HUMAN MILK OLIGOSACCHARIDES ARE NOT DIGESTED AND ABSORBED IN THE SMALL INTESTINE OF YOUNG INFANTS

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Human milk is a rich source of oligosaccharides which appear to play a protective role against infection in breast-fed infants (Kunz and Rudloff 1993). However, the enzymes necessary for their digestion are not present in the intestinal brushborder or lumen. We hypothesised that human milk oligosaccharides escape digestion in the small intestine and undergo fermentation in the infant colon to short chain fatty acids and gases such as H_2.

To test the hypothesis, we recruited healthy mother-infant pairs in the maternity wards of two major hospitals of Sydney. Infant inclusion criteria included normal physical examination, growth, no history of diarrhoea or vomiting and exclusive breast feeding until at least 3 months' of age. The breath hydrogen method was used to assess human milk oligosaccharide absorption. Hydrogen gas produced during colonic fermentation of unabsorbed carbohydrate is excreted via the lungs, with the concentration of hydrogen in the breath directly proportional to the carbohydrate load. Lactulose, a safe non-absorbable disaccharide was used as the control. The change in hydrogen excreted in the breath after ingestion of the oligosaccharides was compared with the response after lactulose. Human milk oligosaccharides are not available commercially, thus we collected 1-2 L milk from each mother over the first few weeks' of lactation and isolated 5-10 g of the purified oligosaccharides.

At 3-9 months of age (mean 4.5 months) the infants underwent two carbohydrate loading tests (0.5-1.0 g/kg body weight), once with lactulose and once with the purified oligosaccharide fraction isolated from their own mother's milk. Both carbohydrate loads were dissolved in 100 mL water and administered by bottle over 10 minutes. Breath samples were collected in duplicate every 30 min for 4 h via a face-mask sampling device fitted with a three-way tap. All hydrogen readings were 'normalised' to the same oxygen level.

A breath hydrogen test was considered positive (ie indicating significant fermentation of the carbohydrate in the colon) if the breath hydrogen level increased by more than 20 ppm above the lowest recorded hydrogen value. Out of 20 infants tested, only six gave a positive result with lactulose (one male, five female). These six were then tested with the oligosaccharide load. All six produced a positive result. The area under the breath hydrogen curve for the lactulose and oligosaccharide was 3980 ± 1160 and 5250 ± 800 ppm 4 h respectively respectively.

The findings indicate that human milk oligosaccharides are not digested and absorbed to any significant degree in the intestine of young infants. Resistance to digestion would permit the oligosaccharides to act as ligands for pathogenic bacteria and thereby prevent bacterial adherence to the small intestine, a prerequisite for infection. The presence of human milk oligosaccharides in the colon provides growth factors for beneficial Bifidobacteria. Part of their energy value may be salvaged in the large intestine through the absorption of short chain fatty acids. The indigestibility of human milk oligosaccharides has implications for both breast-fed infants and formula-fed infants.

KUNZ, C. and RUDLOFF, S. (1993). Acta Paediatr. 82:903.

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