



Chemical and mycological evaluation of sweetened condensed and evaporated milks in Menofia governorate.

Dina, I. EL Zahaby¹ and Nermeen, H. Ghazaly².

¹ Animal Health Research Institute, Shibin EL Koom branch, Department of Food Hygiene.

² Animal Health Research Institute, Shibin EL Koom branch, Department of Mycology.

ABSTRACT

Fifty random samples of imported concentrated milk (25 each of sweetened condensed and evaporated milk) were collected from different supermarkets in Menofia Governorate for chemical and mycological examination. The mean values of total solids, fat, protein, sucrose contents and sugar/water ratio in the examined sweetened condensed milk samples were 29 ± 0.31 , 8.5 ± 1.3 , 7.9 ± 1.1 , 43 ± 0.32 and 61.91 ± 0.35 , respectively. While, the mean values of total solids, fat and protein contents in examined evaporated milk samples were 25.7 ± 1.1 , 8.5 ± 0.23 and 7.1 ± 1.0 , respectively. Mold and yeast were detected in both sweetened condensed and evaporated milk. *Aspergillus* and *Penicillium* genera were frequently isolated than other genera of fungi. *Aspergillus spp.* were isolated with percentage of (32%) and (44%) from sweetened condensed and evaporated milk respectively. *A. flavus* was the most dominant spp. in the examined samples with percentage of (87.5%) and (27.5%) from sweetened and evaporated milk respectively. From yeast isolated the genus *Saccharomyces* was the most dominant in the contaminated sweetened condensed milk samples (40%), followed by *Rhodotorula* (12%), then genus *Candida* (8%). While from evaporated milk the isolated yeast were *Rhodotorula*, *Candida*, and *Saccharomyces* with percentage (12%), (8%) and (4%), respectively.

Keywords: condensed milk, evaporated milk, mold, yeast.

(<http://www.bvmj.bu.edu.eg>)

(BVMJ-31(2): 16-20, 2016)

1. INTRODUCTION

Dairy products of reduced moisture content are produced to achieve savings in transportation and merchandising costs related to the reduced volume and weight. These products, with their greater concentration of milk solids are useful in the manufacture of ice cream, candies, and a variety of other food items (ADPI, 2000). Sweetened condensed milk is concentrated milk with sugar and is obtained by the partial removal of water only from milk (25% moisture content). Full cream sweetened milks are not sterile and the microorganisms that survive heat treatments are usually thermophilic or thermophilic group. (NDPRC, 2009). Unsweetened evaporated milk is defined as the sticky and thick liquid product prepared from fluid milk or milk powder as a raw material without any sugar added with 75% moisture content (Robinson, 2002). The canned sweetened condensed milk with its high sugar content may swell occasionally owing to the growth of yeast (Tudor and Board, 1993). The

molds most likely to be present are *Aspergillus* and *Penicillium* and molds may contaminate the product between the pasteurization and the can-closing machine through a defective seal (Milner, 1995). The increased concentration of milk solids brought about by the removal of water by evaporation also contributed to the increase in osmotic pressure but this is relatively minor compared to the added sugar. The use of sugar to extend the shelf life should not be considered a substitute for good quality raw milk proper sanitation, and adequate processing and holding practices. *Aspergillus* and *Penicillium* may associate with defects in condensed milk especially if the canned products are held for long time without proper storage condition (Robinson, 2002). This work was planned to assess the chemical and mycological status of condensed and evaporated milks marketed in Menofia governorate.

2. Materials and methods

2.1. Collection of samples:

Fifty random samples of concentrated milk cans (25 each of sweetened condensed and evaporated milk) of different brands were collected from large supermarkets in Menofia governorate. Samples were still valid for consumption as shelf life is 18 months from production time. Samples were transported to the laboratory with a minimum of delay and examined to assess their quality according to the following steps: Physical examination (Coren et al., 1978). Organoleptic examination (APHA, 1992).

Chemical examination: (FSSAI, 2015), Determination of total solids content, Determination of fat content, Determination of protein content, Determination of sucrose content, Determination of sugar /water ratio.

2.2. Isolation and identification of mold and yeast:

Identification of mold genera and species were carried out according to (Raper and Fennel, 1965) and (Samson, 1979) for genus *Asperigillus*, (Arx, 1967); (Raper and Thom 1969); (Samson et al., 1976) and (Zycha et al., 1969) for the other mold genera. Identification of isolated yeast genera were carried out according to the methods recommended by (Deak and Beuchat, 1996).

3. RESULTS

Table (1) showed that the mean values of total solids, fat and protein contents in the examined full cream evaporated milk samples were 25.7 ± 1.1 , 8.5 ± 0.23 and 7.1 ± 1.0 , respectively, while for sweetened condensed milk samples The mean values of total solids, fat, protein, sucrose contents and sugar/water ratio were 29 ± 0.31 , 8.5 ± 1.3 , 7.9 ± 1.1 , 43 ± 0.32 and 61.91 ± 0.35 , respectively.

The common isolated mold was *Penicillium*, *Aspergillus*, *Mucor* and *Geotrichum* spp. They were found in full cream sweetened condensed milk samples in percentage 40, 32, 40 and 12 % respectively. While the mold isolated from evaporated milk were *Penicillium*, *Aspergillus*, *Mucor*, *Rhizopus* and *Geotrichum* in percentage 48, 44, 12, 8 and 4%, respectively Table (2). *Aspergillus flavus* was the most common *Aspergillus* spp. isolated with percentage of 87.5%, 27.5% from condensed and evaporated milk respectively. Table (3). The most common yeast species isolated from sweetened condensed milk were *Saccharomyces*, *Rhodotorulla* and *Candida* with percentage of 40, 12 and 8%, respectively, while yeast isolated from evaporated milk samples

Table (1): Statistical analytic results of chemical examination of the Examined samples of concentrated milk. (N=50)

Product Chemical Parameters	Sweetened condensed milk (N=25)		Evaporated milk (N=25)	
	Mean \pm SE	Mpl	Mean \pm SE	Mpl
Total solids %	29.8 ± 0.31	28	25.7 ± 1.1	25
Fat content%	8.5 ± 1.3	8	8.5 ± 0.23	7.5
Protein content %	7.9 ± 1.1	-----	7.1 ± 1.0	-----
Sucrose %	43.49 ± 0.32	43	-----	-----
Sugar /water	61.91 ± 0.35	60-66	-----	-----

MPL: minimum permissible limits (E.S., 2005a and b)

were *Saccharomyces*, *Rhodotorulla*, *Candida* and *Torulopsis* with percentage 4, 12, 8 and 8%, respectively (Table 4).

4. DISCUSSION

Chemical examination results given in table (1) revealed that the mean values of total solids, fat, protein, sucrose contents and sugar / water ratio in examined full cream sweetened condensed milk samples were 29.8 ± 0.31 , 8.5 ± 1.3 , 7.9 ± 1.1 , 43.49 ± 0.32 , 61.91 ± 0.35 , respectively. These result nearly agreed with that obtained by (Ashry-Sally,

2011). All samples were complied with the Egyptian standards (E.S., 2005, a) which stated that full cream sweetened condensed milk should contain not less than 28% total milk solids and not less than 8% milk fat and also all samples complied with chemical standard stated by (APHA, 1992) for sucrose that must be not less than 43% and sugar/water ratio (60- 66%). As sweetened condensed milk is preserved by addition of sugar, consequently its water activity is reduced to a point that inhibit to most microorganisms. Also, the increased milk solids content decreases the water activity. The sugar in water concentration of

Table (2): Incidence of different mold isolated from concentrated milk.

Sample	Sweetened condensed milk (N=25)		Evaporated milk (N=25)	
	No. of + ve sample	%	No. of + ve sample	%
Isolated molds				
Aspergillus	8	32%	11	44%
Pencillium	10	40%	12	48%
Rhizopus	----	----	2	8%
Absidia	----	----	1	4%
Mucor	10	40%	3	12%
Geotrichum	3	12%	1	4%
Nigrospora	----	----	1	4%
Paecilomyces	----	----	1	4%

Table (3): Identification of isolated Aspergillus spp. from condensed and evaporated milk.

Aspergillus Spp.	Sweetened condensed milk (N=8)		Evaporated milk (N=11)	
	No. of + ve sample	%	No. of + ve sample	%
A. flavus	7	87.5%	3	27.5%
A. fumigatus	----	----	2	18%
A. niger	----	----	3	27.5%
A. versicolor	----	----	1	9%
A. ochraceous	----	----	1	9%
A. clavatus	----	----	1	9%
A. terreus	1	12.5%	----	----

Table (4): Incidence of different yeast isolated from concentrated milk.

Sample	Sweetened condensed milk (N=25)		Evaporated milk (N=25)	
	No. of + ve sample	%	No. of + ve sample	%
Isolated yeast				
Saccharomyces spp.	10	40%	1	4%
Rhodotorulla spp.	3	12%	3	12%
Candida spp.	2	8%	2	8%
Torulopsis spp.	----	----	2	8%

sweetened condensed milk is called the sugar/water ratio. In addition, table (1) showed that the mean values of total solids, fat and protein contents in the examined full cream evaporated milk samples were 25.7 ± 1.1 , 8.5 ± 0.23 and 7.1 ± 1.0 , respectively. All samples complied with the Egyptian standard (E.S., 2005b) which stated that full cream evaporated milk should contain not less 25% total milk solids and not less than 7.5% milk fat. Mycological examination: Sweetened condensed milk is not a sterile product and the various methods of heat treatment used are not adequate to kill the contaminant microorganisms that may exist. The sugar normally added is sucrose, but other sugars may be used, the sugar is normally an unimportant source of microorganisms, but under unfavorable conditions, it may contaminate with mold spores and osmophilic yeast. Sugar storage should be in a dry

place free from dust, insect and rodent contamination (Robinson, 2002).

The results reported in table (2) revealed that the common isolated mold were *Penicillium*, *Aspergillus*, *Mucor* and *Geotrichum* spp. were found in full cream sweetened condensed milk samples with percentage of 40, 32, 40 and 12 %, respectively. While the mold isolated from evaporated milk were *Penicillium*, *Aspergillus*, *Mucor*, *Rhizopus* and *Geotrichum* in percentage 48, 44, 12, 8 and 4%, respectively.

Amer and EL- Mosalami (2006) found *Aspergillus flavus*, *Aspergillus niger* and *Penicillium* spp. isolated from evaporated milk samples in percentage 5, 0 and 5%, respectively. While from the condensed milk they isolate *Alternaria alternaria*, *Aspergillus flavus*, *Aspergillus*

niger, *Penicillium spp.* in percentage 5,10,20,20 % respectively.

Table (3) revealed that *Aspergillus flavus* was the most common *Aspergillus spp.* in percentage 87.5%,27.5% from condensed and evaporated milk respectively while (Ashry-Sally, 2011) isolated mold from sweetened condensed milk and evaporated milk and classified as *Aspergillus flavus*, *Aspergillus fumigates*, *Aspergillus Niger*, *Aspergillus terreus*, and *Penicillium spp.* in percentage 18.2, 9.0, 18.2, 24.2 ,15,2 and 20, 16, 24, 20, 8 8%, respectively.

Aspergillus spp. are usually regarded as spoilage microorganism, may cause invasive disease as aflatoxicosis in human (Quinn et al., 2007) and (Leila et al., 2010).

Table (4) showed that the most common yeast species isolated from sweetened condensed milk were *Saccharomyces*, *Rhodotorulla* and *Candida* in percentage 40, 12 and 8%, respectively, while yeast isolated from evaporated milk samples were *Saccharomyces*, *Rhodotorulla*, *Candida* and *Torulopsis* with percentage 4, 12, 8 and 8%, respectively. Yeast specially genus *Candida* have a major public health hazards, because it causes several pathogenic lesions as stomatitis, diarrhea, intestinal disturbance, endocarditis and fetal systemic disease (Bier, 1994), (Koneman et al., 1997), (Lott and Effat, 2001), (Santana and Erturanz, 2010). *Saccharomyces cerevisiae* is considered a common colonizer of human gastrointestinal and urinary tract as it cause invasive disease in immune compromised person (Pillai et al., 2014). In these work The number of samples which failed to comply with (E.S., 2005, b) for sweetened condensed milk was (15 samples) and for evaporated milk was (10 samples) as it stipulated that, both sweetened condensed milk and evaporated milk must be free from mold and yeast in one gram.

5. CONCLUSION

Generally, concentrated milks are favorable media for the growth of many environmental contaminants specially yeast and mold, so using high quality raw milk and sugar in condensed milk manufacture with application of good sanitation and hygienic condition during production, handling and storage are important to prevent such product from spoilage and to protect the consumer from infection.

6. REFERENCES

- ADPI, 2000. Evaporated milk. Utilization and production trends. American Dairy Products Institute, Chicago.
- Amer, A.A., EL- Mosalami, H.A., 2006. Quality assessment of sweetened condensed and evaporated milks in Alexandria Governorate. Assiut Vet. Med. J., 52, 97-108.
- APHA, 1992. American Public Health Association. Compendium of methods for the Microbiological Examination of foods, 3rd ed, Washington, DC.
- Arx, J.A., 1967. Pilzkunde, J. Cramerinder A.R. Canter Verlag, Kommanditge Sellschaft, FL-9490 Vaduz.
- Ashry-Sally, A.A. 2011. Quality evaluation of concentrated milk sold in the local marketsM.V.Sc., Alex. Univ.
- Bier, R.c., 1994. Toxocology of natural occurring chemicals in foods. HuiYH, food borne diseases and disease caused hazard, 3 ed, New York.
- Coren, S., Porac, C., Ward, L.M., 1978. Sensation and perception. Academic press, New York.
- Deak, T., Beuchat, L., 1996. Handbook of food spoilage yeasts. CRC Press, Boca Racon, FL, USA.
- E.S., 2005, a. Egyptian standards 1830 / 2005. Arab Republic of Egypt. Egyptian Organization for Standardization and Quality Control for evaporated milks.
- E.S., 2005, b Egyptian Standards 1830/2005. Arab Republic of Egypt. Egyptian Organization for Standardization and Quality Control for condensed milks
- FSSAI, 2015. Food Safety and standards Authority of India Ministry of Health and family welfare Government of India. Manual of Methods of Analysis of Foods.Lab.Manual I, Milk and Milk Products. Ministry of Health and Welfare, FDA Bhawan, Kotla Road, New Delhi-110002, India.
- Koneman, E., Allen, S., Janda, W., schrechenberger, c., w., w., 1997. color Atlas and text book of Diagnostic Microbiology 5ed. Lippincott, Philadelphia, New York.
- Leila, s.z., Alireza, k., Mosein, E., 2010. comparison of allergenic powder of *A.fumigatus*, *A.flavus* and *A.niger* fungi by using patients sera with asthma. Middle east Journal of Research 5, 350-354.
- Lott, T.J., Effat, M.M., 2001. *Candida albicans* North American Population Microbiology
- Milner, F.E., 1995. Microbiology Handbook. Leather head Food RA, Randalls Road, Surrey KT227 RY.

- NDPRC, 2009. (National Dairy Products Research Center). Internet Search about Concentrated milks.
- Pillai, U., Devasahayam, J., Kurup, A.N., Lacasse, A., 2014. Invasive *Saccharomyces cerevisiae* infection: a friend turning foe? Saudi J Kidney Dis Transpl 25, 1266-1269.
- Quinn, p.J., carter, B.M.E., Markey, G.R., 2007. clinical Veterinary Microbiology. Grafos, Velog Gmbm, Madrid, spain
- Raper, K.B., Fennel, D.L., 1965. The genus *Aspergillus*., 1 ed. Williams and Wilkins Co., Baltimore, USA.
- Raper, K.B., Thom , C., 1969. A manual of the *Penicillia* Hafner publishing Co., New York, USA.
- Robinson, R.K., 2002. Dairy microbiology Handbook, the Microbiology of concentrated and dried milk, 3 ed. Wiley inter science, New York.
- Samson, R., Stalk, A., Hadlok, R., 1976. Revision on the subsection *fasiculata* of *Pencillium* and some allied species studies in mycology. Appl. Microbiol. 24, 172-176.
- Samson, R.A., 1979. A complication of *Aspergillus*, described since 1965 studies in mycology. Baarn 18, 1-36.
- Santana, D., Erturanz, G.E., 2010. The antifungal susceptibilities of oral candida spp. Isolates from HIV-infected patients. African J of Microbiol. Research 4, 1831-1835.
- Tudor, E.A., Board, R.G., 1993. Food spoilage-yeast. The yeasts, Yeast Technology. Eds A.H. & J.S. , 2 ed. Academic Press, Harrison London.
- Zycha, H., Siepman, R., Lineman, G., 1969. *Mucorales* Eine Beschreibung aller Gattungen und Arten Dieser pilzgruppe verlagvan. J. Canner, West Germany.