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Composition of Milk Obtained From Unmassaged Versus Massaged Breasts of Lactating Mothers

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ABSTRACT

Background: The Oketani method is a program of breast massage and clinical counseling developed by the midwife Satomi Oketani. The purpose of this study is to examine the effects of the method on the quality of breast milk by determining the chemical composition of the milk before and after massage.

Methods: Milk samples were obtained immediately before and after massage from healthy, exclusively breast-feeding Japanese mothers at two different periods of lactation one <3 months the other >3 months after parturition. Lipids, whey protein, casein, lactose, ash, and total solids in milk were measured in milk samples.The gross energy content of milk was estimated.

Results: Breast massage significantly increased lipids in the late lactating period but not in the early lactating period. In the early lactating period casein was increased by breast massage but was not significantly affected in the late lactating period. Breast massage caused a significant increase in total solids from the first day to 11 months post partum. The gross energy in the late lactating period was significantly increased by breast massage but not in the early lactating period. Lactose was not significantly changed by breast massage.

Conclusions: Breast massage improves the quality of human milk by significantly increasing total solids, lipids, and casein concentration and gross energy. The milk of mothers treated by Oketani breast massage may improve the growth and development of infants. ***JPGN 38:484–487, 2004.*** **Key Words:** Breast massage—Chemical composition—Human milk—Oketani method. © 2004 Lippincott Williams & Wilkins

It is widely recognized that breast-feeding is an important factor in the physical and developmental wellbeing of children, and that it is very important for the mother. Proponents have claimed that performing Oketani breast massage before lactation raises the quality of the excreted milk and thereby provides significant growth and developmental benefits to the infant (1–3).

The Oketani breast massage is a connective tissue massage developed by the midwife Sotomi Oketani (4). The specific reasons for the beneficial effects on milk from mothers who receive Oketani massage have not been scientifically examined. It seems, however, that massage may change the milk composition including its content of protein, lipid, saccharide, and trace nutrients. To study the effects of Oketani breast massage on the quality of milk, we examined quantitative differences in the composition of milk obtained from lactating mothers before and after breast massage.

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MATERIALS AND METHODS

Characteristics of Lactating Mothers

Thirty-nine breast-feeding mothers participated in this study and were divided into two groups, early lactating group and late lactating group, based on the duration of lactation after delivery. The early lactating group (n = 20) was defined as from 1 to 90 days after parturition, and the late lactating group (n = 19) as 91 to 320 days after parturition (Table 1). The average age of lactating mothers was 31.0 years (range, 28–38 years) in the early lactating group and 32.5 years (range, 21–41 years) in the late lactating group. The average order of infant birth was 2.1 in the early lactating group and 1.8 in the late lactating group. The average age and order of infant birth were not significantly different between the early and late lactating groups.

The Oketani Method of Breast Massage

Breast massage of the lactating mothers in this study was performed following the Oketani method, for which special

TABLE 1. *Characteristics of lactating mothers*

Lactating periods	Mother's age (years)	Order of infant	Infant's age (days)
Early lactating period (before 3 months)	31.0 ± 2.9	2.1 ± 1.1	38.5 ± 24.6
Late lactating period (after 3 months)	32.5 ± 4.8	1.8 ± 0.8	193.2 ± 75.8

Values are mean ± SD.
N = 20 in early lactating group.
N = 19 in late lactating group.

training and technique are essential (2,4). This connective tissue massage encourages breast health by manual separation of adhesions between the breast base and the major fascia of the pectoral muscles with the aim of helping to restore and maintain natural breast contour and normal breast function. The breast base consists of connective tissue and is affected to various degrees by the conditions of the mother's life. The massage process of the Oketani method is said to increase the mammary depth, and it can be seen in Figure 1 that the base or mammary depth appears expanded after the massage, that is, the elasticity of the base is improved. The most salient characteristics of the Oketani method are the following (2,4): 1) the massage causes no discomfort or pain to the mother, 2) the mother will suddenly feel general relief and comfort, 3) lactation is enhanced regardless of the size or shape of the mother's breasts and nipples, 4) deformities such as inversion, flattening or cracking of the nipples are rectified, and 5) nipple injuries and mastitis are prevented.

Collection and Classification of Milk Samples

Milk samples were obtained freshly within 30 minutes before massage and immediately after massage from healthy, exclusively breast-feeding Japanese mothers at various stages of lactation. Usually, lactating mothers ate breakfast and then visited the maternity clinic. A midwife trained and licensed in the Oketani massage method performed the massage. Each mother provided only one pair of samples before and after massage in this study, and did not participate again as late lactation mothers. The samples before and after massage were collected by the mother herself. We did not make any intervention for the milk sample collection. Milk was expressed by hand until the entire breast was emptied. Milk was collected in small plastic vials and stored at −20°C for later analysis of its chemical composition.

Analysis of Chemical Composition

All samples were thawed and homogenized before analysis. The total lipid content was measured using a modified Folch method (5). Lactose concentration was determined by high-pressure liquid chromatography (HPLC) according to the method described by Coppa et al. (6). In the HPLC system (C-R7A with RID-10A detector, Shimazu Co., Ltd, Kyoto, Japan) using Asahipak NH2–50, column 2D (2.0 × 150 mm, 5 μm, Shodex Co., Ltd, Tokyo, Japan) and operating at a constant temperature of 40°C, the column was eluted with HPLC-grade acetonitrile and water (75:25) at a flow rate of 0.2 mL/minute. Ash and total solids were measured according to the method described by the Association of Official Analytical Chemists (7). to separate whey protein and casein, all samples were first defatted by centrifugation at 4,000 × *g* for 30 minutes at 4°C, then 10-mL milk samples were centrifuged using Ultracentrifuge (CP 100 MX, Hitachi Koki Co., Ltd., Tokyo, Japan), at 105,000 *g* for 30 minutes at 20°C. The supernatants were collected to determine the whey protein concentration, and the sediments were dissolved in 5 mL of saline adjusted to pH 8.0 with sodium hydroxide (8). The Bradford method (9) was used to determine the respective concentrations of whey protein and casein, using bovine serum albumin as a standard.

The gross energy density was calculated according to Garza et al. (10), by summing the values for protein (whey protein and casein), lactose, and lipid concentrations and multiplying them by 4.22, 3.87, and 9.16 kcal/g, respectively (11).

Data Analysis

Statistical analysis was performed using SPSS Base 10.0 (12). A paired comparison *t* test was used to compare the means

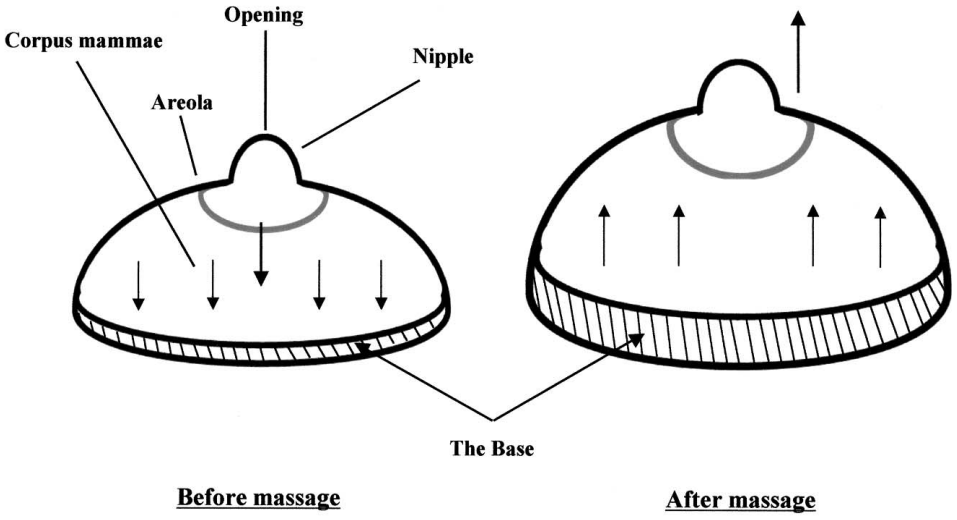

FIG. 1. The base of a woman's breast before and after massage.

of all variables before and after massage within each group in the study, and Student *t* test was used to compare the two different periods, after getting the results of equal variances. Any value of $P < 0.05$ was considered to indicate a significant difference.

Ethics

The study protocol and detailed description were reviewed and approved by the Ethics Committee of Siebold University of Nagasaki.

RESULTS

Table 2 shows the component concentrations of milk before and after breast massage from 1 day to 11 months of lactation. The whey protein concentration of pre-massage milk decreased steadily from 0.84 to 0.73 g/100 mL between the early lactating period and the late lactating period ($P < 0.05$), and that of postmassage milk had a similar decrease ($P < 0.01$). Breast massage caused a slight decrease in whey protein level in early lactation milk.

Casein concentration of pre-massage milk increased from 0.32 to 0.46 g/100 mL during the early lactating period through the late lactating period ($P < 0.001$), and that of post-massage samples significantly increased from 0.27 g to 0.45 g/100 mL ($P < 0.001$) between the early and late lactating periods. It is obvious that the casein concentration of pre-massage samples is markedly higher in the late lactating period than in the early lactating period. Casein levels in the early lactating period were significantly decreased by breast massage ($P < 0.001$), whereas breast massage did not cause significant change during the late lactating period. These results are consistent with those obtained by Kunz and Lönnerdal (13), who reported that casein synthesis is low or absent early in lactation, increases rapidly, and then decreases.

Total lipid concentration in the post-massage samples was higher in the late lactating period than in the early lactating period ($P < 0.001$), although those of pre-massage samples were not significantly different between the two lactating periods. Breast massage distinctly increases milk lipid concentration in the late lactating period but had no effect in early lactation. Previously available data showed that milk lipids in the pre-massage samples increased from 1 day to 9 months and then decreased slightly after 9 months (14,15).

Lactose concentrations were essentially stable during the early and late lactating periods, whether the milk came from massaged or unmassaged breasts. Lactose concentrations of pre-massage samples were 7.1 g/100 mL in the early lactating period and 7.3 g/100 mL in the late lactating period, and those of postmassage samples were approximately 7.3 g/100 mL. Interestingly, lactose levels were not significantly affected by breast massage.

The total ash content of milk from pre-massage breasts significantly decreased during the early to late lactating periods ($P < 0.01$), and that from post-massage breasts slightly decreased during lactation ($P < 0.05$). Breast massage had only a slight effect on ash content during lactation.

The total solid content of milk was significantly increased by breast massage during both lactating periods. The total solid content in the early lactating period was significantly increased by breast massage from 12.3 to 13.6 g/100 mL ($P < 0.001$) and in the late lactating period was increased from 12.1 to 13.2 g/100 mL ($P < 0.001$). These results were underscored by the color of the milk itself: light white before massage and yellow after massage.

Table 3 shows the effect of breast massage on gross energy content of milk from the two lactating period groups. It is clear that gross energy of milk was significantly increased by breast massage in both early and late lactation ($P < 0.01$). The gross energy in the late lactating period was significantly increased by breast massage from 67.2 to 74.1 kcal/100 mL ($P < 0.01$); in contrast, gross energy in the early lactating periods was not affected by breast massage. After 3 months of lactation, breast massage brought about a significant increase in the gross energy of milk.

TABLE 2. *Effect of breast massage on the component concentration of mother's milk for different lactating periods (g/100 mL)*

	Early lactating period (before 3 months)		Late lactating period (after 3 months)	
	Premassage	Postmassage	Premassage	Postmassage
Whey protein	0.84 ± 0.1^{e}	0.82 ± 0.1^{h}	0.73 ± 0.2^{e}	0.74 ± 0.6^{h}
Casein protein	$0.32 \pm 0.1^{a,f}$	$0.27 \pm 0.1^{a,i}$	0.46 ± 0.03^{f}	0.45 ± 0.04^{i}
Lipid	3.5 ± 0.4	3.6 ± 0.7^{j}	3.7 ± 0.4^{c}	$4.5 \pm 0.3^{c,j}$
Lactose	7.1 ± 0.4	7.3 ± 0.3	7.3 ± 0.3	7.3 ± 0.4
Ash	0.19 ± 0.04^{g}	0.20 ± 0.03^{k}	0.16 ± 0.03^{g}	0.17 ± 0.03^{k}
Total solid	12.3 ± 0.7^{b}	13.2 ± 0.5^{b}	12.1 ± 0.5^{d}	13.3 ± 0.5^{d}

There are significant differences between pre- and postmassage in the early lactating period, at $P < 0.001$ for a, b, c; at $P < 0.01$ for d, by paired Student *t* test, respectively.

There are significant differences between early and late lactating periods in both pre- and postmassage, at $P < 0.001$ for e, f, h, i, j; at $P < 0.01$ for g; at $P < 0.05$ for k by Student *t* test, respectively.

Values are mean ± SD.

N = 20 in early lactating group.

N = 19 in late lactating group.

DISCUSSION

It is anecdotally reported that the Oketani connective tissue breast massage performed before lactation improves the quality of the milk and stimulates the physical and mental development of infants (1,3), improving both their mood and sleep patterns. An association of mid-

TABLE 3. *Effect of breast massage on gross energy of mother's milk for different periods of lactation*

	Premassage milk (kcal/100 mL)	Postmassage milk (kcal/100 mL)
Early lactating period	64.4 ± 03.9[a]	66.1 ± 5.5[c]
Late lactating period	67.2 ± 4.2[a,b]	74.1 ± 3.2[b,c]

a, c: There are significant differences between early and late lactating periods in both pre- and postmassage, at $P < 0.01$ by Student t test, respectively.

b: There are significant differences between pre- and postmassage in early lactating, at $P < 0.01$ by paired Student t test.

Values are mean ± SD.

N = 20 in early lactating group.

N = 19 in late lactating group.

wives was established to promote and spread the Oketani method in Japan, and this promotion for lactating mothers has now expanded throughout Japan and to some other Asian countries.

Our results show considerable differences in many components of human milk (with the exception of lactose) before and after Oketani breast massage during 11 months of lactation. The effects of breast massage on milk composition may be a result of oxytocin and prolactin excretion. The gross energy and lipid content increased significantly after breast massage. These changes appear to raise the energy supply to the infant, whose hunger may thus be more easily satisfied. The increase of gross energy by breast massage may be especially important in the late lactating period, during which period the energy requirements for growth are great. Furthermore, the increase of lipid and total solids by breast massage might change the taste of the breast milk, which may also result in better satisfaction of the infant.

The physical and mental benefits for the infant cannot be explained solely in terms of quantitative changes in chemical components, such as proteins, lipids, carbohydrates, and ash. It is likely that other functional materials such as opioid and other small peptides are enhanced through massage and then are excreted to the breast milk.

Ohno (16) found that the Oketani massage increased by 22% the average amount of a small peptide (molecular weight, less than 10,000 Da) in 11 of 15 lactating mothers. The physiological function, if any, of this peptide has not been identified. Nevertheless, it appears that a specified protease activity may be stimulated by the connective tissue massage and that the small peptide may thus be converted from a larger peptide or protein. Ohno (16) also demonstrates that lipoxygenase activity was significantly decreased by the Oketani massage method in 23 of 27 subjects. These results suggest that the Oketani method may induce an antiallergic effect. These beneficial effects by the Oketani breast massage may improve infant development.

Our preliminary experiments using SDS-polyacrylamide gel electrophoresis demonstrate that certain proteins of small molecular size (such as casein) and those of large molecular size (such as immunoglobulins) were significantly affected by Oketani connective tissue massage. These data strongly suggest that some proteins are produced from other proteins through Oketani massage (unpublished data), ie, that Oketani massage may activate some proteases or protein synthesis and may produce some functional peptides and proteins, especially opioids. As a result, the quality of the milk improves, providing greater benefits for the infant.

Although this study demonstrated the change of chemical components of milk after massage by the Oketani method, additional research is needed to clarify the specific mechanisms involved in these beneficial effects on human milk.

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