Effect of Taurine in Milk on the Growth of Rat Pups

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Taurine (2-aminoethane sulphonic acid) is one of the end products of sulfur metabolism. It has been illustrated to play many important physiological roles in animals, especially during their developmental stages. In many species, high concentrations of taurine are found in milk, especially in the colostrum. However, from where the taurine in milk is derived and how important it is as a nutrient for the neonate, is still obscure. The present study was conducted to elucidate the physiological significance of milk taurine and its possible mechanism of action on the development of rat pups.

Our results indicated that during lactation, and especially for the first few days after birth, taurine was at a far higher concentration in rat milk than in rat serum. Pups that did not ingest colostrum by taking no milk from natural mothers but from foster mothers which had been nursing their own pups for 5 days, showed a slower growth rate. Intraperitoneal administration of 0.2g/day of taurine to the foster mothers in the first five days, restored the growth retardation induced by foster nursing, suggesting that a high concentration of taurine in milk at an early lactation stage has a profound effect on the growth of offspring. The intraperitoneal administration of 0.2g/day of β-alanine, a taurine transport inhibitor, to the natural mother during lactation, induced a slower growth rate of their pups. This β-alanine treatment to dams did not decrease taurine concentration in milk, but increased β-alanine concentration in milk. Serum taurine concentration in the pups receiving this milk was elevated. Direct administration of β-alanine to pups also increased the serum taurine concentration in a dose-dependant manner. The intraperitoneal administration of 0.02g/head of β-alanine to pups significantly decreased [3H]taurine incorporation into all the organs examined, while in contrast, [3H]taurine concentrations in serum and urine were elevated. Thus, β-alanine inhibited taurine incorporation into cells but accelerated taurine excretion into urine. Serum IGF-I levels in pups receiving β-alanine, either directly or via their mothers, were significantly lower than those in control pups, suggesting that IGF-I synthesis would depend on taurine availability. Cumulatively, taurine ingestion from milk at an early lactational period seems critical for maintaining normal growth rate of neonatal rats through maintaining normal serum IGF-I levels. By RT-PCR, mRNA of cysteine-sulfinate decarboxylase (CSD), the rate-limiting enzyme for taurine biosynthesis, was found to be expressed in the rat mammary gland as in rat liver. The mRNA expression level of CSD in the mammary gland was higher in the earlier lactational stage (Days 1 and 6 of lactation) than that in the later lactational stage (Day 14). By sequencing analysis, the partial nucleotide sequence of CSD cDNA in rat mammary gland was found to be identical to that in the rat liver, which was already known. By in situ hybridisation, the CSD mRNA was demonstrated in rat mammary gland epithelial cells.

In conclusion, the present study demonstrated that taurine can be synthesised by rat mammary gland and this is responsible for the high concentrations of taurine in milk, and especially in colostrum. Body growth of rat pups was retarded if they did not receive to high concentration of taurine in the colostrum, probably due to the impaired secretion of IGF-I.

(Supported by JSPS-RFTF 97 L00904)

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