The fatty acids Determination in breast milk and in infant formula milk

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Abstract. Breast milk is the first and best food for the baby and the natural source of all the nutrients needed by the infant to grow and move. At present, local and international markets are full of milk products and alternatives milk products. The aim of this study was to find the differences between the infant formula and breast milk in the presence and percentages of fatty acids during the period of lactation. A total of 240 samples of healthy mothers (ages 18-33 years) which had an infants aged 3-11 months were collected voluntarily, the samples were collected daily and five days per week. A representative sample of the week was taken to measure the presence and percentages of fatty acids by GC mass. The results of fatty acids for the mother sample for the period less than six months were shows (Capric, Lauric, Myristic, Palmitic, Palmitoleic, Stearic, Oleic, Linoleic and Margaric acid 1.41, 1.49, 0.86, 2.59, 0.85, 0.64, 9.09, 10.3, 0.85%), while the infant formula was (IF1 = Linoleic 14.75 %, Oleic 5.11%, Stearic11.39%, Palmitic 3.9%, Myristic 1.04%, Lauric 2.71% and Capric 0.52 %, IF2 = Capric 1.44%, Lauric 9.44%, Myristic 3.34%, Palmitic 5.86%, stearic 1.92%, Oleic 12.51% and Linoleic 6.37%, IF3 = Capric 0.7%, Lauric 1.39%, Myristic 0.53%, Palmitic 4.51%, stearic 0.71%, Oleic 3.73% and Linoleic 2.44% ). While it were the results of breast milk from fatty acids in the period after six months were as follows (Capric 0.84%, Lauric 3.14%, Myristic 2.94%, Palmitic 5.33%, Palmitoleic 0.2%, Stearic 1.8%, Oleic 6.23%, Linoleic 7.06%, Margaric acid 1.16%) , the results of the infant formula varied for the same period(IF4 = capric 0.84%, Lauric 3.52%, Myristic 0.94%, Palmitic 5.12%, Palmitoleic 3.64%, Stearic 1.06%, Oleic 5.62% and Linoleic 2.95% IF5 = Capric 0.97 %, Lauric 4.59 %, Myristic 0.74%, Palmitic 3.42 %, Palmitoleic 18.44 %, Undecanoic acid 4.53 %, Oleic 5.13 %, Linoleic 3.02 %, Stearic 1.18 %, Margaric acid 1.64 % and Arachidic acid 0.88 %, IF6 = Lauric 0.5%, Myristic 0.55%, Palmitic 2.83%, Palmitoleic 20.1%, Sebacic 1 %, Arachidic acid 0.98%, Linoleic 1.49 %, Stearic 1.1 % ). The study showed that the earliest infant formula was (IF5) in terms of the fatty acids presence for the second period compared to breast milk, but in terms of ratios did not find a match between breast milk for the periods before and after six months, as well as between breast milk and infant formula.

1. Introduction
Fat is one of the most important milk ingredients as a source of necessary energy for the growth and development of the infant, helps in the metabolic and physiological functions of the infant body, such as
vitamins dissolved in fat absorption. The availability of essential fatty acids, which are the hormones building blocks, is an essential component in the cell membranes formation and as precursors of the various active molecules of the body are also necessary for the development and vision of the human brain [1]. In the breast milk fat is the main source of energy. The mother's breast milk supplies about 50% of the energy to infants and constitutes 4% of the mother's milk [2,3,4]. Several studies have shown the benefits of breast milk for infants with Regarding to gastrointestinal function, risk of infectious diseases, growth, nervous and immune system development [5], The aim of this study is to determine the fatty acids of breast milk and infant formula.

2. Methods
The study included 240 samples were collected for two periods before and after six months. On a daily basis from mothers aged (18-33 years) which had infants with a mean age of (3-11 months). A representative sample of the week was taken according to the treatment and stored at -18 °C Until the tests. The infant formula milk, 6 samples of infant milk products were selected based on the recommendation of pediatricians and the quantities of sales in (Najaf - Iraq), 3 sample for the first period group (IF1, IF2, IF3) and another 3 sample from the same company for the second period group (IF4, IF5, IF6) also this 6 sample of infant formula were retrieved according to company instructions and stored at (-18 °C) Until the tests.

2.1 The esterification
The esterification process was performed by placing 0.5 mL of the milk sample in a closed glass test tube, add 2 mL pure methanol (99.99%), mix the mixture by vortex and add 0.5 ml of concentrated sulfuric acid in droplets. The mixture heated (by the hot plate stirrer Device) to boiling point (2 minutes) to make it unclouded solution and then cool to room temperature. Add 2 ml of hexane and 2 ml of distilled water, then locked the glass tube, the mixture was separated by the vortex system to allow the separation of the top layer represented of 20% of the methyl ester of fatty acids in hexane, after that this layer was injected accurately into the gas chromatography device without prior concentration [6]

2.2 Determination the content of fatty acids
The study was conducted in the laboratories of the Food Sciences - Faculty of Agriculture - University of Basra using GC-MS with the following specifications: Oven temperature of 100 °C, source temperature of ion is 200 °C, injection temperature is 250 °C, surface temperature is 230 °C, the injections type is Division distribution Control of pressure flux, the Pressure 89.7 kpa, total column 79.2 ml/min, Column flow 1.2ml/min, Linear speed 40.7cm /sec, Speed reading target 0.6 sec, Scanning speed 100, Solvent flow time off min 3, Start time 4 min and the end time 29.83 min.

3. Results and discussion
A comparison of the fatty acids content of infant milk and the breast milk preparations was the target of this study. Samples of infant milk products were analyzed for the first age group under 6 months of age and the second age group over 6 months and under 12 months. Table 1 shows the ratios and types of fatty acids obtained from breast milk fat for the targeted samples at the first stage of infancy, as well as the ratios and types of fatty acids obtained from infant formula milk fat (IF1) (IF2) (IF3) for the first 6 months age.
Table 1. The first period fatty acid results

| Fatty acids    | Carbon atoms number | Breast milk % | %IF1 | %IF2 | %IF3 |
|----------------|---------------------|---------------|------|------|------|
| Capric         | 0:10                | 1.41          | 0.52 | 1.44 | 0.7  |
| Lauric         | 12:0                | 1.49          | 2.71 | 9.44 | 1.39 |
| Myristic       | 14:0                | 0.86          | 1.04 | 3.34 | 0.53 |
| Palmitic       | 16:0                | 2.59          | 3.9  | 5.86 | 4.51 |
| Palmitoleic    | 16:1                | 9.09          | -----| -----| -----|
| Margaric       | 17:0                | 0.85          | -----| -----| -----|
| Stearic        | 18:0                | 0.64          | 11.39| 1.92 | 0.71 |
| Oleic          | 18:1                | 10.3          | 5.11 | 12.51| 3.73 |
| Linoleic       | 18:2                | 0.85          | 14.75| 6.37 | 2.44 |

From the results presented in Table 1, the fatty acids of breast milk samples were comparable to a study [7] which revolves around the types of fatty acids of various infant formulas which studied at the Faculty of Agriculture and Veterinary Medicine, University of Brasilia in Brazil and the Department of Nutrition, Faculty of Health Sciences of the same university. Also, the results were almost similar to the study [4] in his study of the fatty acids of infant milk and the effects on the health of infants as the following acids were obtained (C10:0 Capric, C12:0 Lauric, C14:0 Myristic, Palmitic C16:0, C16:1 Palmitoleic, C18:0 Stearic, Oleic C18:1, Linoleic C18:2). The fat content of the fatty acids targeted in this study for the three varies infant formula samples of is different from that presented by [8] by studying human breast milk chemistry as the fatty acid content in milk fat (Caprylic acid C8, Capric acid C10, Lauric acid C12, Myristic acid C14, Palmitic acid C16, Margaric acid C17, Stearic C18), compared with this study, the infant formula of the three species lacked Margaric acid. In comparison with the mother's milk sample, the results of the studied were sample lacked for the fatty acids of Palmitoleic and Margaric acid. Table 2 shows fatty acids in the fat of breast milk samples for the second stage of breastfeeding after 6 months of age of the infant and below the age of one year. The fatty acids specified in the fat of the mother's milk were similar to the findings [1] where the fat
content was of fatty acids (C10:0 Capric, C12:0 Lauric, C14:0 Myristic, Palmitic C16:0, C16:1 Palmitoleic, C18:0 Stearic, Oleic C18:1, Linoleic C18:2)

Table 2. The second period fatty acid results

| Fatty acids   | Carbon atoms number | Breast milk % | %IF4  | %IF5  | %IF6 |
|---------------|---------------------|---------------|-------|-------|-------|
| Capric        | 0:10                | 0.84          | 0.84  | 0.97  | -     |
| Lauric        | 12:0                | 3.14          | 3.52  | 4.59  | 0.5   |
| Myristic      | 14:0                | 2.94          | 0.94  | 0.74  | 0.55  |
| Palmitic      | 16:0                | 5.33          | 5.12  | 3.42  | 2.83  |
| Palmitoleic   | 16:1                | 0.2           | 3.64  | 18.44 | 20.1  |
| Margaric      | 17:0                | 1.16          | -     | 1.64  | -     |
| Stearic       | 18:0                | 1.8           | 1.06  | 1.18  | -     |
| Oleic         | 18:1                | 6.23          | 5.62  | 5.13  | -     |
| Linoleic      | 18:2                | 7.06          | 2.95  | 3.02  | 1.49  |

Table 2 shows fatty acids in infant milk fat for the age group above 6 months IF4 the results of this study are consistent with [4] When comparing the fat content of breast milk fatty acids with the fat content of the second age group IF4 fatty acids is different from the milk sample in fatty acid content as the preparation lacks the presence of Margaric acid. Table 2 shows the results of this study from the samples targeted for the determination of fatty acids in the fat of infant formula milk IF5 were similar to the results of the study. When compared to fatty acids of the product with fatty acids of the mother's milk after 6 months, the second age group IF5 was the closest target in this study to the mother's milk fatty acid content in the preparation of the fatty acids. Table 2 shows the fatty acids studied for the fat samples of infant formula milk for the second age group IF6, while these results differ with [9] in the appearance of Sebacic acid as well as the lack of Capric acid. When comparing the IF6 milk sample for the second age group, there was a difference in fatty acid content between infant formula and breast milk for breastfeeding after 6 months. [10] No fatty acid Capric acid wasn’t available.
4. Conclusion

Differences in content and ratios of fatty acids for infant formula among them as well as differences for each type when compared to mother's milk.

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