Zagazig Veterinary Journal
Volume 43, Number 3, p. 1-9, 2015

DOI: 10.21608/zviz.2015.28436

Microbiological Status of Rehydrated Infant Formula Milk Powder Versus Expressed Breast Milk for Neonates

Asmaa B. M. B. Tahoun* and Eman N. Abdelfatah
Food Control Department, Faculty of Veterinary Medicine, Zagazig University, 44511, Egypt

Article History: Received: 4/10/2015 Received in revised form: 1/11/2015 Accepted: 18/11/2015

Abstract

Breast milk is considered the best food for infants, however in some cases the infant must stay away from his mother and must be supplied with milk by other means. In this case we have the choice between expressed breast milk and rehydrated infant formula and so, we applied this work to assess the microbiological status of both. The findings achieved in our study revealed that 27 (54%) out of the examined rehydrated infant formula milk samples were contaminated with different microbes with a mean count of $6.8\times10^3\pm 2\times10^2$ CFU/ml. In case of expressed breast milk samples, 78% were contaminated with an average count of 3.3×10^5 CFU/ml. *Stapylococcus epidermidis* was the most prevalent micro-organism in both types of milk as it was present in 10% and 30% in infant formula and breast milk samples, respectively. Other microbes, including *Staphylococci*, *Enterobactericeae*, *Enterococci*, yeast and moulds were also detected with variable percentages. Although the higher contamination rate of expressed breast milk compared to the rehydrated infant formula, breast milk remains the best choice for feeding babies. Such finding is attributed to the immune protection normally provided through feeding on breast milk. However, strickt hygienic measures during collection of breast milk should be followed to ensure minimal contamination.

Keywords: Infant formula, Breast milk, *Enterobacteriaceae*, *Enterococci*, *Staphylococci*, Yeast, Mould

Introduction

Milk is considered a very important part of the daily diet, especially for both pregnant women and young children [1]. It is nearly sterile when secreted directly from the breast, however, it is easily to be contaminated with a wide range of microbes from different sources [2].

Human milk is the basic food for neonates, as it contains elements needed for healthy growth and increases the bond strength between the mother and child [3]. Furthermore, breast milk strengthens the immune system of neonates because development of the newborn immunity has not yet been completed [4]. Therefore, the first six months of life for breast fed infants can be considered as the most healthy period [5]. Prematurity, low birth weight infants and immunocompromised conditions prevent the infant to suck the mother's breast effectively [6]. In this case, they must be supplied with milk by other means [7]. It is recommended to give these neonates expressed breast milk instead of breast feeding as the mother must stay away from the child for long period. Mothers are therefore encouraged to express breast and store milk in containers for a time [8].

***Corresponding author e-mail: (dr.asmaatahoun@gmail.com), Food Control Department, Faculty of Veterinary Medicine, Zagazig University, Zagazig, 44511, Egypt.**

In case of breast feeding, the probability of milk contamination is very low as the infant suckles directly from the mother's breast. In case of expressed breast milk, it cannot be considered entirely sterile or free from bacterial contamination [9]. This variation could be attributed to the method of breast milk collection [10].

Manually expressed breast milk has been reported to be less contaminated than milk obtained with breast pumps and it is worth mentioning that manual expressing at home is a risk for contamination than that performed in a hospital due to the variation in personal hygiene [11]. Another possible reason for the contamination of expressed milk could be the storage temperature because the warm temperature of the environment, encourages bacterial growth [12].

Infant's formula (IF) is considered the most common breast-milk substitute during the first sensitive period of development [13]. It supplies infants with all the nutritional requirements during the first period of life until they are able to complete with breast feeding or complementary feeding [14]. The contamination of infant formula can occur during its preparation, reconstitution procedures or during their transportation and storage [15]. Neonates are considered to be a part of the high-risk group of individuals, as their immune systems may have not yet be fully developed and so they can be easily infected with microbes [16]. Consequently, it is reasonable that products used for infants should be of higher safety than foods for adults who have developed several mechanisms of defense against infection [17].

The current study aimed to assess the microbial profile of both expressed breast milk and rehydrated infant formula milk powder to conclude an advice about the most suitable and safe choice for neonates.

Material and Methods

Collection of samples

A total of 100 samples of IF milk powder and expressed breast milk samples (50, each) were collected. Infant formula samples were collected from different markets and sent immediately to the laboratory for microbiological examination. Regarding expressed breast milk samples, they were collected from the neonatal intensive care unit at Benha Children Hospital, Benha, Egypt. Before examination, milk powder samples were reconstituted by following up reconstitution instruction on its original package, while expressed breast milk samples were thoroughly mixed.

Microbial examination

Eleven ml of each sample were added aseptically into sterile tube containing 99 ml of sterile saline solution. The latter was shaken well to have 1:10 dilution, followed by decimal serial dilution according to APHA [18]. Enumeration of the total bacterial count was performed using Standard Plate Count Agar (PCA) medium at 32ºC±1 for 48±2 hours [19]. Enumeration and identification of *Staphylococci* using Baired-Parker agar medium at 35ºC±1 for 48±2 hours [19], *Enterobacteriaceae* using Violet Red Bile Glucose (VRBG) agar medium at 35ºC±1 for 48±2 hours [18] and *Enterococci* using the ESD agar medium at 35ºC±1 for 48±2 hours [19] were carried out. Yeast and Mould count using Sabaroud Dextrose agar medium at 22ºC for 7 days were performed according to APHA [20].

Results and Discussion

The findings achieved in the present study revealed that 27 (54%) out of 50 examined rehydrated infant formula milk samples were contaminated with a mean value of $6.8\times10^3\pm 2\times10^2$ CFU/ml (Tables 1 and 2). These results are nearly similar to those reported by Rajput *et al*. [21]. On the contrary, Toscano *et al*. [22]

found that all products analyzed during their study were free from bacterial contamination. Moreover, Abdullah Sani *et al*. [16] reported that only 19.6% of IF samples were contaminated with microorganisms within the range of 10^3-10^4 CFU/ml, while Chap *et al.* [23] and Matug *et al*. [24] observed very high aerobic counts (>10^4) in the examined samples. The results also showed that *Staphylococcus* spp. were detected in 12% of the examined rehydrated IF milk samples with an average count of 2×10^2 CFU/ml (Table 1).

The current results clarified that *S. epidermidis* isolation rate (10%) was higher than *S. aureus* (2%). Likewise, Wang *et al*. [25] detected *S. aureus* in 11.2% of powdered IF in China, while, Carneiro *et al.* [26] and Matug *et al*. [24] did not isolate *S. aureus* from any of the examined samples.

Table 1: Microbial counts (CFU/ml) in the examined rehydrated infant formula and expressed breast milk samples (n=50, each)

Microorganisms	Infant formula			Expressed breast milk		
	+ve samples (No)	%	Mean± S.E	+ve samples (No)	%	Mean± S.E
Total bacterial count	27	54%	$6.8\times10^3\pm2\times10^2$	39	78%	$3.3\times10^5\pm4.7\times10^4$
Staphylococcus count	6	12%	$2\times10^2\pm 4.2\times10$	21	42%	$2.8\times10^3\pm6.8\times10^2$
Enterobacteriaceae count	12	24%	$6\times10 \pm 5.3$	14	28%	$9.5\times10\pm9.8$
Enterococcus count	6	12%	$7.9\times10\pm5.3$	9	18%	$3.5\times10^2\pm7.8\times10$
Yeast & Mould counts	7	14%	6±0.9	5	10%	6.2±0.73

n: Number of the examined samples.

In the current investigation, *Enterobacteriaceae* were identified in 12 (24%) of the examined infant formula samples (Table 1), including *E. agglumerans* (8%) followed by *E. Cloacae*, *C. Freundii*, *C. sakazaki* and *K. pneumonae* with the isolation rates of 6%, 6%, 2% and 2%, respectively (Table 2). Abdullah Sani *et al*. [16] reported that *C. sakazaki* was not isolated from the examined samples, while, *Enterobacter* spp. and *Citrobacter spp*. (5.6%, each) followed by *Klebsiella spp.* (3.3%) were identified. Moreover, Iversen and Forsythe [27] isolated *Pantoea* spp., *Escherichia coli*, *Klebsiella* spp. and *Enterobacter* spp. from various infant milk samples.

In agreement with the present study Lai [28] and Leuschner *et al*. [29] clarified that infant milk powder is considered a vehicle of infection with different microbes including pathogenic *C. sakazaki*.

Cronobacters are generally incapable of surviving pasteurization [30], indicating that any contamination with them could be resulted from contaminated additional ingredients, plant equipment or via asymptomatic diseased workers in the plant [31]. The potential growth of *Cronobacter* in reconstituted infant milk might be attributed to the inefficient temperature of water used in preparation or that of the room in which the milk was prepared and stored or reheated [32].

Enterococci and yeast and moulds were detected in 12% and 14% of the examined IF samples, respectively. Rajput *et al.* [21] detected yeast and moulds in various infant milk samples with a count less than 5 CFU/ml. While, Matug *et al*. [24] found that the total mould count in most of the examined samples was equal to or less than 3.7 $\log_{10}$ CFU/gm. In contrary, Tudela *et al*. [33] did not detect any pathogenic bacteria in 156 examined rehydrated milk formulas.

Infant milk contains highly nutritional substances that could support the growth of a wide range of bacteria as well as yeast and moulds [34]. Although IF is pasteurized during its manufacture, some microorganisms can be

detected especially those resist heat-treatment. Also, the presence of some microorganisms in the finished dried products could be attributed to contamination from the factory environment either during drying or packaging [35]. Moreover, the presence of pathogens in IF might be resulted from either improper handling such as inadequate cleaning of bottles and nipples or using contaminated water [36].

Multiple reheating, or improper rehydration procedures could also increase the number of harmful bacteria, therefore, reconstituted infant milk formula is considered a high-risk food causing serious illness. As a result, WHO [37] in 2007 released a guideline to the general public about safe milk handling to minimize possible contamination of IF when breast feeding is not possible [38]. One of these guidelines is cooling the reconstituted milk formula to 40-55°C because these temperatures are suitable for feeding infants. However, *Cronobacters* and other *Enterobacteriaceae* can grow at these temperatures [23]. Therefore, after cooling, IF should be given to the baby directly, to avoid the probability of contamination.

Concerning expressed breast milk samples, 39 (78%) samples were contaminated with a mean value of $3.3\times10^5\pm4.7\times10^4$ CFU/ml (Table 1). This contamination varied between *Staphylococci*, *Enterobactericeae*, *Enterococci*, yeast and moulds with the percentages of 42%, 28%, 18% and 10%, respectively (Table 1).

In accordance, Deodhar and Joshi [39] and Serafini *et al*. [40] showed that 79.3% and 70.1% of their examined samples were contaminated, respectively. Higher contamination rate (85%) was reported by Karimi *et al*. [41], moreover, Israel-Ballard *et al*. [42], Collado *et al*. [43] and Hososaka *et al.* [4] found that all the examined breast milk samples were contaminated. In the present investigation, *S. epidermidis* (30%), *S. aureus* (12%), *K. pneumonae* (12%), *E. faecium* (12%), *E. aerogens* (6%), *E. faecalis* (6%), *E. coli* (4%), *C. sakazaki* (2%), *E. agglumerans* (2%) and *E. cloaceae* (2%) were isolated (Table 2). While *Yeast* and *Mould* were detected in 10% of the examined samples (Table 1). Similarly, Rozolen *et al.* [9] and Karimi *et al*. [41] concluded that klebsiellae and coagulase negative *Staphylococci* were the most isolated microorganisms from the examined samples.

Table 2: Isolation rates of different bacteria isolated from the examined rehydrated infant formula and expressed breast milk samples (n=50, each)

Type of the organism	Infant formula		Expressed breast milk	
	No	%	No	%
***Staphylococcus* spp.**				
Staphylococcus epidermidis	5	10	15	30
Staphylococcus aureus	1	2	6	12
***Enterobacteriaceae* spp.**				
Enterobacter agglumerans	4	8	1	2
Enterobacter cloacae	3	6	1	2
Enterobacter aerogens	0	0	3	6
Cronobacter sakazaki	1	2	1	2
Klebsiella pneumonae	1	2	6	12
Citrobacter freundii	3	6	0	0
Escherichia coli	0	0	2	4
***Enterococcus* spp.**				
Enterococcus faecium	4	8	6	12
Enterococcus faecalis	2	4	3	6

n: Number of the examined samples

On the contrary, Deodhar and Joshi [39], Serafini *et al*. [40] and Israel-Ballard *et al*. [42] reported that *S. aureus* were the most frequent isolated strains, while Collado *et al*. [43] detected *Staphylococci* in all the examined samples. In addition, Karimi *et al*. [41] and Hososaka *et al*. [4] found that *E. coli* and *Klebsiellae* were predominated in the examined breast milk samples. The presence of enteric bacteria, such as *E. coli, Klebsiella* and *Citrobacter* is an indicator of contamination either from the body or clothes, therefore, babies are at risk of being infected with many diseases caused by entropathogenic *E. coli* [45] while *klebsiella* spp. may lead to septicemia in neonates [46]. *S. aureus* forms part of the normal flora of skin, upper respiratory tract and intestinal tract, therefore, its presence in breast milk revealed the unsanitary condition of the breast nipples as well as the utensils employed in its manipulation [39]. Serafini *et al*. [40] detected yeast and moulds in 31.6% of the examined breast milk samples, while Collado *et al*. [43] detected *Enterococci* in 76% of the samples.

The aforementioned studies reported higher results than those obtained in the present study for yeast and moulds and even *Enterococci*. The presence of yeast and moulds is an indicator of an inadequate hygienic conditions due to contamination originating from the environment [47].

Bacteria can contaminate the breast milk during expression from the breast skin, hands, breast pump or other containers used for its collection [48]. The application of hygienic measures such as washing and disinfection of breast and hands as well as sterilization of all equipment used can decrease the contamination from the previously mentioned sources [49]. Also, temperature and the period of milk storage is of great importance, this was supported by Nwankwo *et al*. [50] who observed that storage of the expressed milk at warm ambient temperatures resulted in faster growth rate of contaminating bacteria. Therefore, the storage of the expressed breast milk in the infants' ward, results in more chance for contamination posing risk of infection to infants [6].

Conclusion

Although the expressed breast milk showed a higher contamination rate than that of rehydrated IF, breast milk remains the best choice for feeding babies at least for the first six months of life. Because formula-fed infants lack the immune protection provided normally by breast milk feeding. In addition, infant formula requires a high level of microbiological quality control during production, distribution and usage.

It is important to ensure that infant formulae are prepared using good hygienic practice, with rapid cooling and minimization of the time between preparation and consumption. In case of breast milk, it is essential to health-educate breast feeding mothers about personal hygiene to minimize bacteria adhering to their breast or containers and immediate storage after expression not for more than 2 hours by refrigeration.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgement

We are grateful to Dr. Elsayed Abdelaziz, Neonatologist at Benha Children Hospital (BENCH), Egypt. for supplying us with all the examined expressed breast milk samples.

References

[1] Olatunji, E.A.; Jubril, A.E.; Okpu, E.O.; Olafadehan, O.A.; Ijah, U.J. and Njidda, A.A. (2012): Bacterial assessment and quality analysis of raw milk sold in Gwagwalada area council of the federal capital territory (FCT), Abuja, Nigeria. Food Sc Quality Manage, 7 (online).

[2] Godič Torkar, K. and Golc Teger, S. (2008): The microbiological quality of raw milk after introducing to the two day's milk collecting system. Acta Agric Slov, 92 (1):61-74.

[3] Hanson, L.A. (2007): Session 1: Feeding and infant development breast-feeding and immune function. Proc Nutr Soc, 66 (3):384-396.

[4] Hososaka,Y.; Nukita, H.; Ishii, Y.; Onishi, A.; Isonishi, S. and Ito, F. (2013): Bacteriological safety of human milk storage. Jikeikai Med J, 60:17-22.

[5] Vanderzant, C. and Splittstoesser, D.F. (1992): Compendium of methods for the microbiological examination of foods. 3rd ed. Washington (DC): American Public Health Association.

[6] Vervoort, A.; Delsat, L.; Pieltain, C.; De Halleux, V.; Carpentier, M. and Rigo, J. (2007): Evaluation of the bacteriological quality of breast milk in a neonatology service in Belgium. Rev Med Liege, 62:159-65.

[7] Serafini, A.B.; André, M.C.; Rodrigues, M.A.V.; Kipnis, A.; Carvalho, C.O.; Campos, M.R.; Monteiro, E.C.; Fábia Martins, F. and Jubé, T.F.N. (2003): Microbiological quality of human milk from a brazilian milk bank. Rev Saúde Pública, 37 (6):775-779.

[8] Eteng, M.U.; Ebong, P.E.; Eyong, E.U. and Ettarh, R.R (2001): Storage beyond three hours at ambient temperature alters the biochemical and nutritional qualities of breast milk. Afr J Reprod Health, 5 (2):130-134.

[9] Rozolen, C.D.; Goulart, A.L. and Kopelman, B.I. (2006): Is breast milk collected at home suitable for raw consumption by neonates in Brazilian public intensive care units? J Hum Lact, 22 (4):418-425.

[10] Ng, D.K.; Lee, S.Y.; Leung L.C. Wong, S.F. and Ho, J.C. (2004): Bacteriological screening of expressed breast milk revealed a high rate of bacterial contamination in chinese women. J Hosp Infect, 58 (2):146-150.

[11] Boo, N.Y.; Nordiah, A.J. Alfizah, H.; Nor-Rohaini, A.H., and Lim, V.K. (2001): Contamination of breast milk obtained by manual expression and breast pumps in mothers of very low birth weight infants. J Hosp Infect, 49 (4):274-81.

[12] Ukegbu, P.O.; Uwaegbute, A.C.; Ijeh, I.I. and Ukegbu, A.U. (2013): Bacterial load in expressed and stored breast milk of lactating mothers in Abia state, Nigeria. African J Food Agric Nutr Dev, 13 (4):8139-8154.

[13] Lönnerdal, B. (2012): Preclinical assessment of infant formula. Ann Nutr Metab, 60 (3): 196-199.

[14] Kent, R.M.; Fitzgerald, G.F.; Hill, C.; Catherine Stanton, C. and Ross, R.P. (2015): Novel approaches to improve the intrinsic microbiological safety of powdered infant milk formula. Nutrients, 7 (2):1217-1244.

[15] Patchell, C.J.; Anderton, A.; MacDonald, A.; George, R.H. and Booth, I.W. (1998): Bacterial contamination of enteral feeds. Arch Dis Child, 70 (4):327-330.

[16] Abdullah Sani, N.; Hartantyo, S.H. and Forsythe, S.J. (2013): Microbiological assessment and evaluation of rehydration instructions on powdered infant formulas, follow- up formulas, and infant foods in Malaysia. J Dairy Sci, 96 (1):1-8.

[17] Aggett, P.J.; Agostini, C.; Goulet, O.; Hernell, O.; Koletzko B.; Lafeber, H.L.; Michaelsen, K.F.; Rigo, J. and Weaver, L.T. (2001): The nutritional and safety assessment of breast milk substitutes and

other dietary products for infants: a commentary by the ESPGHAN Committee on Nutrition. J Pediatr Gastroenterol Nutr, 32 (3):256-258·

[18] American Public Health Association "APHA" (2004): Compendium of methods for the microbiological examination of food. 17th ed, APHA, Washington D. C. USA.

[19] BAM, online (2009): Bacteriological analytical manual online. U.S. Food and Drug Admnistration Center for Food Safety and Applied Nutrition.

[20] American Public Health association "APHA" (2003): Compendium of Methods for the Microbiological examination of food. 3rd ED.(Vanderzant,C & Splittoesser, D.Eds.) Washington D. C. USA.

[21] Rajput, I.R.; Khaskheli, M.; Rao, S.; Fazlani, S.A.; Shah, Q.A. and Khaskheli, G.B. (2009): Microbial quality of formulated infant milk powders. Pak J Nutr, 8 (10):1665-1670.

[22] Toscano, M.; Peroni, D.; De Vecchi, E.; Mattina, R. and Drago, L. (2013): Microbiological assessment of some powdered infant formulas: from quality to antibiotic resistance evaluation. J Food Process Technol, 4: 4:284. Doi: 10.4172/2157-7110.1000284.

[23] Chap, J.; Jackson, P.; Siqueira, R.; Gaspar, N.; Quintas, C.; Park, J.; Osaili, T.; Shaker, R.; Jaradat, Z.; Hartantyo, S.H.; Abdullah Sani, N.; Estuningsih, S. and Forsythe, S. J. (2009): International survey of *Cronobacter sakazakii* and other *Cronobacter* spp. In follow-up formulas and infant foods. Int J Food Microbiol, 136 (2): 185-188.

[24] Matug S.M.; Aidoo, K.E. and Elgerbi, A.M. (2015): Microbiological examination of infant food and feed formula. Emer Life Sci Res, 1 (1): 46-51.

[25] Wang, X.; Meng, J.; Zhang, J.; Zhou, T.; Zhang, Y.; Yang, B.; Xi, M. and Xia, X. (2012): Characterization of *Staphylococcus aureus* isolated from powdered infant formula milk and infant rice cereal in China. Int J Food Microbiol, 153 (1-2): 142-147.

[26] Carneiro, L.A.; Silva, A.P.; Merquior, V.L. and Queiroz, M.L (2003): Antimicrobial resistance in Gram-negative bacilli isolated from infant formulas. FEMS Microbiol Lett, 228 (2): 175-179.

[27] Iversen, C. and Forsythe, S. (2004): Isolation of *Enterobacter sakazakii* and other *Enterobacteriaceae* from powdered infant formula milk and related products. Food Microbiol, 21 (6): 771-777.

[28] Lai, K.K. (2001): *Enterobacter sakazakii* infections among neonates, infants, children, and adults-case reports and a review of the literature. Medicine, 80 (2):113-122.

[29] Leuschner, R.G. and Bew, J. (2004): A medium for the presumptive detection of *Enterobacter sakazakii* in infant formula: interlaboratory study. J AOAC Int, 87 (3):604-613.

[30] Strydom, A.; Cawthorn, D-M.; Cameron, M. and Witthuhn, R.C. (2012): Species of *Cronobacter*–A review of recent advances in the genus and their significance in infant formula milk. Int Dairy J, 27 (1-2):3-12.

[31] Kandhai, M.; Heuvelink, A.E.; Reij, M.W.; Beumer, R.R.; Dijk, R.; Van Tilburg, J.J.H.C.; Van Schothorst, M. and Gorris, L.G.M. (2010): A study into the occurrence of *Cronobacter* spp. In the Netherlands between 2001 and 2005. Food Control, 21 (8):1127-1136.

[32] Rosset, P.; Noel, V. and Morelli, E. (2007): Time-temperature profiles of infant milk formula in hospitals and analysis of *Enterobacter sakazakii* growth. Food Control, 18 (11): 1331-1476.

[33] Tudela, E.; Croizé, J.; Lagier, A. and Mallaret. M.R. (2008): Microbiological monitoring of milk samples and surface samples in a hospital infant formula room. Pathol Biol (Paris) 56 (5):272-278.

[34] Philips, J.D. and Griffiths, M.W. (1990): Pasteurized dairy products: constraints imposed by environmental concentration. In: Contamination from environmental sources. Wiley, USA, 387-456.

[35] Kandhai, M.C.; Reij, M.W.; Gorris, L.G.; Guillaume-Gentil, O. and van Schothorst, M. (2004): Occurrence of *Enterobacter sakazakii* in food production environments and households. Lancet, 363 (9402) :39-40.

[36] Morais, T.B.; Sigulem, D.M.; de Sousa Maranhão, H. and de Morais, M.B. (2005): Bacterial contamination and nutrient content of home-prepared milk feeding bottles of infants attending a public outpatient clinic. J Tropical Pediatr, 51 (2):87-92.

[37] WHO (World Health Organization) (2007a): How to prepare powdered infant formula in care settings. Department of Food Safety, Zoonoses and Foodborne Diseases, WHO, and the Food and Agriculture Organization of the United Nations (FAO), Geneva, Switzerland, 2007a.

[38] WHO (World Health Organization) (2007b): Safe preparation, storage and handling of powdered infant formula: Guidelines. WHO and the Food and Agriculture Organization of the United Nations (FAO), Geneva, Switzerland. 2007b.

[39] Deodhar, G. and Joshi, S. (1991): Microbiological study of breast milk with special reference to its storage in milk bank. J Postgrad Med, 37 (1):14-16.

[40] Serafini, B.; André, M.C.D.P.B.; Rodrigues, M.A.V.; Kipnis, A.; Carvalho, C.O.; Campos, M.R.H.; Monteiro, É.C.; Martins, F. and Jubé, T.F.N. (2003): Microbiological quality of human milk from a Brazilian milk bank. Rev Saúde Pública, 37 (6): 775-779.

[41] Karimi, M.; Eslami, Z.; Lotfi, M. H.; Nori, S.; Zandi, H.; Taghipour-Zahir, S. and Akhondzardaini, R. (2013): Bacterial contamination of expressed breast milk in neonatal intensive care unit. Zahedan J Res Med Sci, 15: 48-52.

[42] Israel-Ballard, K.I.; Coutsoudis, A.; Chantry, C.J.; Sturm, A.W.; Karim, F.; Sibeko, L. and Abramsa, B. (2006): Bacterial safety of flash-heated and unheated expressed breast milk during storage. J Trop Pedriatr, 52 (6): 399-405.

[43] Collado, M.C.; Delgado, S.; Maldonado, A. and Rodrı ´guez, J.M. (2009): Assessment of the bacterial diversity of breast milk of healthy women by quantitative real-time PCR. Lett Appl Microbiol, 48 (5): 523-528.

[44] Karimi, M.; Eslami, Z.; Shamsi, E.; Moradi, j.; Ahmed, A.Y. and Baghianimoghadam, B. (2012): The effect of ducational Intervention on decreasing mother's expressed breast milk bacterial contamination whose infants are admitted to neonatal intensive care unit. J Res Health Sci, 13 (1):43-47.

[45] Itah, A.Y. and Ben, A.E. (2004): Incidence of enteric bacteria and *Staphylococcus aureus* in day care centers in Akwa Ibom State, Nigeria. Southeast Asian J Trop Med Public Health, 35 (1):202-209.

[46] Podschun, R.; Acktun, H.; Okpara, J.; Linderkamp, O.; Ullmann, U. and Bornef-Lipp, M. (1998): Isolation of *Klebsiella planticola* from newborns in a neonatal ward. J Clin Microbiol, 36 (8):2331-2332.

[47] Mislivec, P.B.; Beuchat, L.R and Cousin, M.A. (1992): Compendium of methods for the microbiological examination of foods. 3rd ed. Washington (DC): Am Public Health Assoc, 239-49.

[48] Boo, N.Y.; Nordiah, A.J.; Alfizah, H.; Nor-Rohaini, A.H. and Lim, V.K. (2001): Contamination of breast milk obtained by manual expression and breast milk pumps in mothers of very low weight infants. J Hosp Infect, 49 (4): 274-281.

[49] Hands, A. (2003): Safe storage of expressed breast milk in the home. MIDIRS Midw Digest, 13:378-385.

[50] Nwankwo, M.M.; Offor, E.; Okolo, A.A. and Omene, J.A. (1988): Bacterial growth in expressed breast milk. Ann Trop Paediatr, 8 (2):92-95.

الملخص العربي

الحالة الميكروبيولوجية لوصفات حليب الأطفال المسحوقة المميهة مقابل حليب الأم المعصر للأطفال حديثي الولادة

أسماء بدر مصطفى بدر طاحون ، إيمان نبيل عبدالفتاح

قسم مراقبة الأغذية - كلية الطب البيطرى – جامعة الزقازيق

يعد حليب الأم أفضل غذاء للرضع ولكن في بعض الحالات يجب أن يبقى الرضيع بعيدا عن والدته ويجب أن يمد بالحليب بوسائل اخرى وفي هذه الحالة علينا الاختيار بين حليب الأم المعصر وحليب الأطفال. ولهذا قامت هذه الدراسه لتقييم الحالة الميكروبيولوجيه لكلا النوعين من الحليب. لقد اظهرت النتائج أن ٥٤٪ من عينات حليب الأطفال كانت ملوثة بمتوسط قدره ٦.٨ ×١٠^{٣} ± ٢ × ١٠^{٢} خلية / مل، بينما بلغ نسبة تلوث عينات حليب الأم المعصر ٧٨٪ بمتوسط قدره ٣.٣ ×١٠^{٥} ± ٤.٧ × ١٠^{٤} خلية / مل. وقد تضمنت الملوثات المعزولة المكورات العنقودية، الميكروبات المعوية، المكورات المعوية والخميرة والعفن .كانت المكورات العنقودية من نوع الابيديرمس الأكثر انتشارا في كلا النوعين من الحليب بنسبة ١٠٪ في حليب الأطفال و٣٠٪ في حليب الأم المعصر وعلى الرغم من أن عينات حليب الأم المعصر أظهرت تلوث أعلى من حليب الأطفال يبقى حليب الأم الخيار الأفضل لتغذية الرضع بسبب زيادة فرصة العدوى في الأطفال الذين يرضعون حليب الأطفال لأنه يفتقر إلى حماية الجهاز المناعي التي تمنح عادة عن طريق حليب الأم.