Study sheds new light on importance of human breast milk ingredient

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A new University of Illinois study shows that human milk oligosaccharides, or HMO, produce short-chain fatty acids that feed a beneficial microbial population in the infant gut. Not only that, the bacterial composition adjusts as the baby grows older and its needs change.

Even though HMO are a major component of human milk, present in higher concentration than protein, many of their actions in the infant are not well understood. Furthermore, they're virtually absent from infant formula. The scientists wanted to find out what formula-fed babies were missing.

"We refer to HMO as the fiber of human milk because we don't have the enzymes to break down these compounds. They pass into the large intestine where the bacteria digest them.

"We're curious about the role they play in the development of the breast-fed infant's gut bacteria because the bacteria found in the guts of formula-fed infants is different," said Sharon Donovan, the U of I's Melissa M. Noel Endowed Professor in Nutrition and Health.

With this study, Donovan is gaining insight into the mystery. For the first time, scientists have shown that a complex mixture of HMO and a single HMO component produce patterns of short-chain fatty acids that change as the infant gets older.

A healthy microbiome has both short- and long-term effects on an infant's health. In the short term, beneficial bacteria protect the infant from infection by harmful bacteria. In the long term, beneficial bacteria strengthen the immune system so that it can fend off chronic health problems like food allergies and asthma, she said.

In the study, breast milk was obtained from mothers of preterm infants at Chicago's Rush University Medical Center, and the HMO were isolated and analyzed. The scientists tested bacteria from 9- and 17-day-old sow-reared and formula-fed piglets. Because piglets grow so rapidly, these ages reflect approximately three- and six-month-old human infants.

The colon bacteria were added to test tubes containing HMO and two prebiotics commonly used in infant formulas. These mixtures were allowed to ferment and then sampled to see how the bacterial population was changing over time and what products were being produced by the bacteria.

"When the HMOs were introduced, the bacteria produced short-chain fatty acids, at some cases at higher levels than other prebiotics now used in infant formula. The short-chain fatty acids can be used as a fuel source for beneficial bacteria and also affect gastrointestinal development and pH in the gut, which reduces the number of disease-causing pathogens," she said.

Further, different HMOs produced different patterns of short-chain fatty acids, and the composition of bacteria in the gut changed over time. "It was distinctly different at 9 vs. 17 days, making it likely that the functions of HMO change as the human infant gets older," she said.

According to Donovan, HMO are critically important in understanding how breastfeeding protects babies.

"Several companies are now able to synthesize HMO, and in the future, we may be able to use them to improve infant formula. There's evidence that these compounds can bind to receptors on immune cells and, to our knowledge, no current prebiotic ingredient can do that," she said.

The study was published in the April issue of the *Journal of Nutrition.*

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