

How Does The Fasting of Ramadan Affect Breast Milk Constituents?

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ABSTRACT

Background: Breast-feeding of infants is associated with their better biological, psychological and intellectual development. However, many factors affect the volume and composition of human milk such as stage of lactation and maternal diet. Many breast-feeding Muslim mothers fast the lunar month of Ramadan. The effects of fasting on milk constituents have not been previously studied in Sudan. Therefore, we aimed to investigate the variations between milk constituents during fasting and non-fasting periods among a group of Sudanese women.

Materials and Methods: Twenty four healthy breast-feeding mothers volunteered to participate in this cross-sectional study. Each mother provided 100 ml of breast milk during fasting and again 2 weeks after end of the fasting month of Ramadan. Milk was properly stored and analyzed for the various constituents, using the appropriate laboratory methods. The main constituents analyzed were: ash, protein, lactose, iron and electrolytes.

Results: The age range of lactating women was between 18 and 38 years, mean (\pm SD) 28.8 (\pm 5.15 years). Most mothers 17 (70.8%) were house-wives. Analysis of breast milk during fasting and non-fasting periods showed that: lactose, protein, sodium, potassium, calcium and phosphate were significantly decreased in the fasting breast milk compared with the non-fasting milk ($p=0.01$), while total soluble solid, moisture, ash and iron constituents had not significantly changed during fasting.

Conclusion: Fasting of Ramadan significantly affects proteins, carbohydrates and electrolytes in breast milk.

Keywords: breast-feeding, milk constituents, Ramadan, fasting.

Breast-feeding is associated with better biological, psychological and intellectual development of infants¹⁻⁴. However, many factors affect the volume and composition of human milk such as stage of lactation and maternal diet^{5,6}. Three aspects of maternal nutrition affect milk composition: current dietary intake, body

stores, and alterations in nutrient utilization as influenced by hormonal changes which is an important characteristic of lactation. Although maternal nutrition may be frequently compromised, the concentration of nutrients in milk and milk volume remain unchanged, and nutrients such as proteins, lipids, lactose etc. for milk synthesis are furnished by maternal stores or body tissues^{7,8}.

Human milk contains 0.8% to 0.9% protein, 4.5% fat, 7.1% carbohydrates, and 0.2% ash (ash is defined as the compounds that remain after a scientific sample is burned).⁹ Carbohydrates are mainly lactose. The fat fraction contains specific triglycerides of palmitic and oleic acid, besides lipids with trans bonds e.g. vaccenic acid, and

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conjugated linoleic acid (CLA) accounting for up to 6% of milk fat^{10,11}.

Throughout Ramadan, Muslims refrain from eating and drinking during daytime. The effects of Ramadan on many aspects of body physiology are well researched¹. Healthy lactating women are exempted from fasting if they feel themselves or their babies will be harmed by fasting³. Despite this flexible mandate, a great number of breastfeeding women do fast in Ramadan. For instance, in Turkey, up to 69% of lactating women fast during Ramadan⁴.

In Sudan, there are no published researches about the effect of Ramadan fasting on human milk composition. Therefore, we aimed to determine the effect of Ramadan fasting on breast milk composition.

MATERIALS AND METHODS:

Subjects: The study was conducted in a primary healthcare centre at National Ribat University, Khartoum, Sudan in July 2012 to January 2013. A total of 24 breast-feeding mothers who were fasting during Ramadan month and volunteered to give milk samples were included. All were non-smokers and none of them was taking any medications or dietary supplements. The volunteers had no chronic diseases. Their infants were more than three and less than six months of age.

Study design and sample collection: The study was designed in two stages. The first stage was during Ramadan (second week of Ramadan) and the second stage was conducted 2 weeks after Ramadan. Milk samples were obtained by manual self-extraction from each breast immediately after the first nursing period of the day in the morning between 09.00 – 11.00 am. Similar samples were obtained from the same mothers 2 weeks after Ramadan. The samples were stored in sterile polypropylene tubes and kept frozen in -21° C, then transported to the laboratory in a cool box and analyzed.

Analytical methods: Before analysis, breast milk was brought to room temperature, and homogenized. Milk samples were defatted by centrifugation in 4° C at 3000 rpm for 15 minutes. After removing the fat layer the milk protein was determined as total non-protein nitrogen (NPN) as described by Kjeldahl (AOAC, 2000)¹². Protein content was calculated as (TN-NPN) ×6.25. The removed fat layer was collected, weighed and calculated as percentage of the initial weight to determine fat content according to gravimetric method. Lactose levels in milk samples were determined by the AOAC Method 984 spectrophotometric enzymatic of (Lynch, J. M. *et al*, 2007)¹³.

Moisture and ash content of milk samples was measured by gravimetric method. Sodium, potassium, and calcium in milk samples were analyzed by means of Gallen Kamp® FBA-330 flame photometric determinations described by (Snezana *et al*, 2012)¹⁴. Phosphorous levels in milk samples were determined by the spectrophotometric determination (Miguel, A., F., and Manuel, J., 1995).

Laboratory work was done in Food Analysis Laboratory at University of Gezira, Wad Medani, Sudan.

Ethical issues: A written consent was obtained from each participant and her husband after explanation of the objectives and procedures of the study. Participants were informed about the voluntary nature of participation, that they can quit at any time and that any health concerns were addressed during study period. An ethical approval was obtained from the ethical committee of the National Ribat University.

Statistical analysis: All the data were analyzed using Statistical Package for Social Sciences (SPSS v.16, SPSS Inc., Chicago, IL, USA). The results were given as mean (±SD) values. Paired *t*-test and Wilcoxon signed rank test were used to compare the differences between the means. $P < 0.05$

was considered as the cut-off value for significance.

RESULTS:

The age range of lactating women was between 18 and 38 years, mean (\pm SD) 28.8 \pm 5.15 years). Sociodemographic characteristics of participants were displayed in table 1. Most mothers (70.8%) were house-wives and 29.2% were workers. Analysis of breast milk during fasting and non-fasting periods was shown in table 2. Lactose, protein, sodium, potassium, calcium and phosphate were significantly decreased in the fasting breast milk when compared with the non-fasting milk (*p*-values less than .01). While total soluble solid, moisture, ash and iron constituents had not significantly changed during fasting.

Table 1: Socio-demographic characteristics of fasting breast-feeding mothers in Sudan, 2012. (n=24)

Characteristic	Variable	N (%)
Age group (years)	18 - 24	5 (20.8)
	25 - 31	12 (50.0)
	32- 38	7 (29.2)
Residence	Khartoum	11 (45.8)
	Omdurman	7 (29.2)
	Khartoum-north	6 (25.0)
Educational level	Primary	5 (20.8)
	Secondary	9 (37.5)
	College	10 (41.6)
Occupation	Housewife	17 (70.8)
	Employee	7 (29.2)
Number of household (individuals)	3 - 5	9 (37.5)
	6 - 9	11 (45.8)
	\geq 10	4 (16.7)

In this study Protein, Sodium, Potassium and phosphate were significantly decreased. A team of Turkish investigators¹⁷ claimed in a recent paper that, although the quantity of macronutrients in the breast milk remains virtually unaltered, some of the

micronutrients such as zinc, magnesium, and potassium can decrease significantly if the nursing women fast during Ramadan. Though the results are seemingly fascinating, the study is fraught with several inconsistencies and ambiguities.¹⁷

DISCUSSION:

The composition of breast milk in the non-fasting Sudanese mothers was consistent with the international constituents of breast milk¹⁵. The recorded protein content is between 1.0- 1.6 g/100 ml and lactose is 6.5- 7.5 g/100 ml; in this study it was found to be 1.6146 g/100 ml and 7.0521 g/100 ml respectively. Also, calcium concentrations reported in various studies vary from 25-35 mg/100 ml. Phosphorus at 13--16 mg/100 ml and in this study calcium was found to be 35.6250 and phosphorus 13.9792¹⁶.

In a study done by Prentice, A. M. *et al*, they referred the change in composition and osmolality of the milk due to inadequate water intake in Ramadan¹⁸. Investigators from Arab Emirates reported that except for an insignificant variation of lipids there was no significant difference in the composition of major nutrients in breast milk before and after Ramadan². A few investigators studied the effects of Ramadan on the composition of breast milk but ended up with variable results¹⁹.

In the study done in Turkey in 2006 showed that Potassium was significantly decreased during fasting Ramadan, which is consistent with this study¹⁷. No significant differences were seen in the content of major nutrients of milk taken during and after Ramadan².

Ramadan fasting had no significant effect on the macronutrient composition of the breast milk and consequently the growth of the infants. There were significant differences in some of the micronutrients such as zinc, magnesium and potassium. The nutritional status of lactating women was affected by Ramadan fasting. All of the nutrient intakes (except vitamins A, E and C) decreased

Table 2: Comparison between milk constituents of fasting breast-feeding mothers during the fasting and non-fasting period in Sudan, 2012. (n=24)

Item measured (g/100ml)	Status of mother				P value
	Fasting		Non-fasting		
	Mean	Standard deviation	Mean	Standard deviation	
Total soluble solid	9.503	0.77	9.9079	1.06	.081
Water	88.743	0.99	88.7517	1.09	.976
Ash ^o	0.3900	0.11	.4288	0.13	.193
Lactose	6.582	0.40	7.0521	0.45	.000
Protein	1.506	0.22	1.6146	0.22	.000
Dry matter	11.26	0.98	11.4346	0.99	.978
Sodium	7.2555	2.64	10.1662	4.20	.001
Potassium	10.3633	2.20	12.6621	3.42	.009
Calcium	33.1667	2.99	35.6250	4.39	.001
Phosphorus	11.95	1.50	13.9792	1.76	.000
Iron	0.1958	.02	.2008	0.01	.306

^oThe compounds that remain after a scientific sample is burned.

during Ramadan. For these reasons, it would seem prudent to excuse lactating women from fasting during Ramadan¹⁷.

There are variations between Islamic countries concerning the rate of breast feeding mothers who fast during Ramadan. Therefore, healthcare providers need to be knowledgeable about religious and cultural norms, study the effects of Ramadan fasting and form links with Islamic teachings to find religiously and culturally appropriate methods to combat the possible unfavorable effects for infants and children⁴.

Ramadan fasting by breast-feeding mothers did not adversely affect the growth parameters of exclusively breast-fed infants in short-term²⁰.

Mean phosphorus and lactose levels decrease ($P=.000$ and $P = .000$, respectively)²¹.

The concentrations of total protein, fat, lactose and calcium (Ca) in human milk were measured in 68 lactating women who were 14-425 days postpartum. Relationships of those concentrations in human breast milk with maternal food intake frequency, and the amount of dairy milk intake were investigated. Quantification theory III statistical analysis was applied to analyze

food intake patterns. The concentrations of total protein at 2-5 months postpartum, fat and Ca at 1-5 months postpartum were low in milk obtained from mothers with low frequency of consumption of meat, egg, dairy products and food prepared with oil, while having a high frequency of consumption of rice, vegetables, beans and seaweed. The concentration of Ca in milk from mothers who habitually had no dairy milk intake was significantly lower compared to that from mothers who had more than 300 ml intake of dairy milk per day. Lower frequency or no intake of animal food and dairy milk appeared to affect the quality of mother's milk²².

Milk production is a complex process where nutritional factors interact with structural hormonal and behavioural influences. In recent years important advances have been made in understanding the role of the nutritional status of lactating women on the outcome of breast feeding²³.

There are many limitations in this study. The small sample size of participants may not allow generalizations to be made about the effects of fasting on breast milk constituents. However, it is not feasible to find and trace too many fasting lactating

mothers who volunteer to express their milk for testing. The nutritional habits during the non-fasting hours may also influence milk constituents, as good and balanced nutrition may ameliorate the effect of daytime fasting. However this study is novel and is the first of its type in Sudan. Therefore, it may constitute a database for further larger studies in the future.

In conclusion, fasting of Ramadan significantly affects proteins, carbohydrates and electrolytes in breast milk. The implications for these findings on the nutritional status of the infant are to be determined by further studies.

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