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Selenium Intake in Breast-fed Infants during Course of Lactation

Eul-Sang Kim†, Hae-Kyoung Keum and Yuzo Tamari*

Dept. of Food Science and Nutrition Dankook University, Seoul 140-714, Korea
**Dept. of Chemistry, Konan University, Kobe 658, Japan*

Abstract

The purposes of this study were to investigate selenium content of human milk and selenium intake of breast-fed infants at each period of lactation longitudinally. The human milk intake in breast-fed infants was measured by test-weighing method from 20 lactating mothers at 1, 2 and 3 months postpartum. Selenium content in the milk was determined by atomic absorption spectrophotometry with hydride generation after wet digestion of samples. Selenium intake in breast-fed infants was calculated by multiplying human milk intakes by selenium contents. The milk intakes were 640, 726 and 715g/day at 1, 2 and 3 months postpartum. The selenium contents in human milk were characterized by a pattern of slight decline with advancing stage of lactation: 13.1, 11.5 and 9.8μg/L at 1, 2 and 3 months during lactation. There was a large individual variation at any stage of this study. The mean dietary selenium intakes in breast-fed infants were 8.38, 8.35 and 6.98μg/day at 1, 2 and 3 months postpartum, respectively. The mean daily intakes on a body weight basis were gradually decreased during the course of lactation.

Key words: selenium content, human milk, selenium intake, breast-fed infants

INTRODUCTION

Although the essential nature of selenium(Se) in animal diets was first documented in 1957, it was not until 1979 that selenium was shown to be essential in human nutrition(1-3). Selenium-dependent glutathione peroxidase, which requires selenium for its structure and function(4), has been shown to play a crucial role in the prevention of free radical formation by the conversion of lipid and hydrogen peroxides to harmless oxygen species via the oxidation of glutathione. These enzyme activities in the erythrocytes and plasma, as well as, serum selenium concentration, are lower in newborns than in their mothers and other adults(5,6). In 1989 selenium was determined to be an essential nutrient for infants by the National Academy of Sciences; a recommended dietary allowance(RDA) of 10μg Se/day for infants between birth and 6 month was declared(7).

An adequate content of selenium in human milk is of special importance to exclusively breast-fed infants as human milk is their sole dietary source. However, a few reports of selenium content of human milk are available in the literature(8-13), while longitudinal study of selenium content in the breast milk is lacking(14-17). Furthermore, little information is selenium intake of Korean breast-fed infants.

The purposes of this study are to investigate selenium content of breast milk and selenium intake of breast-fed infants at each period of lactation longitudinally.

MATERIALS AND METHODS

Subjects and samples

Twenty Korean women from 24 to 38 years of age (mean 29.2) donated milk samples in the present study. All subjects had delivered healthy, full-term infants weighing from 3.1 to 4.4kg(mean 3.6kg) and did not experience any complications during pregnancy or at delivery. All mothers were healthy, well-nourished and lived in Incheon, Korea. Ten mothers were primiparae and the others were multiparae. Sixty human milk samples were obtained longitudinally at 1, 2 and 3 months postpartum. These were collected in the morning from 10 to 12 a.m. by manual milking before the baby was due to be fed. Approximately 10 to 30ml was obtained directly into acid washed polyethylene bottles, after breasts were cleaned with deionized water. Immediately after collection, all milk samples were frozen at

†Corresponding author

-18°C until analysis. Informed consent was obtained from all mothers.

Human milk intake

Milk intake of breast-fed infants was determined by test-weighing method(18) at 1, 2 and 3 months postpartum. Each mother was provided with a CAS electronic balance(CAS computing scale 10D) accurate to the nearest of 2 gram. Accuracy of the balances was checked once a month using known weights.

Selenium analysis

Milk selenium content was determined by atomic absorption spectrometry with hydride generation(HGAAS) reported by Tamari et al.(19), after decomposition of the milk with a mixture of nitric and perchloric acids and then reduction to selenite by boiling with hydrochloric acid. The detection limit of the method was 0.2 ng selenium/ml. For the standard reference material NBS(National Bureau of Standards) SRM-1549 milk powder, fairly good agreement of selenium determination was obtained between the certified value of 0.11 ±0.01μg/g and our value of 0.103±0.006μg/g from 6 determinations. Selenium intake of breast-fed infants per day was calculated by multiplying breast milk intake by selenium content.

Statistical evaluation was performed by mean±SD and analysis of variance and Duncan's multiple range test. The level of significance was set at $p<0.05$.

RESULTS AND DISCUSSION

Human milk intake

Human milk intakes in infants during the course of lactation are shown in Table 1. As shown, milk intakes are 640, 726 and 715g/day at 1, 2 and 3 months postpartum. Human milk intakes in this study are similar to those of other reported data(18,20-24).

Table 1. Human milk intake of breast-fed infants

Months postpartum	No. of subject	Volume (g/day)
1	20	640±203[a]
2	20	726±155[a]
3	20	715±236[a]

Values are mean±SD
[a]Means with the same letters in the vertically same row are not significantly different at 5% level

Selenium content in human milk

The selenium content in milk samples obtained longitudinally from 20 mothers is shown in Table 2. There are a large individual variation at any stage of this study. The milk selenium content gradually decreased during the course of lactation(Table 2). The selenium content in colostrum rapidly decreased during the course of lactation(14,16). This high selenium secretion immediately after delivery seems to be related to the essential enzyme activity of glutathione peroxidase in newborns, because this enzyme activity of erythrocytes and plasma as well as serum selenium concentrations are lower in newborns than in their mothers(5,6). There are some data in the literature on mature milk selenium. The data in this study were 13.1, 11.5 and 9.8μg/L at 1, 2 and 3 months postpartum, respectively.

Ten and 18μg/L(6 to 39μg/L) were obtained in Japan (14,16); 18μg/L(7 to 33μg/L) in the U.S.A.(11); 15μg/L in Greece(25); 17.6 to 31.0μg/L in Germany(26); 10 to 100μg/L for low and high selenium areas in China(27); 5.7 to 10.7μg/L in Finland(15,28); 2.6μg/L for the Keshan disease area in China(27); and, generally, 10 to 20μg/L for almost all population in the world(28).

Therefore, the selenium content of mature milk is estimated to be in the range of 10 to 20μg/L in most countries of the world, with the exception of low and high selenium areas.

These results may be to indicate a causal relationship

Table 2. The selenium content of breast milk

Months postpartum	No. of subject	Selenium content(μg/L)	Range
1	20	13.1±3.2[a]	(3.9~17.8)
2	19	11.5±3.9[ac]	(2.5~16.4)
3	20	9.8±4.7[bc]	(0.6~16.8)

Values are mean±SD
[a-c]Means with the same letters in the vertically same row are not significantly different at 5% level

Table 3. The selenium intake of breast-fed infants

Months postpartum	No. of subject	Selenium intake	
		μg/day	μg/kgBW/day
1	20	8.38±3.25[a]	1.80±0.74[a]
2	19	8.35±3.11[a]	1.41±0.65[ac]
3	20	6.98±4.31[a]	1.02±0.70[bc]

Values are mean±SD
[a-c]Means with the same letters in the vertically same row are not significantly different at 5% level

between dietary selenium intake and the level of selenium in human milk. Furthermore, comprehensive data (11) on the level of selenium in the breast milk of women living in 17 different states in the United States demonstrate significantly higher concentration levels in high selenium area such as South Dakota(28±3μg/L) compared to lower selenium areas such as Ohio(13±1μg/L). These data were further supported by the result from selenium supplementation studies performed on lactating mothers demonstrating a strong correlation between dietary selenium intake and selenium in their milk(29,30).

Selenium intake in infants

Table 3 shows selenium intake of breast-fed infants during the course of lactation. The mean dietary selenium intakes of infants were almost constant as 8.38, 8.35 and 6.98μg/day at 1, 2 and 3 months postpartum, respectively. However, the mean daily intake on a body weight basis was gradually decreased during the course of lactation(Table 3). US RDA on selenium for infants between birth and 6 month is 10μg/day(7). The selenium intake in Korean infants of this study is lower than 10μg/day of US RDA for infants.

All of the infants studied, however, were healthy, gaining weight and height according to the norms of typical Korean infants(31). Kumpulanien et al.(15) showed that the dietary selenium intake of the Finnish infants was 8.0±1.8μg/day at 1 month and 4.7±1.1μg/day at 3 month postpartum.

Further study is necessary to determine the factors influencing the selenium concentration of human milk and transport mechanisms of selenium from maternal blood to breast milk.

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