology of cereal grain from area of Iran with a high incidence of oesophageal cancer. J. Stored Prod. Res. 24(1): 39-50.

Mossel, D.A.A. (1982): Microbiology of food, 3rd Ed. The Univ. of Ulterecht., The Netherlands ISBN.

Moustafa, M.K., Ahmed, A>A>H.; El-Bassiony, T.A. and Aboul-Khier, F. (1984): Microbiological quality of infant milk foods. Assiut Vet. Med. J. 12(24): 163-167.

Northolt, M.D. and Soentoro, P.S.S. (1988): Fungal growth on foodstuffs related to mycotoxin contamination. In Introduction to Foodborne Fungi, eds R.A. Samson & E.S.

van Reenen-Hoekstra. Centraalbureau voor Schimmelcultures, Baarn, The Netherlands, pp. 231-238.

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

Raper, K.B. and Fennell, D.I. (1965): The genus *Aspergillus.* Williams and Wilkins, Baltimore, USA.

Rosa, M.C. De La, Mosso, M.A.; Fernandez-Sanfrancisco, M.T. and Gasten De Iriarte, E. (1979): The microbiology of infant foods. Anales de Bromatologia 31(2): 127-136. Dairy Sci. Abst. 43, 929 (1981).

Sabreen, M.S. (1986): Microflora in baby foods. M.V.sc. Thesis. Fac. Vet. Med. Assiut Univ., Egypt.

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

Seham, M.; Abdel-Rahman, H.A.; Morgan, S.D. and Hafez, R.S. (1983): Mycological studies on Egyptian soft cheese and cooking butter. Assiut Vet. Med. J. 11(21): 151-155.

Sutic, M.; Mitic, S. and Svilar, N. (1979): Aflatoxin in milk and milk products. Mijekarstvo 29(4): 74-80.

Torrey, G.S.A. and Marth, E.H. (1977): Isolation and toxicity of moulds from food stored in homes. J. of Food Protection 40(3): 187-190.

Table 1: Statistical analytical results of total molds recovered from the examined samples of milk powder.

Molds / Media	No. of +ve samples/50	Count/g			
		%	Min.	Max.	Average
Mesophils on dicloran agar	44	88	10	$21X10^3$	$34.88X10^2$
Mesophils on malt extract agar	28	56	10	$7.0X10^3$	$9.0X10^2$
Thermophils on dicloran agar	19	38	10	$4.3X10^3$	4.0X10

Table 1.Molds associated with milk powder samples.

Fungi	Mesophiles								Thermophiles			
	Dicloran agar				Malt agar				Dicloran agar			
	C	%C	NS	%F	C	%C	NS	%F	C	%C	NS	%F
Acremonium strictum W. Gams	126.7	0.08	3	6	10	0.04	1	2	-	-	-	-
Alternaria alternata (Fr.) Keissler	2033.3	1.33	3	6	4250	16.83	8	16	-	-	-	-
Aspergillus	105563.3	68.78	40	80	5450	21.58	12	24	230	30.67	17	34
A. aureolatus Munt-Cvat. & Bata	-	-	-	-	10	0.04	1	2	-	-	-	-
A. flavus Link	20400	13.29	6	12	1000	3.96	1	2	-	-	-	-
A. fumigatus Fresenius	706.7	0.46	3	6	-	-	-	-	-	-	-	-
A. fumigatus var. *albus* Rai, Tewari & Agarwal	-	-	-	-	-	-	-	-	40	5.33	1	2
A. melleus Yukawa	666.7	0.43	1	2	-	-	-	-	-	-	-	-
A. niger van Tieghem	77650	50.59	36	72	3340	13.23	8	16	120	16.0	13	26
A. parasiticus Speare	4666.7	3.04	1	2	-	-	-	-	-	-	-	-
A. proliferans G. Smith	666.7	0.43	1	2	-	-	-	-	-	-	-	-
A. sydowii (Bainier & Sartory) Thom & Church	336.6	0.22	2	4	-	-	-	-	-	-	-	-
A. tamarii Kita	366.6	0.24	2	4	-	-	-	-	-	-	-	-
A. terreus Thom	-	-	-	-	-	-	-	-	70	9.33	5	10
A. ustus (Bainier) Thom & Church	-	-	-	-	1000	3.96	1	2	-	-	-	-
A. versicolor (Vuill.) Tiraboschi	133.3	0.07	1	2	100	0.4	1	2	-	-	-	-
Cladosporium	726.7	0.47	4	8	100	0.4	1	2	-	-	-	-
C. cladosporioides (Fres.) de Vries	53.3	0.04	2	4	-	-	-	-	-	-	-	-
C. sphaerospermum Penz.	673.4	0.44	2	4	100	0.4	1	2	-	-	-	-
Cochliobolus	2000	1.30	2	4	120	0.48	3	6	-	-	-	-
C. lunatus Nelson & Haasis	1333.3	0.87	1	2	-	-	-	-	-	-	-	-
C. spicifer Nelson	666.7	0.43	1	2	120	0.48	3	6	-	-	-	-
Emericella	10700	6.97	4	8	1200	4.75	3	6	500	66.67	3	6
E. nidulans (Eidam) Vuillemin	10366.6	6.75	4	8	1200	4.75	3	6	500	66.67	3	6
E. quadrilineata (Thom & Raper) Benjamin	333.3	0.22	1	2	-	-	-	-	-	-	-	-
Fusarium oxysporum Schlecht.	66.6	0.04	2	4	250	0.99	5	10	-	-	-	-

Table 2: Cont.

Fungi	Mesophiles								Thermophiles			
	Dicloran agar				Malt agar				Dicloran agar			
	C	%C	NS	%F	C	%C	NS	%F	C	%C	NS	%F
Gibberella acuminata Wollenweber	-	-	-	-	400	1.58	1	2	-	-	-	-
Malbranchea sp.									10	1.33	1	2
Mucor racemosus Fresenius	100	0.07	2	4	-	-	-	-	-	-	-	-
Paecilomyces variotii Bainier		-	-	-	10	0.04	1	2	-	-	-	-
Penicillium	31513.2	20.53	22	44	11240	44.52	21	42	-	-	-	-
P. aurantiogriseum Dierckx	20006.6	13.03	3	6	-	-	-	-	-	-	-	-
P. brevicompactum Dierckx	670	0.44	3	6	-	-	-	-	-	-	-	-
P. chrysogenum Thom	2513.3	1.64	10	20	4540	17.98	6	12	-	-	-	-
P. citrinum Thom	333.3	0.22	1	2	6390	25.31	16	32	-	-	-	-
P. corylophilum Dierckx	-	-	-	-	100	0.4	1	2	-	-	-	-
P. pinophilum Hedgecock	6500	4.24	3	6	210	0.83	2	4	-	-	-	-
P. puberulum Bainier	390	0.25	3	6	-	-	-	-	-	-	-	-
P. variabile Sopp	433.3	0.28	2	4	-	-	-	-	-	-	-	-
P. waksmanii Zaleski	666.7	0.43	1	2	-	-	-	-	-	-	-	-
Rhizomucor pusillus (Lindt) Schipper	-	-	-	-	-	-	-	-	10	1.33	1	2
Rhizopus stolonifer (Ehrenb.) Lindt	666.6	0.43	2	4	1200	4.75	3	6	-	-	-	-
Setosphaeria rostrata Leonard	-	-	-	-	10	0.04	1	2	-	-	-	-
Stachybotrys charbarum (Ehrenb.:Lindt) Hughes	-	-	-	-	10	0.04	1	2	-	-	-	-
Trimmatostroma betulinum (Corda) Hughes	-	-	-	-	1000	3.96	1	2	-	-	-	-
Total fungi	153496.5	100	44	88	25250	100	28	56	750	100	19	38
Yeasts	750	-	1	2	-	-	-	-	220	-	4	8
Bacteria (*Bacillus* spp.)	69716.6	-	8	16	1010	-	2	4	-	-	-	-

C: counts of fungi per g milk powder in 50 samples tested.
%C: percentage count calculated per total fungal counts.
NS: number of contaminated milk powder samples out of 50.
%F: percentage frequency of fungi calculated per 50 samples.

Table 3: Counts of mesophilic Molds (C, per g milk powder) and the number of contaminated samples (NS) of various brands of milk powder on dicloran agar at 25°C.

Fungi	Brand A (5)		Brand B (5)		Brand C (7)		Brand D (6)		Brand E (9)		Brand F (10)		Brand G (8)	
	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS
Acremonium strictum	-	-	-	-	-	-	-	-	-	-	126.7	3	-	-
Alternaria alternata	-	-	-	-	-	-	1333.3	1	666.7	1	-	-	33.3	1
Aspergillus	24470	5	8896.6	5	18073.3	7	44026.7	5	7343.4	6	280	6	2473.3	6
A. flavus	-	-	-	-	-	-	19666.7	3	-	-	-	-	733.3	3
A. fumigatus	-	-	-	-	-	-	-	-	666.7	1	40	2	-	-
A. melleus	-	-	-	-	-	-	-	-	666.7	1	-	-	-	-
A. niger	24470	5	8793.3	5	12403.3	7	24026.7	4	6010	5	240	5	1706.7	5
A. parasiticus	-	-	-	-	4666.7	1	-	-	-	-	-	-	-	-
A. proliferans	-	-	-	-	666.7	1	-	-	-	-	-	-	-	-
A. sydowii	-	-	-	-	3.3	1	333.3	1	-	-	-	-	-	-
A. tamarii	-	-	-	-	333.3	1	-	-	-	-	-	-	33.3	1
A. versicolor	-	-	103.3	1	-	-	-	-	-	-	-	-	-	-
Cladosporium	20	1	-	-	-	-	666.7	1	-	-	-	-	40	2
C. cladosporioides	20	1	-	-	-	-	-	-	-	-	-	-	33.3	1
C. sphaerospermum	-	-	-	-	-	-	666.7	1	-	-	-	-	6.7	1
Cochliobolus	-	-	-	-	1333.3	1	666.7	1	-	-	-	-	-	-
C. lunatus	-	-	-	-	1333.3	1	-	-	-	-	-	-	-	-
C. spicifer	-	-	-	-	-	-	666.7	1	-	-	-	-	-	-
Emericella	33.3	1	-	-	666.7	1	-	-	10000	2	-	-	-	-
E. nidulans	33.3	1	-	-	333.3	1	-	-	10000	2	-	-	-	-
E. quadrilineata	-	-	-	-	333.3	1	-	-	-	-	-	-	-	-
Fusarium oxysporum	33.3	1	33.3	1	-	-	-	-	-	-	-	-	-	-

Table 3. Cont.

Fungi	Brand A (5)		Brand B (5)		Brand C (7)		Brand D (6)		Brand E (9)		Brand F (10)		Brand G (8)	
	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS
Mucor racemosus	-	-	66.7	1	-	-	-	-	-	-	-	-	33.3	1
Penicillium	21000	3	766.6	5	4070	5	1000	2	3666.6	2	276.7	3	733.3	2
P. auranticgriseum	20000	1	3.3	1	3.3	1	-	-	-	-	-	-	-	-
P. brevicompactum	-	-	3.3	1	666.7	2	-	-	-	-	-	-	-	-
P. chrysogenum	-	-	270	2	66.7	1	1000	2	333.3	1	110	2	733.3	2
P. citrinum	333.3	1	-	-	-	-	-	-	-	-	-	-	-	-
P. pinophilum	-	-	-	-	3000	1	-	-	3333.3	1	165.7	1	-	-
P. puberulum	-	-	390	3	-	-	-	-	-	-	-	-	-	-
P. variabile	-	-	100	1	333.3	1	-	-	-	-	-	-	-	-
P. waksmanii	666.7	1	-	-	-	-	-	-	-	-	-	-	-	-
Rhizopus stolonifer	333.4	1	-	-	-	-	333.3	1	-	-	-	-	-	-
Total fungi	45890	5	9763.2	5	24143.3	7	48026.7	5	21676.7	6	683.4	10	3313.2	6
Yeasts	-	-	750	1	-	-	-	-	-	-	-	-	-	-
Bacteria (*Bacillus* spp.)	44000	3	25383.3	4	-	-	-	-	333.3	1	-	-	-	-

Table 4: Counts of xerophilic molds (C. per 1 g milk powder) and the number of contaminated samples (NS) of various brands of milk powder on malt agar at 25°C.

Fungi	Brand A (5)		Brand B (5)		Brand C (7)		Brand D (6)		Brand E (9)		Brand F (10)		Brand G (8)	
	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS
Acremonium strictum	-	-	-	-	10	1	-	-	-	-	-	-	-	-
Alternaria alternata	130	2	-	-	2000	1	10	1	1110	3	-	-	1000	1
Aspergillus	110	2	1110	3	3110	3	1100	2	10	1	10	1	-	-
A. aureolatus	-	-	-	-	10	1	-	-	-	-	-	-	-	-
A. flavus	-	-	-	-	-	-	1000	1	-	-	-	-	-	-
A. niger	110	2	10	1	3111	2	100	1	10	1	10	1	-	
A. ustus	-	-	1000	1	-		-	-	-	-	-	-	-	
A. versicolor	-	-	100	1	-	-	-	-	-	-	-	-	-	
Cladosporium sphaerospermum	100	1	-	-	-	-	-	-	-	-	-	-	-	
Cochliobolus spiciter	100	1	10	1	-		10	1	-	-	-	-	-	-
Emericella nidulans	-	-	100	1	1100	2	-	-	-	-	-	-	-	-
Fusarium oxysporum	130	2	100	1	-	-	10	1	10	1	-	-	-	-
Gibberella acuminata	400	1	-	-	-	-	-	-	-	-	-	-	-	-
Paecilomyces variotii	-	-	-	-	10	1	-	-	-	-	-	-	-	-
Penicillium	470	5	1330	5	8810	6	320	3	300	1	10	1	-	-
P. chrysogenum	30	1	210	2	4100	2	-	-	200	1	-	-	-	-
P. citrinum	440	4	1120	4	4510	5	320	3	-	-	-	-	-	-
P. corylophilum	-	-	-	-	-	-	-	-	100	1	-	-	-	-
P. pinophilum	-	-	-	-	200	1	-	-	-	-	10	1	-	-
Rhizopus stolonifer	-	-	1000	1	-	-	200	2	-	-	-	-	-	-
Setosphaeria rostrata	-	-	10	1	-	-	-	-	-	-	-	-	-	-
Stachybotrys chartarum	10	1	-	-	-	-	-	-	-	-	-	-	-	-
Trimmatostroma betulinum	-	-	-	-	-		-	-	-	-	-	-	1000	1
Total fungi	1450	5	3060	5	15040	5	1650	5	1430	4	20	2	2000	1
Bacteria (*Bacillus* spp.)	-	-	-	-	-	-	-	-	10	1	-	-	1000	1

Table 5: Counts of thermophilic Molds (C, per g milk powder) and the number of contaminated samples (NS) of various brands of milk powder on dicloran agar at 5.5°C.

Fungi	Brand A (5)		Brand B (5)		Brand C (7)		Brand D (6)		Brand E (9)		Brand F (10)		Brand G (8)	
	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS	C	NS
Aspergillus	20	3	90	3	10	1	40	3	10	1	40	4	20	2
A. fumigatus var. *albus*	-	-	40	1	-	-	-	-	-	-	-	-	-	-
A. niger	10	2	30	3	10	1	20	2	10	1	20	2	20	2
A. terreus	10	1	20	1	-	-	20	1	-	-	20	2	-	-
Emericella nidulans	-	-	430	1	-	-	-	-	40	1	30	1	-	-
Malbranchea sp.	-	-	-	-	-	-	-	-	-	-	10	1	-	-
Rhizomucor pusillus	10	1	-	-	-	-	-	-	-	-	-	-	-	-
Total fungi	30	3	520	4	10	1	40	3	50	1	80	5	20	2
Yeasts	190	2	20	1	-	-	10	1	-	-	-	-	-	-