

Fatty Acid Composition of Breastmilk of Israeli Mothers

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We conducted this study to determine the fatty acid composition of breastmilk of Israeli women and compare it with baby milk substitutes. Samples of mature breast milk, from 29 lactating Israeli Jewish mothers were collected during feedings. Total milk lipids extracts were transmethylated and analyzed by using an improved gas-chromatographic method. About 72% of the total fatty acids in the investigated breast milk comprised oleic (18:1c; 31±4%), palmitic (16:0; 21±4%), and linoleic (18:2n-6; 20±4%) acids. Total saturated fatty acids represented 42±7% of total fatty acids. The monounsaturated fatty acids content was 33±5%, of which 94% was oleic acid, and the polyunsaturated fatty acids content was about 24±4%, of which 85% was linoleic acid. The α -linolenic acid level found in this study, 2.0±0.6%, was higher than the range of values reported for the world population (0.10-1.4%). The main fatty acids composition of the milk substitutes has very similar composition to the breast milk. Docosahexaenoic acid levels are particularly low among the population of Jewish nursing mothers in relation to the milk substitutes, containing docosahexaenoic acid in their formulations.

Key words: Breastmilk, polyunsaturated fatty acids, Jewish.

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The presence of long chain polyunsaturated fatty acids (LC-PUFAs) during early life is thought to be vital to nervous system growth and maturation, and as such, great emphasis has been placed on the LC-PUFAs content of breast milk [1,2]. The breast milk fats present in maternal milk vary widely throughout the world according to both maternal dietary habits and environmental background [3]. The amount of docosahexaenoic acid (DHA) present in breast milk varies considerably and is dependent largely on maternal diet. Research has shown that breast milk concentrations of DHA typically comprise between 0.1 and 1.0% of the total FAs content, with the differences depending on the maternal intake of marine food sources [4,5].

There is little information about the distribution of fatty acids in breast milk of Israeli women [6]. Therefore, this study analyzed the fatty acid composition of the mature breast milk of Israeli Jewish woman. In addition, because a large portion of Israeli infants are fed using infant formulas, we also compared the composition of breast milk to that of infant formulas commonly used in Israel.

METHODS

This study involved 29 lactating healthy Israeli Jewish mothers (8-12 weeks post-partum) from the south of

Israel whose full term infants (born at 37-41 weeks gestation) were fed exclusively with breastmilk. All women were consuming self-selected diets. All study procedures were approved by the institutional ethics committee of Ben-Gurion University of Negev, Soroka Medical Center, and informed consent was obtained from all participants.

Samples (60–100 mL) of mature breast milk were collected from all the women during feedings at approximately the midpoint (after three minutes) of each feeding, by manual extraction. Time of collection was between 12:00 to 15:00. Milk samples were collected during the year 2008 and immediately frozen at -80°C. The mothers were interviewed by a medical doctor about their dietary habits in general.

The lipid profile of the breast milk was analyzed using a procedure previously described in the literature [7]. Lipid composition of baby milk powders was taken from the packaging, according to the manufacturer's report from two infant formulas of two different companies (A and B; "d" stands for dairy and "s" stands for soy milk) that are popular in Israel. Formula "A" has added long-chain fatty acids DHA and ARA.

Statistical analysis. All data were analyzed using the statistical data analysis package included with Microsoft Excel 97. Correlations between the percentage (w/w) of

each FA, total *trans* FAs, and groups of similar FAs were examined using Pearson correlation coefficients. Relations were considered significant at $P < 0.05$.

RESULTS

The amount of linoleic (18:2n6), α -linolenic (18:3n3), arachidonic (20:4n6), and docosahexaenoic (22:6n3) acids and the sums of FAs groups (**Web Table 1**) did not show significant correlations with each other, except for the correlation between n-3 and n-6 LC-PUFAs. **Table I** shows the main FAs content of the breast milk.

About 72% of the total FA in the investigated breast milk comprised oleic (18:1c; $31 \pm 4\%$), palmitic (16:0; $21 \pm 4\%$), and linoleic (18:2n-6; $20 \pm 4\%$) acids. Total SFA represented $42 \pm 7\%$ of total fatty acids, of which about half was palmitic acid. The MUFAs content was $33 \pm 5\%$, of which 94% was oleic acid, and the PUFAs content was about $24 \pm 4\%$, of which 85% was linoleic acid. The mean total *trans* FAs concentration was $0.39 \pm 0.13\%$.

DISCUSSION

Saturated fatty acids found in mature human breast milk in our study were very close to the results of several others recent studies [2,8,9] Lactating women from Asian countries and Saudi Arabia showed higher SFAs contents (52–66%) [10,11], whereas Chinese [10,12], Canadian [8], Brazilian [13], European [1], and Turkish [3] lactating women showed similar values to those found in our study (38–45%). Percentages of medium chain saturated fatty acids (MC-SFAs, C8:0–C14:0) found in the milk of Israeli women were within the range of values found for other populations [3, 11–14]. The MUFAs content of the milk in our study was also consistent with those obtained in previous studies [18–20].

Trans fatty acids comprised a relatively low proportion ($0.40\% \pm 0.13$) of the fatty acid content of

Israeli women's breast milk compared to most other populations around the world. The low *trans* FAs values found in this study are difficult to explain. The total PUFAs of mature breast milk in this study was higher than those found for the North American (10–17%) and European (9–14%) populations [1,15] and similar to those of Turkish lactating women (27% PUFAs and 24% C18:2n-6). The similar findings are probably due to the consumption of similar plant oils. The α -linolenic acid level found in the milk of Israeli Jewish women in this study was higher than the range of values reported for the world population (0.10–1.4%) [3,9–11,15–17]. We found a significant correlation ($r = 0.7$, $P < 0.05$) between n-6 and n-3 LC-PUFAs in the human milk in this study (**Fig. 1**). It was suggested that this finding may be explained by a mutual pathway for LC-PUFAs synthesis and secretion in milk, which is shared by both the n-6 and the n-3 fatty acids, [3]. This pathway may protect the

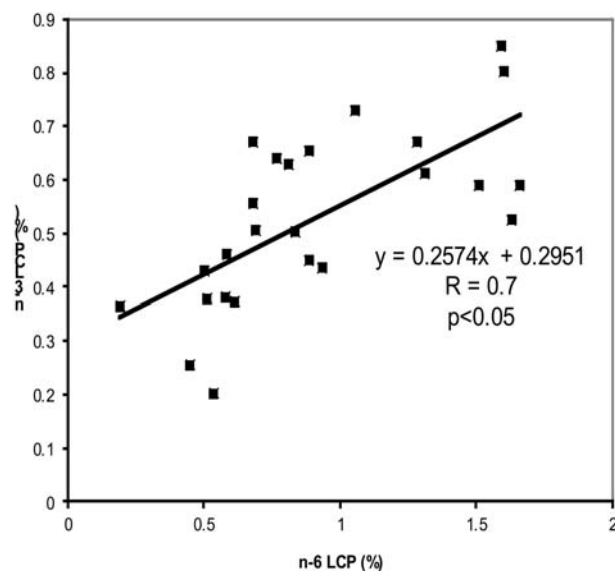


FIG 1. Correlation of LC-PUFAs content of the n-3 and the n-6 (LC-PUFAs) series in human milk lipids from Israeli mothers.

TABLE I ESSENTIAL FATTY ACID COMPOSITION OF BREAST MILK OF JEWISH MOTHER AND COMMERCIAL BABY MILK FORMULA

% by weight of total fats	Infant formula A dairy	Infant formula A soy bean*	Infant formula B dairy	Infant formula B soy bean*	Breast milk Mean (SD)
Saturated fats	55%	45%	64%	32%	43 (7%)
Unsaturated fats	46%	54%	36%	67%	57 (7%)
Linoleic acid (18:2n6)	19%	16%	18%	18%	20 (4%)
α -Linolenic acid (18:3n3)	2.0%	1.4%	1.9%	—	2.0 (0.6%)
ARA (20:4n6)	0.43%	0.52%	—	—	0.44 (0.17%)
DHA (22:6n3)	0.41%	0.49%	—	—	0.17 (0.11%)

Vegan milk; ARA: Arachidonic acid; DHA: Docosahexamic acid.

infant by providing a relatively constant n-6/n-3 ratio in infant diets that carries over into the tissues [3].

DHA levels are particularly low among the population of Jewish mothers in relation to the milk substitutes containing DHA in their formulations. 20% of nursing women's milk contained DHA below the limit of measurement. Israeli women's diet is based mainly on dairy products, carbohydrates, poultry and vegetables, and poor in fish from deep-water sources. Thus, it is unlikely to provide sufficient DHA to support optimal postnatal neuro-visual development. It is possible that high levels of α -linolenic acid (18:3n3) often compensate for the lack on DHA.

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