Note

Alpha-Tocopherol Content of Breast Milk in China

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Summary  The \(\alpha\)-tocopherol content of breast milk was measured in 71 mothers of preterm and term infants in China. The mean \(\alpha\)-tocopherol content of breast milk was much lower than that reported in developed countries. \(\alpha\)-Tocopherol levels were higher in colostrum and then decreased in the transition milk. Mothers of preterm infants produced colostrum with a slightly higher \(\alpha\)-tocopherol content than that of the mothers of term infants. However, \(\alpha\)-tocopherol levels in transition milk were similar in both groups.

Key Words  \(\alpha\)-tocopherol, breast-feeding, preterm and term infants

It is well known that vitamin E acts as a chain-breaking antioxidant, especially in biomembranes (1). Therefore, vitamin E is thought to be important in preventing oxidative damage from neonates after birth and their sudden exposure to higher oxygen levels than those in the intrauterine environment. The plasma vitamin E level in neonates is well known to be very low, so newborn infants (especially premature infants) have been suggested to suffer from vitamin E deficiency despite the lack of clinical manifestations (2–4). Because of their very low plasma vitamin E levels, vitamin E supplementation was previously performed in preterm infants receiving oxygen therapy (5–9). However, the administration of pharmacological dosages of vitamin E to prevent the development of pulmonary diseases in premature infants was associated with the risk of sudden death, necrotizing colitis, and sepsis (10–13). The neonatal low plasma vitamin E level in neonates generally increases promptly towards the normal childhood level after commencement of the oral intake of vitamin E in breast milk and/or infant formula (14, 15). The vitamin E content of breast milk has been studied in Europe, the USA, and Japan, and has been found to be almost sufficient to maintain a satisfactory vitamin E status in infants (16–19). However, there have been no studies on the vitamin E status of Chinese infants. Due to differences of feeding habits, vitamin E content of breast milk is likely to be the prime determinant of the vitamin E status of Chinese infants. However, there have been no reports regarding the vitamin E content of breast milk in China, to our knowledge. Accordingly, we determined the vitamin E levels in the breast milk of Chinese mothers in this study.

Materials and methods. During the first 12 days of breast-feeding, human
milk samples were obtained from 28 mothers of preterm infants (gestational age: 28 to 36 weeks; birth weight: 2,062±379 g, M±SD) and 43 mothers of full-term infants (gestational age: 38 to 41 weeks; birth weight: >2,700 g). All the mothers lived in the city of Guilin in south China, and belonged to middle class families. Each mother gave informed consent to the study. Since α-tocopherol is the most active of the various naturally occurring forms of tocopherol (11, 12), only α-tocopherol was measured using HPLC with fluorescent detector by modification of the method of Haug (20). Briefly, 500 μl of absolute ethanol containing 0.2 mg of 5,7-dimethyltocol (as the internal standard) was added to 500 μl of milk. After mixing, 5 ml of n-hexane was added and mixing was performed again for 5 min. The mixture was then centrifuged, and the hexane layer was collected and evaporated under nitrogen gas. Next, the residue was dissolved in 100 μl of methanol and a 10-μl aliquot of this solution was injected into the HPLC system (LC-6A, Shimadzu, Japan) equipped with a CLC-ODS column. The solvent was methanol: water (95:5, v/v), and the flow rate was 2 ml/min. Detection was performed with a fluorescence detector (RF 530, Shimadzu, Japan), with excitation at 295 nm, emission at 325 nm. α-Tocopherol content of breast milk was calculated using an internal standard.

Results and discussion. During the first 12 days of breast-feeding, the mean α-tocopherol concentrations of breast milk of preterm and term infants were 6.00 and 6.98 mg/liter, respectively. Changes in the α-tocopherol concentration throughout the 12-day period are shown in Table 1. In the first 3 days of breast-feeding, α-tocopherol concentrations were higher than in the later period (Table 1). This was consistent with the previous finding of a rapid increase in plasma tocopherol concentration in early neonatal life (15). During 3 days of breast-feeding, the α-tocopherol concentration was slightly higher (statistically not significant) in the milk of preterm mothers than in that of term mothers. The higher α-tocopherol levels in colostrum then decreased and were similar in both groups in the subse-

Table 1. Changes of α-tocopherol content of breast milk over time after birth.

<table>
<thead>
<tr>
<th>Day after delivery</th>
<th>Group</th>
<th>N</th>
<th>α-Tocopherol (mg/liter) (M±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2–3</td>
<td>Preterm</td>
<td>8</td>
<td>7.77±2.88^1</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>14</td>
<td>7.41±3.18^2</td>
</tr>
<tr>
<td>4–5</td>
<td>Preterm</td>
<td>5</td>
<td>4.86±1.41</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>16</td>
<td>7.08±4.23</td>
</tr>
<tr>
<td>6–7</td>
<td>Preterm</td>
<td>6</td>
<td>6.46±5.22</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>8</td>
<td>6.33±2.37</td>
</tr>
<tr>
<td>8–12</td>
<td>Preterm</td>
<td>11</td>
<td>4.68±2.94^4</td>
</tr>
<tr>
<td></td>
<td>Term</td>
<td>5</td>
<td>4.65±1.32^3</td>
</tr>
</tbody>
</table>

^1Comparison between 2–3 days group and 8–12 days group in preterm infant: t = 2.17, p < 0.05. ^2Comparison between 2–3 days group and 8–12 days group in term infant: t = 1.77, p < 0.05.
quent period. These findings also agreed with those of some previous studies (17, 20), but conflicted with another (21).

In developed counties, the recommended daily allowance of many nutrients for infants has been estimated based on their content in breast milk and the total intake of milk in the population studied. The vitamin E requirement for infants has been determined in the same manner as 3 mg \( \alpha \)-tocopherol equivalent/day in the USA. However, the \( \alpha \)-tocopherol content in Chinese breast milk was only about half of that reported in Europe, the USA, and Japan. If the vitamin E requirement of Chinese infants is calculated from the breast milk content, it would be far smaller than that in developed countries. The total intake of energy, protein, and fat as well as total income, has been reported to influence the daily dietary vitamin E intake in a population study (22). Therefore, the vitamin E content of breast milk in Chinese mothers should be considered in relation to the total nutritional status of the overall population, although our study was performed in a selectively sampled small population. Accordingly, improvement of the total nutrition of Chinese mothers, rather than just vitamin E supplementation, may be required to improve the health of their infants.

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