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**MICROBIOLOGICAL QUALITY OF DRIED  
MILK-BASED INFANT FOODS IN ASSIUT CITY**  
(With 6 Tables)

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(Received at 25/3/2003)

التقييم الميكروبيولوجي لبعض أغذية الأطفال اللبنية الجافة في مدينة أسيوط

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يتزايد الإقبال على استعمال اللبن الأطفال كبديل للبن الأم نتيجة لعدم قدرة بعضهن على إرضاع أطفالهن ، لذلك كان لابد من استعمال بائل مناسبة للأعمار المختلفة ومتوافر بها الشروط الصحية لضمان سلامة الأطفال. لذا تم في هذه الدراسة تجميع ٩٠ عينة عشوائية من أغذية الأطفال اللبنية الجافة ، بواقع ٣٠ عينة من كل من ٤ أنواع من اللبن البودرة للأطفال حديثي الولادة ( أ ) ، ٣ أنواع من أغذية أقطام الجافة المحتوية على خلاصة الحبوب (ب) ونوع واحد من الألبان الجافة كاملة النسم والتي تعطى للأطفال من عمر سنة (ج) وذلك من المحلات والصيدليات المختلفة بمدينة أسيوط والتي تم إنتاجها خلال عامي ٢٠٠١-٢٠٠٢م وكانت صالحة للاستهلاك خلال عام من تاريخ الإنتاج . وقد تم فحص هذه العينات ميكروبيولوجيا، ودلت النتائج على أن متوسط العدد الكلي للميكروبات والميكروبات اللاهوائية ، الباسيلس سيربوس والفطريات والخمائر في العينات (أ) كان  $9.50 \times 10^3$  ،  $1.0 \times 10^4$  ،  $1.0 \times 10^4$  ،  $1.0 \times 10^4$  ،  $1.0 \times 10^4$  في الجرام على التوالي ، أما في حالة النوع (ب) وجد أن ١١ (٣٦,٦٦%) ، ٢ (٦,٦٦%) و ١٣ (٣٣,٣٣%) من العينات المفحوصة تحتوي على ميكروبات هوائية ، ميكروبات لا هوائية والفطريات والخمائر على التوالي، هذا وقد لوحظ أن متوسط العدد الكلي للميكروبات ، الباسيلس سيربوس والميكروبات المحبة للبرودة، الميكروبات المقاومة للحرارة والفطريات والخمائر كان على التوالي  $1.0 \times 10^6$  ،  $1.0 \times 10^5$  ،  $1.0 \times 10^3$  ،  $1.0 \times 10^3$  ،  $1.0 \times 10^3$  في الجرام من عينات (ج). وأوضحت النتائج أيضا عدم وجود الميكروبات القولونية والذكور العنقودي الذهبي في كل العينات (أ) و (ب) و (ج) بالإضافة إلى عدم عزل كل من الميكروبات المحبة للبرودة والمقاومة للحرارة في عينات (أ) ، ومثلها علاوة على الباسيلس سيربوس في عينات (ب) والميكروبات اللاهوائية في عينات (ج). وقد نأش البحث الأثار المترتبة على تواجد هذه الميكروبات وتأثيرها على صحة الأطفال ، استرشادا بالمواصفات القياسية المصرية والعالمية للألبان الجافة توصى بتحليل هذه المنتجات بصفة دورية للتأكد من عدم تلوثها بالميكروبات الممرضة بأنواعها المختلفة.

## SUMMARY

Ninety random samples of dried milk-based foods (30 samples each) comprising 4 brands of infant's milk powder (A) (for babies after birth), 3 brands of milk-cereal based weaning foods (B) (from up 4 months) and dried milk powder (C) (from up one year) were collected from different shops and pharmacies in Assiut City during 2001-2002. These samples were examined for incidence of different types of microorganisms, to evaluate their quality. The obtained results revealed that the average counts of APC, anaerobes, *B. cereus* and yeasts and molds were  $9.5 \times 10^3$ ,  $0.4 \times 10$ ,  $2.1 \times 10$  and  $3.6 \times 10^3/g$  of examined samples of type A, respectively. However, coliforms, psychrotrophes, *Staph. aureus* and thermotolerants failed to be detected. In case of type B, 11(36.66%), 2(6.66%) and 13(43.33%) of the examined samples contained aerobic bacteria, anaerobes and yeasts and molds, respectively, while no *B. cereus*, coliforms, psychrotrophes, *Staph. aureus* and thermotolerants could be isolated. Moreover, it was noticed that the average values of APC, *B. cereus*, psychrotrophes, thermotolerants and yeasts and molds were respectively,  $6.5 \times 10^4$ ,  $6.0 \times 10^2$ ,  $9.5 \times 10$ ,  $1.3 \times 10^2$  and  $3 \times 10^3/g$  of the examined samples of type C. On the contrary, anaerobes, coliforms and *Staph. aureus* could not be detected. The public health and economic significance as well as suggestive measures for improving the microbiological quality of these products were discussed.

*Key words: Microbiological quality, dried milk-based infant foods.*

## INTRODUCTION

Fresh milk and its products have made a major contribution to infants and adults diet in all countries all over the world. In recent years, there has been a growing use of baby foods with dairy base as replacers of fresh milk or in addition to it. In Egypt, dried milks are utilized in many food industries as baking, confectionery and dairy industry. In addition, 8 to 10 thousand tons of standardized fortified milk powder is imported for infant milk food, infant formulae and milk-based cereal weaning foods (Abdel-Mottaleb, 1988). Undoubtedly, the ideal food for babies is the breast milk, however, there are occasions when a substitute must be found. Dried milk is still the most ingredient of breast milk substitute formulation, because many mothers cannot nurse their infants (El-Shinawy *et al.*, 1995). Moreover, milk powder has long shelf life, consequently lowers the cost of transportation and stored for long

periods without significant deterioration (Edgar and Axel, 1998 and Ranken and Baker, 1999).

The manufacture of baby foods based on dried milk involving mixing of various ingredients so, serious health hazards may be found if good manufacturing and hygienic practices are not followed (Anon, 1986). Furthermore, the shelf life, storage stability, flavor quality and nutritional value of milk powder are impaired when stored at high temperatures over a long period (Renner, 1988). Mettler (1989) reported that numerous incidents of salmonellosis associated with the use of milk powders, while Hobbs and Roberts (1993) found that contamination of milk powder with *Staph. aureus* causes many cases of food poisoning. Normal powder quality can be judged by subjective tests, which include physical (taste, odor and texture), chemical properties and both quantitative and qualitative estimation of microbial flora (Hayes, 1992). Milk powder microbial quality is of primary concern due to the susceptibility of children to food borne diseases (Ismail and Saad, 1995). Furthermore, reconstituted infant formulas are considered a food class of high risk because of the occurrence of enteric bacterial pathogens, severe response to enterotoxins and increased mortality of the infant population (Rowan and Anderson, 1998).

Many reports have been published earlier worldwide on the microbiological quality of baby foods by several investigators (Jarchovska *et al.*, 1980; Singh *et al.*, 1980; Schwab *et al.*, 1982; Moustafa *et al.*, 1984; Saad, 1985; Alvarez Marante *et al.*, 1986; Sabreen, 1986; Muytjens *et al.*, 1988; Al-Ashmawy *et al.*, 1993; Ismail and Saad, 1995; Saad, 1995 and Rowan and Anderson, 1998).

The most important index of microbiological quality is T.B.C, coliforms, yeasts and molds, thermotolerant counts and detection of specific pathogens and their toxins as recorded by Kwee *et al.* (1986), Robinson (1990) and A.P.H.A. (1992). The microbial quality of infant foods reflects the care with which milk was produced and the sanitary conditions prevailing during its manufacture, thus baby foods must be examined at regular intervals. Therefore, this work was accomplished to secure information regarding the sanitary conditions as well as the existing pathogens in baby foods and some dried milk-based infant foods currently available at the retail level.

## **MATERIALS and METHODS**

### **Collection of samples:**

Ninety random samples of dried milk-based foods (30 samples each) constituting 4 brands of infant's milk powder (for babies after birth), 3 brands of milk-cereal based weaning foods (from up 4 months) and dried milk powder (from up 1 year) were purchased from different shops and pharmacies in Assiut City. These samples were still valid for consumption as shelf life is at least to be one year from production time (2001-2002). They were transferred to the laboratory in their packages to be examined microbiologically to evaluate their quality.

### **Preparation of samples:**

Cartons or cans of samples were cleaned, thoroughly mixed and aseptically opened. Eleven grams of each sample were diluted in 99 ml of peptone water 0.1%, from which decimal dilutions were prepared according to A.P.H.A. (1992).

### **Microbiological examination:**

The prepared samples were subjected to the following examinations:

- 1- Aerobic plate count (APC), psychrotrophic and thermotolerant counts: using Standard plate agar (A.P.H.A., 1992).
- 2- Anaerobic count: by applying Lactose-Sulphite broth (LS) using MPN technique and incubation at 46°C for 18-24 h (Beerens *et al.*, 1982).
- 3- Bacillus cereus count: using direct plating technique on Mannitol egg-yolk polymyxin agar (MYP) (Lancette and Harmon, 1980). Isolates were identified morphologically and biochemically according to the methods adopted by MacFaddian (1976).
- 4- Coliforms count: using Violet red bile agar (A.P.H.A., 1992).
- 5- Staphylococcus aureus count: using Baird-Parker agar (Baird-Parker, 1962).
- 6- Total yeasts and molds count: using Sabouraud's dextrose agar with chloramphenicol to adopt the technique recommended by Mislivec *et al.* (1992).

## **RESULTS**

The obtained results were recorded in Tables 1 - 6.

**Table 1:** Statistical analytical results of microbiological examination of infant milk powder samples.

Types of microorganisms	Positive samples		Count / g		
	No./30	%	Min.	Max.	Average
1- Aerobic plate count	16	53.33	< 10	$1 \times 10^5$	$9.5 \times 10^3$
2- Anaerobic count	1	3.33			$0.4 \times 10$
3- Bacillus cereus count	5	16.66	< 100	$2 \times 10^2$	$2.1 \times 10$
4- Coliforms count	-	-	-	-	.*
5- Psychrotrophic count	-	-	-	-	.*
6- Staph. aureus count	-	-	-	-	.*
7- Thermoduric count	-	-	-	-	.*
8- Yeasts and molds count	7	23.33	< 10	$9 \times 10^4$	$3.6 \times 10^3$

\*Could not be detected on the plate (<10 or <100)

**Table 2:** Frequency distribution of microbiological examination of infant milk powder samples.

Intervals	Aerobic plate count		Anaerobes		Bacillus cereus		Yeasts & molds Count	
	No.	%	No.	%	No.	%	No.	%
< $10^2$					1	20.0		
$10^2$ - < $10^3$	3	18.75	1	100.0	4	80.0		
$10^3$ - < $10^4$	5	31.25					5	71.4
$10^4$ - < $10^5$	7	43.75					2	28.6
* $10^5$ - < $10^6$	*1	6.25						
<b>Total</b>	<b>16</b>	<b>100.0</b>	<b>1</b>	<b>100.0</b>	<b>5</b>	<b>100.0</b>	<b>7</b>	<b>100.0</b>

\*Unacceptable quality

**Table 3:** Statistical analytical results of microbiological examination of milk-cereal based weaning food samples.

Types of microorganisms	Positive samples		Count / g		
	No. / 30	%	Min.	Max.	Average
1- Aerobic plate count	11	36.66	< 10	$5 \times 10^3$	$6.2 \times 10^4$
2- Anaerobic count	2	6.66	1	$3.6 \times 10$	$0.9 \times 10$
3- Bacillus cereus count	-	-	-	-	.*
4- Coliforms count	-	-	-	-	.*
5- Psychrotrophic count	-	-	-	-	.*
6- Staph. aureus count	-	-	-	-	.*
7- Thermoduric count	-	-	-	-	.*
8- Yeasts and molds count	13	43.33	< 10	$2 \times 10^3$	$1.1 \times 10^4$

\*Could not be detected on the plate (<10 or <100)

**Table 4:** Frequency distribution of microbiological examination of milk-cereal based weaning food samples.

Intervals	Aerobic plate count		Anaerobes		Yeasts & molds count	
	No.	%	No.	%	No.	%
< 10 <sup>2</sup>			2	100.0		
10 <sup>2</sup> - < 10 <sup>3</sup>	1	9.1			2	15.4
10 <sup>3</sup> - < 10 <sup>4</sup>					8	61.5
10 <sup>4</sup> - < 10 <sup>5</sup>	6	54.5			1	7.7
*10 <sup>5</sup> - < 10 <sup>6</sup>	*4	36.4			2	15.4
Total	11	100.0	2	100.0	13	100.0

\* Unacceptable quality

**Table 5:** Statistical analytical results of microbiological examination of dried milk powder samples.

Types of microorganisms	Positive samples		Count / g		
	No. / 30	%	Min.	Max.	Average
1- Aerobic plate count	16	53.33	< 10	8×10 <sup>3</sup>	6.5×10 <sup>4</sup>
2- Anaerobic count	-	-	-	-	-*
3- Bacillus cereus count	6	20	< 100	1×10 <sup>4</sup>	6.0×10 <sup>2</sup>
4- Coliforms count	-	-	-	-	-*
5- Psychrotrophic count	8	26.66	< 10	9×10 <sup>2</sup>	9.5×10
6- Staph. aureus count	-	-	-	-	-*
7- Thermophilic count	6	20	< 100	3×10 <sup>3</sup>	1.3×10 <sup>2</sup>
8- Yeasts and molds count	18	60	< 10	5×10 <sup>4</sup>	3.0×10 <sup>3</sup>

\*Could not be detected on the plate (<10 or <100)

**Table 6:** Frequency distribution of microbiological examination of dried milk powder samples.

Intervals	APC		B.cereus count		Psychrotrophes		Thermophilic		Yeasts & molds count	
	No.	%	No.	%	No.	%	No.	%	No.	%
< 10 <sup>2</sup>			1	16.67	2	25.0	1	16.67		
10 <sup>2</sup> - < 10 <sup>3</sup>	2	12.5			6	75.0	4	66.66	6	33.33
*10 <sup>3</sup> - < 10 <sup>4</sup>			*4	66.66			1	16.67	10	55.56
*10 <sup>4</sup> - < 10 <sup>5</sup>	10	62.5	*1	16.67					2	11.11
*10 <sup>5</sup> - < 10 <sup>6</sup>	*4	25.0								
Total	16	100.0	6	100.0	8	100.0	6	100.0	18	100.0

\* Unacceptable quality.

## DISCUSSION

Milk powders are used in many food industries as manufacture of infant formula, ice cream, chocolate, bakery products, sweets as well as supplies to emergency areas in catastrophes and calf milk replacers (Tetra Pak, 1995 and Edgar and Axel, 1998).

The results recorded in Tables 1- 6 showed the min., max. and average values and the frequency distribution of APC, anaerobes, B. cereus, coliforms, psychrotrophes, Staph. aureus, thermoturics and yeasts and molds counts/g of the examined infant milk powder (A), milk-cereal based weaning food (B) and dried milk powder (C) samples.

From the results which given in Tables 1, 3 and 5, it is evident that the APC/g ranged from  $<10$  to  $1 \times 10^5$ ,  $5 \times 10^5$  and  $8 \times 10^5$  with average values of  $9.5 \times 10^3$ ,  $6.2 \times 10^4$  and  $6.5 \times 10^4$  of the examined A, B and C samples, respectively. The highest frequency distribution of the corresponding positive samples (43.75, 54.5 and 62.5%, respectively) lie within the range of  $10^4$  -  $<10^5$  (Tables 2, 4 and 6). Relatively similar findings were stated by Jarchovska *et al.* (1980); Saudi *et al.* (1984); Bhatt *et al.* (1992); Al-Ashmawy *et al.* (1993) and El-Shinawy *et al.* (1995). However, lower counts were estimated by Singh *et al.* (1980) ( $9 \times 10^3$ ), Schwab *et al.* (1982) (52/g), Alvarez Marante *et al.* (1986) and Sabreen (1986) ( $4.8 \times 10^4$ ), while, higher results were recorded by Moustafa *et al.* (1984). According to the limits proposed by Egyptian Standards (1988), A. P. H. A. (1992) and U. S. Dairy Export Council (1996-2002) of dried milks that, APC must not exceed  $5 \times 10^4$ /g, only one (6.25%), 4 (36.4%) and 4 (25.0%) of examined A, B and C samples, respectively are considered unsatisfactory as recorded in Tables 2, 4 and 6.

Many authors recommended the aerobic plate count as an index of hygienic measures, organoleptic quality, safety and utility of infant foods. It reflects the microbial content of raw materials and ingredients, effectiveness of manufacture techniques and sanitary care of equipments and utensils.

The results outlined in Tables 1 and 3 indicated that 1(3.33%) and 2(6.66%) of examined A and B samples, respectively, contained anaerobes. The highest frequency distribution of the corresponding samples had counts within the range of  $10^2$ -  $<10^3$  (Table 2) and  $<10^2$  (Table 4). Higher incidences were postulated with Sabreen (1986) (5-20%) of tested local and imported baby foods and infant's milk powder. Moreover, Saad (1995) could detect *Clostridium perfringens* in 14% of

examined milk powder samples in count ranged from  $<10$ - $10^2$  with an average of 50.48/g. It is worth to mention that, the probability of foodborne illness may occur to children due to the consumption of contaminated products with anaerobes which is indicative of careless methods of productions (Bouer-Hertzberger, 1982). The anaerobic endosporeformer *Cl. perfringens* has also been associated with food poisoning due to spray dried milk and growth in made-up products again appears to have been a major contributory factor (Varnam and Sutherland, 1994). On the contrary, dried milk powder (C) samples were free from anaerobic microorganisms. Although, these bacteria must be absent from dried instant foods for infants as reported by Wiese (1992), *Cl. perfringens* was previously isolated from milk and some milk products by El-Bassiony (1980); El-Bassiony and Aboul-Khier (1983) and Amer *et al.* (1986).

Data recorded in Table 1, show that *B. cereus* was present in 5 (16.66%) with counts varying from  $<100$  -  $2 \times 10^2$  with an average value of  $2.1 \times 10^3$ /g of examined A samples. The highest frequency distribution (80.0%) lies between  $10^2$  -  $<10^3$  (Table 2). Similar finding was recorded by Sabreen (1986) while, higher results were postulated by Singh *et al.* (1980); Moustafa *et al.* (1984); Saad (1985) and El-Shinawy *et al.* (1995). Concerning C samples, 6 (20%) out of 30 found to contain the organism in a min. count of  $<100$  and a max. of  $1 \times 10^4$  with an average of  $6.0 \times 10^2$ /g as noted in Table 5. These results agree to a certain extent with that obtained by Saad (1985). It is worth to detect that 5 (83.33%) of positive samples, which lie in the range of  $10^3$ -  $<10^5$ /g are considered of unacceptable quality (Table 6) which at levels above the Association of Dietetic Food Industries of the European Communities (IDAEC) proposed safety limit of  $10^3$ cfu/g (Rowan and Anderson, 1998). It was suggested that food industry should be concerned with level as low as  $10^2$ - $10^4$  of food because food intoxication may be caused by ingestion of *B. cereus* cells or spores which subsequently form enterotoxins in the ileum (Granum *et al.*, 1993). Furthermore, Becker *et al.* (1994) recorded that 54% of infant food samples distributed in 17 countries were contaminated with diarrheagenic *B. cereus* at level of 0.3-600/g. Thus, the high count indicates lack of adequate precautions taken either during production and processing of raw milk or during handling and distribution of milk powders.

All brands of infant foods including A, B and C samples were free from coliforms. Similar findings were obtained by Jarchovska *et al.* (1980); Singh *et al.* (1980) and El-Shinawy *et al.* (1995). Moreover,



these results were in accordance with Egyptian Standards (1988), A. P. H. A. (1992) and U. S. Dairy Export Council (1996-2002). On the other hand, Schwab *et al.* (1982); Moustafa *et al.* (1984); Saudi *et al.* (1984); Sabreen (1986); Bhatt *et al.* (1992) and Al-Ashmawy *et al.* (1993) pointed out that infant milk powder and other baby foods based on dried milk contained coliform bacteria.

Coliforms can reach the food processing plant and food service establishment from faeces, soil, and water or plant environment. Therefore, they are useful as part of microbiological criteria to indicate the hygienic status during and after processing.

As shown in Table 5, it was evident that 8 (26.66%) of C samples found to harbor psychrotrophes with an average count of  $9.5 \times 10^2/g$  and 75% of positive samples lie in the range of  $10^2 - < 10^3$  (Table 6). While, none of tested A and B samples contained these microorganisms. Cooling of milk and controlling time and temperature during holding on farm and transportation to the factory is an essential mean for monitoring the hazard associated with psychrotrophes growth (ICMSE, 1988).

None of the evaluated samples showed the presence of *Staph. aureus* and this result substantiates what have been recorded by El-Bassiony (1984); Moustafa *et al.* (1984) and Sabreen (1986). In contrast, it was isolated from infant food samples examined by Singh *et al.* (1980); Schwab *et al.* (1982); Saudi *et al.* (1984) and El-Shinawy *et al.* (1995). Many incidents of *Staph. aureus* food poisoning associated with milk powders was traced to direct contamination of powder itself (Mettler, 1989 and Hobbs and Roberts, 1993). Furthermore, intoxication with staphylococcal enterotoxins, which survive subsequent processing, was identified as a major problem of spray dried milk (Varnam and Sutherland, 1994).

Infant milk powder and milk-cereal based weaning food samples (A and B) were free from thermophilic organisms as illustrated in Tables 1 and 3. While, 6 (20%) of dried milk powder samples (C) were contaminated with these organisms in a count ranged from  $< 100$  to  $3 \times 10^3$  with an average of  $1.3 \times 10^2/g$  (Table 5). The highest frequency distribution (66.66%) lies in the range of  $10^2 - < 10^3/g$  as noticed in Table 6.

A lower frequency distribution (27%) was established by Asperger (1990) who examined milk powder samples for thermophilic organisms. A wide range of thermophilics has been isolated from dried milk powder and their occurrence depends on numbers and types of

bacteria in raw milk, preheating temperature, plant hygiene and dryer operating conditions (Varnam and Sutherland, 1994).

Inspection of Table 1 revealed that 7(23.33%) of A samples were contaminated with yeasts and molds in a count ranged from  $<10 - 9 \times 10^4$  with an average of  $3.6 \times 10^3/g$ . The highest frequency distribution 71.4% lies within the range of  $10^3 - <10^4$  as recorded in Table 2. Nearly similar counts were obtained by El-Shinawy *et al.* (1995).

In contrast, higher percentages were outlined by Jesenska and Hardinova (1982) and Sabreen (1986). Moreover, Bhatt *et al.* (1992) stated that *Aspergillus* fungus was present in 5 out of 6 tested infant formulae samples.

In case of milk-cereal based weaning food (B), 13 out of 30 samples (43.33%) found to contain these organisms in a count ranged from  $<10 - 2 \times 10^5$  with an average  $1.1 \times 10^4/g$  (Table 3). As showed in Table 4, it was found that 8 (61.5%) of positive samples existed in numbers ranged from  $10^3 - <10^4/g$ .

The obtained findings were coincident with those reported by Singh *et al.* (1980) while higher incidences were postulated by Moustafa *et al.* (1984) (93.33%); Aboul-Khier *et al.* (1985) and Bhatt *et al.* (1992) (66.67%). Al-Ashmawy *et al.* (1993) stated that 100% of all examined local and imported baby food samples were contaminated with molds.

Results recorded in Table 5 verify that 18 (60%) of examined C samples harbor fungi with a min.  $<10$ , a max.  $5 \times 10^4$  and an average  $3 \times 10^3/g$ . 55.56% of samples had yeasts and molds count within the range of  $10^3 - <10^4$  as noticed in Table 6. Higher percentages (87.5 and 88%) were estimated by Bhatt *et al.* (1992) and Ismail and Saad (1995), respectively. Yeasts and molds may grow over a wide range of temperature and gain entrance to milk powder either from the milk used, air contamination or utensils. So, their presence is indicative of unsatisfactory sanitation during processing and handling of the product.

The above achieved results declared that milk powder and dried milk-based food are liable to contamination by some pathogenic microorganisms constitute public health hazard. Therefore, scrupulous hygienic measures must be maintained from milking, manufacturing, storage and distribution of finished product. Also, application of HACCP system along the line of dried milk production.

## REFERENCES

- A.P.H.A. (1992):* Compendium of Methods for the Microbiological Examination of Foods. 2<sup>nd</sup> Ed., American Public Health Association, Washington, DC, USA.
- Abdel-Mottaleb, L. (1988):* Recombined milk in Egypt. Int. Dairy Federation Special Issue N 9001, 12-16 Nov.: 9.
- Aboul-Khier, F; El-Bassiony, T.A.; Ahmed, A-H.A. and Moustafa, M.K. (1985):* Enumeration of molds and yeasts in dried milk and ice cream products. *Assiut Vet. Med. J.*, 14 (28): 70-78.
- Al-Ashmawy, A.M., Bahout, A.A. and Mansour, M.A. (1993):* Microbiological quality of baby foods. Symposium on Food Pollution, 15-16 Nov., pp. 2-12, Fac. Vet. Med., Zagazig Univ.
- Alvarez Marante, R.; Hardisson De La Torre, A.; Rios Rull, R. and Sierra Lopez, A. (1986):* Microbiological characteristics of dietetic infant foods. I. Humanized infant formulas. *Alimentaria*, No. 169: 15-17. *Dairy Sci. Abst.*, 50, 3 (1988).
- Amer, I.H.; Shelaih, M.A. and El-Sayed, M.S. (1986):* Clostridium organisms in milk and some dairy products. 2<sup>nd</sup> Sci. Cong., Fac. Vet. Med., Assiut Univ.
- Anon (1986):* Sampling plans for milk and milk products. In: *Microorganisms in Foods. Vol. 2, 2<sup>nd</sup> Ed.*, Roberts, T.A.; Bryan, F.L.; Christian, J.H.B.; Kilsby, D.; Olson Jr, J.C. and Silliker, J.H. (eds.), Oxford: Blackwell Sci. Pub. pp: 161-174.
- Asperger, H. (1990):* Thermophilic microorganisms in milk powder. XXIII Int. Dairy Cong Brief Communications. Sub. F., Food Safety, Quality Assurance and Legislation.
- Baird-Parker, A.C. (1962):* An improved diagnostic and selective medium for isolating coagulase-positive Staphylococci. *J. Appl. Bacteriol.*, 25(1): 12-19.
- Becker, H.; Schaller, G.; von Wiese, W. and Terplan, G. (1994):* Bacillus cereus in infant foods and dried milk products. *Int. J. Food Microbiol.*, 23:1-15.
- Beerens, H.; Romond, C.; Lepage, C. and Griquelion, J. (1982):* A liquid medium for the enumeration of Clostridium perfringens in food and faeces. In: *Isolation and Identification Methods for Food Poisoning Organisms*. J.E.L. Corry; D. Roberts and F.A. Skinner (eds.), Academic Press, London, pp. 137-149.
- Bhatt, S.N.; Shah, A.G. and Rani, V.A. (1992):* Microbiological status of infant foods. *J. Food Sci. Technol.*, 29 (2): 103-104.

- Bouer-Hertzberger, S.A. (1982):* Food transmitted diseases of microbial origin. Ph.D. Thesis. Ter Verkryging Van de Graad Van in de diergeneeskunde aan de Prijsuniversiteit Utrecht.
- Edgar, S. and Axel, M. (1998):* Milk and Dairy Product Technology. Marcel Dekker, Inc., New York.
- Egyptian Standards (1988):* Dried Milks. Egyptian Organization for Standardization and Quality Control (1648-988).
- El-Bassiony, T.A. (1980):* Occurrence of *Clostridium perfringens* in milk and dairy products. *J. Food Prot.*, 43 (7): 536-537.
- El-Bassiony, T.A. (1984):* Enumeration of *Staphylococcus aureus* in milk and some dairy products. 1<sup>st</sup> Sci. Cong., Fac. Vet. Med., Assiut Univ.,: 125-134.
- El-Bassiony, T.A. and Aboul-Khier, F. (1983):* Bacteriological evaluation of dried milk products produced in Sakha Processing Dairy Plant. *Assiut Vet. Med. J.*, 11 (21): 159-163.
- El-Shinawy, Saadta, H.; Abd El-Aziz, Aida, M. and El-Hady, H. A. (1995):* Microbiological quality of infant powdered milk. *J. Egypt. Vet. Med. Assoc.*, 55 (1, 2): 147-154.
- Granum, P.E.; Brynestad, S.; O'Sullivan, K. and Nissen, H. (1993):* The enterotoxin from *B. cereus*: Production and biochemical characterization. *Neth. Milk Dairy J.*, 47:63-70.
- Hayes, P. R. (1992):* Food Microbiology and Hygiene. 2<sup>nd</sup> Ed., El Sevier Sci. Pub., LTD., England.
- Hobbs, B. C. and Roberts, D. (1993):* Food Poisoning and Food Hygiene. 6<sup>th</sup> Ed., Edward Arnold, London.
- International Commission on Microbiological Specifications for Foods (ICMSF)(1988):* Microorganisms in Foods. 4. Application of the Hazard Analysis Critical Control Point (HACCP) system to ensure microbiological safety and quality. Blackwell Sci. Pub., Melbourne, p. 242.
- Ismail, M.A. and Saad, Nagah, M. (1995):* Studies on the mycological quality of milk powder. *Assiut Vet. Med. J.*, 32 (64): 173-185.
- Jarchovska, H.; Koudelka, J. and Lukasova, J. (1980):* Microbiological quality of infant foods made from dried milk in Czechoslovakia. *Veterinarni Medicina*, 25 (11): 691-695. *Dairy Sci. Abst.*, 43, 8 (1981).
- Jesenska, Z. and Hardinova, I. (1982):* Molds in foods in Czechoslovakia. *Schimmelpilze in Lebensmitteln der Tschechoslowakei. Zeitschrift fur Lebensmittel- Untersuchung und- Forschung*, 137 (1): 16-20.

- Kwee, W.S.; Dommett, T.W.; Giles, J.E.; Roberts, R. and Smith, R.A.D. (1986):* Microbiological parameters during powdered milk manufacture. *Aust. J. Dairy Technol.*, 41:3.
- Lancette, G.A. and Harmon, M. (1980):* Enumeration and confirmation of *Bacillus cereus* in foods. *J. Assoc. Off. Anal. Chem.*, 63: 581-586.
- MacFaddian, G.F. (1976):* Biochemical Tests for Identification of Medical Bacteria. Williams and Wilkins Company, Baltimore, MD.
- Mettler, A. E. (1989):* Pathogens in milk powders-Have we learned the lessons? *J. Society Dairy Technol.*, 42: 48-55.
- Mislivec, P.B.; Beuchat, L.R. and Cousin, M.A. (1992):* Yeasts and Molds. Chapter 15. *Compendium of Methods for Microbiological Examination of Food*, 3<sup>rd</sup> Ed., Vanderzant, C. and Splittwoesser, D. (eds.), American Public Health Association, Washington, DC, USA.
- Moustafa, M.K.; Ahmed, A-H.A.; El-Bassiony, T.A. and Aboul-Khier, F. (1984):* Microbiological quality of infant milk food. *Assiut Vet. Med. J.*, 12 (24):163-168.
- Muytjens, H.L.; Roelofs-Willemsse, H. and Jaspar, G.H. (1988):* Quality of powdered substitutes for breast milk with regard to members of the family Enterobacteriaceae. *J. Clin. Microbiol.*, 26 (4): 743-746.
- Ranken, K. and Baker, C. (1999):* Food Industries Manual, 24<sup>th</sup> Ed., Hardcover/Blackie Academic and Professional.
- Renner, E. (1988):* Storage stability and some nutritional aspects of milk powders and ultra high temperature products at high ambient temperatures. *J. Dairy Res.*, 55: 125-142.
- Robinson, R. K. (1990):* Dairy Microbiology, 2<sup>nd</sup> Ed., El Sevier Sci. Pub. Co., Inc., New York.
- Rowan, N. J. and Anderson, J. G. (1998):* Effectiveness of cleaning and disinfection procedures on the removal of enterotoxigenic *Bacillus cereus* from infant feeding bottles. *J. Food Prot.*, 61 (2): 196-200.
- Saad, Nagah, M. (1985):* Occurrence of *Bacillus cereus* in milk and milk products in Assiut City. Ph. D. Thesis, Fac. Vet. Med., Assiut Univ., Egypt.
- Saad, Nagah, M. (1995):* Incidence of *Clostridium perfringens* in milk powder. *Assiut Vet. Med. J.*, 32 (64): 151-156.

- Sabreen, M. S. (1986):* Microflora in baby foods. M. V. Sc. Thesis, Fac. Vet. Med., Assiut Univ., Egypt.
- Saudi, A.H.; El-Essawy, H.A. and Moursy, A.W. (1984):* Bacteriological quality of infant milk foods. *Assiut Vet. Med. J.*, 12 (23): 137-142.
- Schwab, A. H.; Swartzentruber, A. ; Wentz, B. A. and Read, Jr. R. B. (1982):* Microbiological quality of dry-milk mixes and milk substitute infant formulas. *Appl. Environ. Microbiol.*, 43 (2): 389-391.
- Singh, R. S.; Sukhbir, S.; Batish, V. K. and Ranganathan, B. (1980):* Bacteriological quality of infant milk foods. *J. Food Prot.*, 43 (5): 340-342.
- Tetra Pak (1995):* Dairy Handbook. Tetra Pak, Lund, Sweden.
- U.S. Dairy Export Council (1996-2002):* U.S. Standards for milk powders. American Dairy Products Institute, Bulletin # 916.
- Varnam, A. H. and Sutherland, J. P. (1994):* Concentrated and dried milk products. In: *Milk and Milk Products. Technology, chemistry and microbiology*. 1<sup>st</sup> Ed., Chapman and Hall, London, pp: 103-158.
- Wiese, W. (1992):* A comparison of microbiological standards, reference values and proposals for dried infant-and baby-foods. 3<sup>rd</sup> World Cong. Foodborne Infections and Intoxications. 16-19 June, Berlin.