Study the effect of lactation period on the Biochemical properties of breast milk during the first year of Breast-feeding

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Abstract:

The aim of this study was to determine the extent of the effect of lactation on biochemical compounds in breast milk in Najaf governorate. Two hundred forty samples of breast milk were collected from healthy mothers aged 18-30 years. Milk samples were collected from (3-11) month of Breast-feeding. In Najaf city, 44 mothers were selected as volunteers to obtain fixed samples per month for analysis. moisture, ash, protein, lactose and fat were measured. The results indicate that there was an effect on the period of breast-feeding at the level of probability ($p<0.05\%$) for fat, protein, lactose and moisture in breast milk. Lactose content increased but protein and fat decreased, while ash continued the same during the study period.

Keywords: Breast-feeding. Breast Milk. Lactose. Protein. Fat.

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Introduction:

Breast milk is a natural food and the source of all essential nutrients needed in the early stages of infant stage. The World Health Organization (WHO) recommends that breast milk is an exclusive source of infant feeding until at least the age of 6 months. Investigations into the content of milk and the factors influencing its composition are important for improving the development of breastfeeding to determine the nutritional needs of nursing mothers (3). Human milk is biologically determined bio-food for each individual, characterized through diverse composition, with regard to nutrients and vitality. From an evolutionary perspective, Human milk composition has evolved over time to provide the child with a well-balanced nutrition and protection against potential infectious pathogens while the infant's immune system is fully developed (13).

Human milk structure affected by time of breastfeeding, length of pregnancy period, maternal diseases, genetics and diet (2). Human milk is differentiated into colostrum, transient and mature milk. However, it should be taken into account that this classification refers to the gradual changes which occur in human milk according to the lactation stage rather than to specific categories of milk. The colostrum the produced first milk contains a high proportion of whey proteins. Casein is present in very small quantities and the content of lactose and fat are lower than that found in mature milk (14).

Human breast milk generally consists of 87% water, 3.8% fat, 1.0% protein, and 7% lactose. Fat and lactose, respectively, provide 50% and 40% of the total energy of milk (12). However, the composition of human breast milk changes over time, adapting to the changing needs of the growing child. For example, during each feeding, the first milk (Pro-milk) is thinner with higher content of lactose, which satisfies the baby's thirst, followed by Hind-milk with a much higher fat content. There are also differences with age of the infant, maternal diet, maternal health, and environmental exposure. During early lactation, protein content in human milk ranges from 1.4 to 1.6 g / 100 ml, decreased to 0.8-1.0 g-100^{-1} ml after 3 to 4 months of lactation, reaching 0.7-0.8 g-100^{-1} ml six months later (6).

Fat content varies significantly with the mother's diet, and is positively associated with weight gain during pregnancy. It had been observed that breast milk contains enough nutrients necessary for the growth and development of the infant even when the mothers own feeding is inadequate (4). In contrast to protein and fat, lactose content is largely constant in mature milk (21 days after birth). The stable concentration of lactose is important in maintaining constant osmotic pressure in the breast milk. Lactose also helps absorb minerals and calcium. In breast milk, many active biochemical compounds of carbohydrates, such as oligosaccharides, are associated with lactose (6).

The aim of this study is to determine the content of Human breast milk of protein, fat, ash and moisture during different stages of Breast-feeding.

Material and Methods: -

The study included 240 samples of breast milk divided into six groups represented by age of the infant, 8 mothers for each of groups age. The latter was divided into two age groups; 3 ages below 6 months and 3 after 6 months. The ages were 3 months, 4 months, 5 months, 9 months, 10 months and 11 months respectively.

The mothers were selected to take samples periodically to measure the concentration of breast milk components of protein, fat, lactose, ash and moisture, after confirming the health and nutritional status of mothers. These samples were collected between February 2018 and March 2019 from the Mashkhab district of the province of Najaf / Iraq. Samples were taken from 20-30 ml of breast milk after training the volunteers the way of sterilizing the hand or milk pump before collection, and save these samples directly in sterile glass bottles sealed with the complete information for each sample as the sample number and the age of the baby. Samples were frozen at -18 ° C in the freezer until tests were conducted.

Chemical composition tests:

Moisture content was determined according to Russell and Gray(16),Fat as per Kerber's method as mentioned by Ling (9),Ash content was tested According to Ling (9) which described by Ali (1), The protein content was estimated by Biuret method mentioned by Luo *et.al*.(11) and Lactose content was determined according to Itzhak and Gill(7).

Results and Discussion:

Protein**:** The results showed that an significant changes in the probability level of the protein during the different feeding periods (Figure 1), indicating a good percentage for the third month (1.28%) and the fourth (1.26%) while the percentage increased in the fifth month (1.43%).However, there was a decrease in the proportion of protein in the ninth month (1.12%) and the tenth month (1.15%). Regarding the results of the eleventh month (0.99%), showed the lowest proportion of protein during the period of breastfeeding targeted by the study. These results were similar to the results mentioned by EFSA (15).

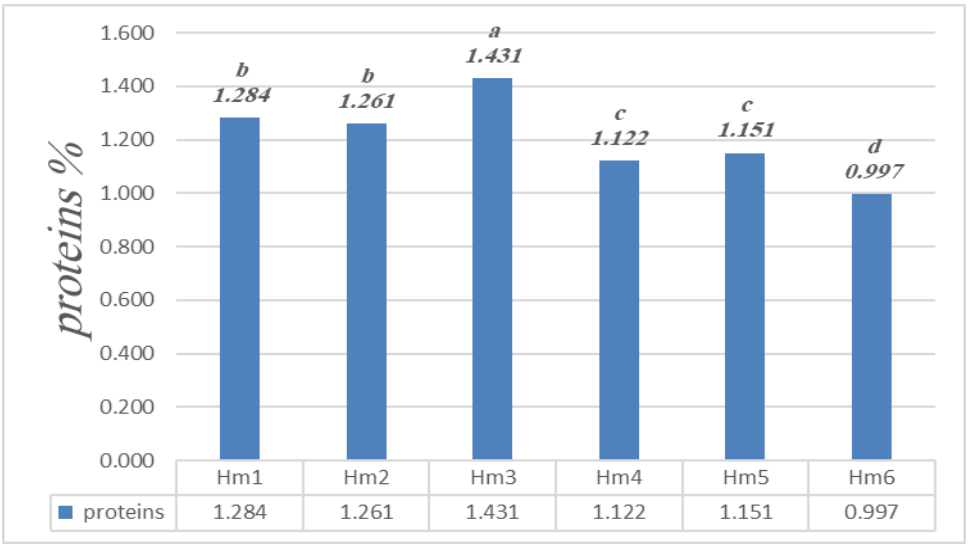

Figure (1) The percentage of protein with time of lactation.

Treatment (T), time (Ti), breast milk for the third month (Hm1), breast milk for the fourth month (Hm2), breast milk for the fifth month (Hm3), breast milk for the ninth month (Hm4), breast milk for the tenth month (Hm5), breast milk for the eleventh month (Hm6). The Small letters that follow the averages in a single column indicate significant differences within the probability level (p> 0.05).

Fat: In The results showed the effect of the period of study of the breast milk sample on the percentage of fat in milk (Figure 2). It was noticed that the increased in the period of breastfeeding decreased the percentage of fat in the milk also the highest

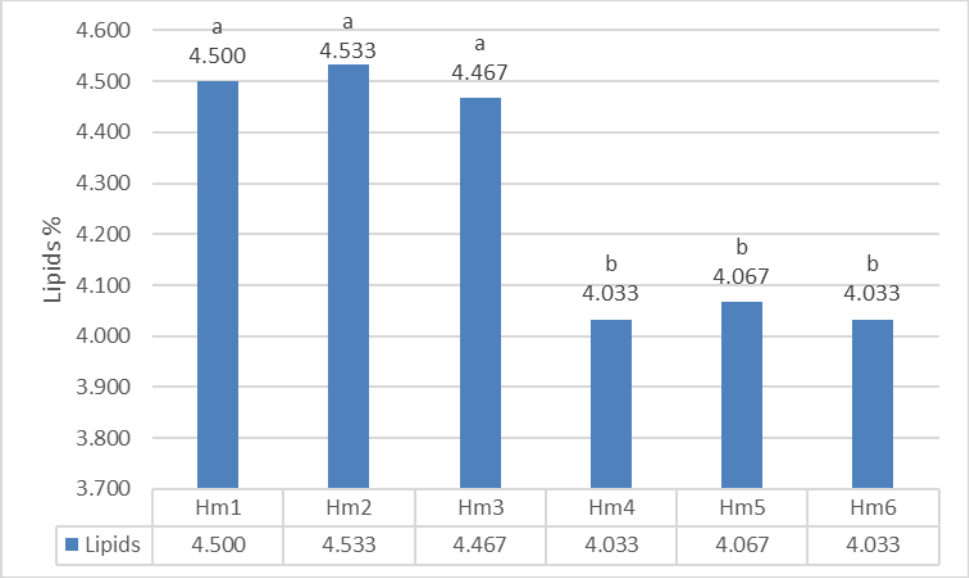

Figure (2) Effect of the period of time on the proportion of fat

Treatment (T), time (Ti), breast milk for the third month (Hm1), breast milk for the fourth month (Hm2), breast milk for the fifth month (Hm3), breast milk for the ninth month (Hm4), breast milk for the tenth month (Hm5), breast milk for the eleventh month (Hm6). The Small letters that follow the averages in a single column indicate significant differences within the probability level (p> 0.05).

percentage of fat in breast milk in the fourth month (4.533%) and in the third month (4.5%) was observed, while the percentage decreased significantly with other months, reaching (4.46%) in the fifth month. Regarding the second period of breastfeeding as the ninth month the fat decreased to (4.033%) and rise slightly in the tenth month to (4.067%), but in the final phase of this study the fat percentage returned to decline in the eleventh month to (4.033%) to show us the extent of change in the proportion of fat in breast milk during different periods of breastfeeding these results were similar to the results described by Long *et. al.* (10) and Jose et. al. (8).

Moisture: Results showed that an significant differences regarding the effect of feeding period on moisture (Table 1) and Figure (3)With a gradual increase in wet content for each of the third month(87.07%), and fourth month (87.1%), while decreased in the fifth month to (86.96%).Regarding the second period of breastfeeding, the results exhibit that the moisture percentage being higher significantly compared to the first period. The percentage of Moisture in the ninth month of the lactation period was (87.98%) followed by a slight decreased in the tenth month (87.95%), then reached the highest percentage in the eleventh month (88.20%).The results were consistent with

the results of this study for both proteins and fats for the months mentioned above, Long(15) fond similar results to what was found in this study (Figure 3).

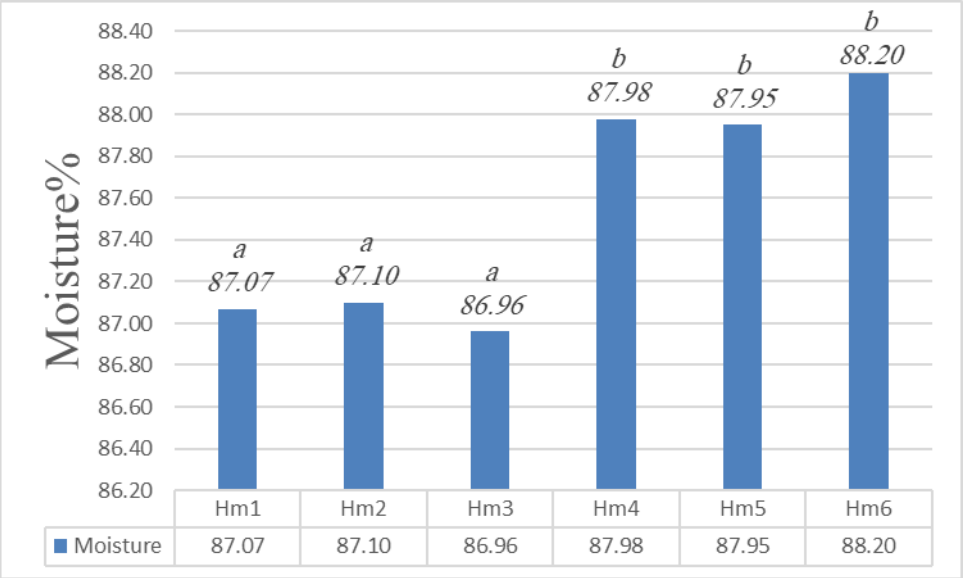

Figure (3) Effect of time period of lactation on Moisture

Treatment (T), time (Ti), breast milk for the third month (Hm1), breast milk for the fourth month (Hm2), breast milk for the fifth month (Hm3), breast milk for the ninth month (Hm4), breast milk for the tenth month (Hm5), breast milk for the eleventh month (Hm6). The Small letters that follow the averages in a single column indicate significant differences within the probability level (p> 0.05).

Ash: Figure (4) showed that the effect of time period of lactation on the ash content in breast milk. The results indicated no significant differences between the first and second period of lactation, these results were similar to the results described by Butts *et. al.*(5).

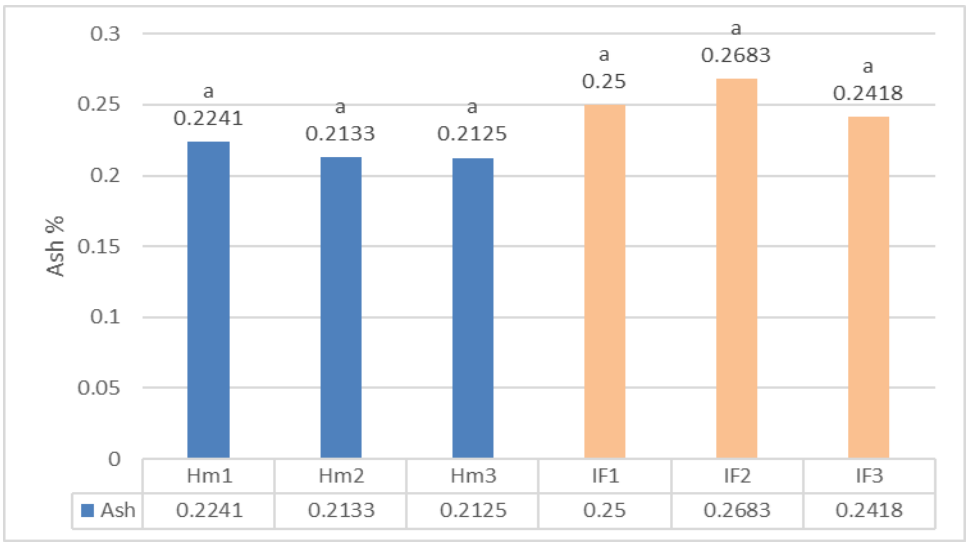

Figure (4) Effect of time period on Ash

Treatment (T), time (Ti), breast milk for the third month (Hm1), breast milk for the fourth month (Hm2), breast milk for the fifth month (Hm3), breast milk for the ninth month (Hm4), breast milk for the tenth month (Hm5), breast milk for the eleventh month (Hm6). The Small letters that follow the averages in a single column indicate significant differences within the probability level (p> 0.05).

Lactose percentage: No significant differences between third, fourth and fifth month for the first period of lactation Figure (5). In addition, the percentage of lactose

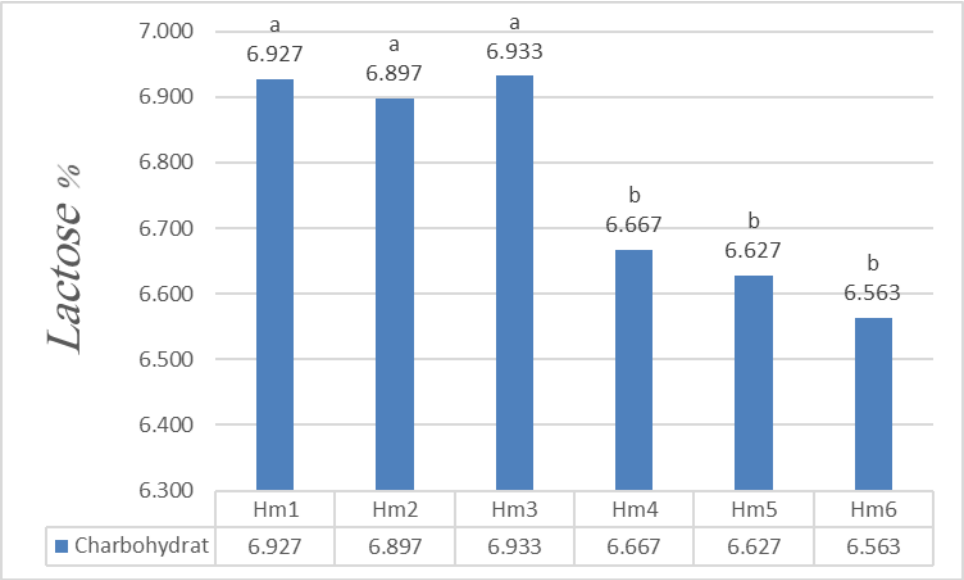

Figure (5) the time period of feeding effect on Lactose percentage.

Treatment (T), time (Ti), breast milk for the third month (Hm1), breast milk for the fourth month (Hm2), breast milk for the fifth month (Hm3), breast milk for the ninth month (Hm4), breast milk for the tenth month (Hm5), breast milk for the eleventh month (Hm6). The Small letters that follow the averages in a single column indicate significant differences within the probability level (p> 0.05).

decreased significantly during the period of lactation for the second period starting from the ninth month (6.667%) to be followed by lower percentage in the tenth month (6.27%). Figure (5), The lowest percentage appeared in the eleventh month to reach (6.563%), thus the lowest percentage of lactose during the first year of breastfeeding, where these results were similar to what was reached by Long *et.al.* (10) and Jose *et.al.* (8).

Table (1): Chemical changes to the composition of breast milk during Breast-feeding

Treatment		Parameters				
		Proteins	Lipids	Moisture	Ash	Carbohydrates
Hm1		1.284[b]	4.500[a]	87.07[c]	0.2241[a]	6.927[a]
Hm2		1.261[b]	4.533[a]	87.1[c]	0.2133[a]	6.897[a]
Hm3		1.431[a]	4.467[a]	86.96[c]	0.2125[a]	6.933[a]
Hm4		1.122[c]	4.033[b]	87.98[b]	0.2003[a]	6.667[b]
Hm5		1.151[c]	4.067[b]	87.95[b]	0.2087[a]	6.627[b]
Hm6		0.997[d]	4.033[b]	88.2[a]	0.2094[a]	6.563[b]
P-Value	Treatment	<.0001	<.0001	<.0001	0.467	<.0001
	Time	<.0001	<.0001	<.0001	0.467	<.0001
	T*Ti	<.0001	<.0001	<.0001	0.467	<.0001

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