

Study on Changes in Breast Milk Vitamin A and β -Carotene in Women of Different Age and Socioeconomic Status

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ABSTRACT

Milk studies in 153 randomly selected lactating women of three socioeconomic (low, middle and high) groups with monthly income up to Rs. 4000, Rs. 4001 to 10000 and above Rs. 10000, respectively and age groups (below 25, 26-32 and above 33 years) of Faisalabad, Pakistan, revealed an overall concentration of retinol and β -carotene to be 732.00 ± 0.91 and 57.01 ± 10.91 RE / L, respectively, during the first week of lactation. The vitamin A content of breast milk increased with the increase in socioeconomic status. However, no significant differences were observed between middle and low as well as between middle and high SES. Higher levels were observed in milk of middle and older age groups than the younger group. Milk vitamin A and β -carotene levels at sixth month was found to be much lower than that at the first week of lactation, being $.316.69 \pm 5.13$ and 48.34 ± 8.99 RE / L, respectively.

Key Words: Breast milk; Vitamin A; β -carotene; Socioeconomic status

INTRODUCTION

Deficiency of vitamin A in diet has long been identified as a serious nutritional handicap, which renders thousands of children blind, in developing countries, each year. Reports indicate that 60 per cent of below 5 years child deaths are due to diarrhea, respiratory tract infections and measles that are highly associated with vitamin A deficiency (Kirmani, 1974; Rawla *et al.*, 1975). Shirali *et al.* (1989) concluded that prevention of neonatal vitamin A deficiency is related to the adequacy of maternal vitamin A stores.

Transfer of vitamin A from mother to offspring occurs through blood and milk, which is influenced by maternal vitamin A intake (Davila *et al.*, 1985) and milk composition is more sensitive to maternal factors including body composition, diet and parity (Nommsen *et al.*, 1991). Vitamin A content of human milk is significantly affected by maternal nutrition in pregnancy and lactation (Lonnerdal, 1986; Ibrahim, 1991). Milk vitamin A is a unique indicator for assessing the vitamin A status of lactating women and their breast fed infants and is recommended by WHO for global elimination of vitamin A deficiency (Stoltzfus & Underwood, 1995). While most of the vitamin-A activity in mature human breast milk is in the form of retinol, some is provided by carotene. β -carotene is stored in the mammary gland during pregnancy and is rapidly secreted into milk during the first few days of lactation (Patton *et al.*, 1990).

Breast milk is virtually the only source of vitamin A, during the first few months and often continues to be one of the most important sources through age two

(Newman, 1994). It was further noted that the average amount of vitamin A in human milk in developing countries is not sufficient to allow liver storage after about six months of lactation (DeMaeyer, 1986). Late in gestation, adequate maternal vitamin A status was important for newborn reserve and sustaining adequate breast milk concentration (Underwood, 1994).

Stoltzfus *et al.* (1993) reported that vitamin-A content of breast milk changes over time to meet the changing needs of the growing infant. It is particularly high in colostrum and decreases over the course of lactation, with the rate of decline greatest during early lactation. For a woman with much smaller stores than normal, whose diet barely meets her own vitamin A requirement, the loss of the vitamin in milk could theoretically deplete vitamin A stores within a few months (IOM, 1991).

Breastfeeding is a common practice in Pakistan as 95.2% of lactating mothers breast feed their babies and breast feeding is often prolonged. 70% of the mothers continue breastfeeding even after the baby is one year old (GOP, 1988). Secretion of vitamin A in breast milk of mothers of different SES and ages is not known. The information on transfer of vitamin A from mothers to neonates in the local population is also lacking. Assuming nutritional deprivation, particularly of vitamin A, the more likely cause of poor health status and higher child mortality, it was felt informative to investigate the prevailing situation. The present study was therefore, carried out to assess the vitamin A status of lactating women through breast milk and study the changes in vitamin A and β -carotene contents during first six months of lactation.

MATERIALS AND METHODS

The study was conducted to determine the vitamin A content of breast milk of women during first week and at sixth month of lactation. The study involved 153 women delivered in the five hospitals of Faisalabad including Allied Hospital, District Headquarter Hospital, National Hospital, Aziz Fatima Hospital and Social Security Hospital. These women were divided into three SES groups (low, middle and high), each comprising 51 women on the basis of monthly income. Each SES group was further divided into three age groups, (women below 25, 26–32 and above 33 years of age).

About 35 ml sample of breast milk was collected within 1st week postpartum. Milk was extracted from both the breasts and mixed. Samples were collected into clean, dry brown colored screw capped glass bottles and kept at -20 °C. β -carotene and retinol were estimated. A second sample was also taken at 6th month of lactation and analyzed for the above-mentioned components. Samples were prepared by using the method of Thompson (1986). β -carotene and retinol were estimated using the method of Neelds and PeaRson (1963). The emulsion of fat in milk was broken and β -carotene were extracted from saponified milk through several extractions and washings. Proteins were precipitated out with alcohol. β -carotene and retinol were extracted into petroleum ether

The data thus obtained on these parameters were subjected to GLM (General Linear Model for factorial experiments) by using Minitab computer software package. The means were compared by Tukey's test for confidence interval by using one way analysis of variance by using same statistical package. Correlation coefficients among different parameters were also worked out by using Minitab (10.2) computer software package (Anonymous, 1994).

RESULTS AND DISCUSSION

First week of lactation. Average retinol level in breast milk during 1-6 days postpartum was 734.00 ± 223.00 RE / L, (Table I). Retinol had a broad range of 325–1391 RE/L in mothers under study. These values were lower than those reported by Neville *et al.* (1988) being 1524 and 1193 RE/L for developed and developing countries, respectively. Jensen *et al.* (1995) reported 550–1250 RE/L for developing countries within 1–6 days postpartum. Milk retinol levels in Sudanese mothers were 82.01 ± 35.9 μg /dL (Al-Othman *et al.*, 1996).

During the present study an overall significant effect of SES was observed on milk retinol levels. Significantly lower milk retinol levels were observed at low as compared to high SES. This may be due to low dietary intake of protein and vitamin A in mothers of low SES. The vitamin A content of human milk is significantly affected by maternal nutrition during pregnancy and lactation (Lonnerdal, 1986; Ibrahim, 1991). Lammi Keefe and Jensen (1984) reported similar effect of low SES.

In older mothers (33 years and above) significantly higher values for milk retinol were observed than in younger age groups. Similar effect of age was observed by Alia (1997) and Barua *et al.* (1997). Unlike retinol, β -carotene is a very effective antioxidant and this provides the infant a defense against oxygen toxicity. This may be particularly important during the first several days of life as the infant adjusts to its new oxygen rich environment (Ostrea *et al.*, 1986; Flodin, 1988; Kirksey & Rahmanifar, 1988). The milk β -carotene level observed during the present study was 57.01 ± 10.91 RE/L, (Table I). These values were much higher than those reported for developing (43 RE/L) and developed (39 RE/L) countries by Newman (1994). These findings suggest that most of the women in developing countries depend upon leafy green vegetables, as a cheaper and most abundantly available source of vitamin A precursor. In poorly nourished populations, the primary dependence for vitamin A is on non-animal sources (Bates *et al.*, 1984; McLaren, 1986). Approximately 5 per cent of vitamin A activity of human milk in developed countries comes from carotene, while it is over 10% in developing countries (Newman, 1994). Present study showed no effect of SES on milk β -carotene levels, however, slightly higher values were observed in mothers of middle and high SES. These findings are contrary to those of Gebre-Medhim *et al.* (1976) who reported a high proportion of β -carotene in milk from disadvantaged Ethiopian women as compared to that of women of higher SES. This was probably due to the fact that most of their vitamin A intake was from β -carotene. It may also be related to an insufficient intake of protein, which is necessary for the transformation of β -carotene into vitamin A (Olson, 1988). Significant effect of age of mothers on milk β -carotene levels was observed. Although the differences between younger and middle age and between middle aged and older mothers were non-significant, significantly higher milk β -carotene levels were observed in older than that of younger mothers during the first week of lactation. This effect might be due to more awareness and better adjustment

Table I. Mean vitamin A and β -carotene levels (RE/L) in breast milk of mothers of different ages and socioeconomic status at first week of lactation

SES	Age Group (years)			Overall meal (\pm SE)
	Below 25	26-32	34 and Above	
	Retinol			
Low	e* 388.40	d 597.90	c 796.40	B 594.30 \pm 74.00
Middle	c 759.30	d 592.60	b 918.70	AB 757.00 \pm 158.00
High	d 596.90	a 1144.50	c 815.40	A 850.60 \pm 253.50
Overall mean \pm SE	B 581.54 \pm 175.30	A 776.62 \pm 282.50	A 843.78 \pm 72.00	734.00 \pm 223.00
	β-carotene			
Low	d 42.47	bc 53.58	b 58.58	51.60 \pm 7.00
Middle	b 64.76	cd 49.17	a 73.00	62.44 \pm 14.0
High	bd 50.41	b 63.17	b 57.35	57.00 \pm 7.20
Overall \pm SE	B 52.70 \pm 13.80	AB 55.36 \pm 7.10	A 62.99 \pm 9.80	57.01 \pm 10.91

*Different capital letters, on overall means for SES and age groups and small letters, on means of SES x age show significant ($P < 0.01$) differences

at higher age in the most prevailing joint family system, with economically more established status at this age.

Sixth month of lactation. Milk retinol and β -carotene levels at 6th month of lactation were observed to be 316.69 \pm 5.13 and 48.34 \pm 8.99 RE/L, respectively, (Table II). These levels were much lower than the levels observed during 1-6 days postpartum. Vitamin A content of milk changes over time. Even in presumably well-nourished population in developed

countries, the concentration of vitamin A (retinol plus carotene) decreases over the course of lactation (Newman, 1994). The milk retinol levels at sixth month were also much lower than those reported by Neville (1988) for developing (459 RE/L) and developed (745 RE/L) countries. Where as higher levels of milk β -carotene were observed than the values reported for developing (43 RE/L) and developed (35 RE/L) countries. This might be due to the fact that most of the vitamin A intake in

Table II. Mean vitamin A and β -carotene levels (RE/L) in breast milk of mothers of different ages and socioeconomic status at sixth month of lactation

SES	Age Group (years)			Overall meal (\pm SE)
	Below 25	26-32	34 and Above	
	Retinol			
Low	c* 259.12	c 292.24	bc 355.00	B 292.12 \pm 62.03
Middle	c 266.88	bc 318.12	ab 355.00	AB 313.33 \pm 52.86
High	c 272.41	a 393.76	ab 367.65	A 344.61 \pm 64.54
Overall mean \pm SE	B 266.14 \pm 49.64	A 334.71 \pm 52.09	A 349.22 \pm 55.08	316.69 \pm 5.13
	β-carotene			
Low	d 36.80	bc 47.00	b 50.35	44.73 \pm 6.49
Middle	b 51.00	c 44.00	a 66.00	53.82 \pm 12.50
High	cd 41.58	b 50.76	bc 47.52	46.80 \pm 4.51
Overall mean \pm SE	B 43.18 \pm 8.77	B 47.33 \pm 3.89	A 54.87 \pm 10.03	48.34 \pm 8.99

*Different capital letters, on overall means for SES and age groups and small letters, on means of SES x age show significant ($P < 0.01$) differences.

developing countries takes place through vegetable and fruits seasonally available at cheaper rates.

Regarding the effect of SES and age on the milk retinol and β -carotene, similar trends were observed as previously noted at 1–6 days postpartum. Significantly higher levels were observed in high age (33 years and above) group. The rate of decline in milk retinol levels was much higher (more than 56%) as compared to that in mothers of developed countries. The average vitamin A in human milk in developing countries is not sufficient to allow for the liver storage after six months of lactation (De Maeyer, 1986) that might be attributed to low intake of vitamin A especially from animal sources.

CONCLUSION

The levels of milk retinol as well as of β -carotene declined with the advancing lactation.

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