MedicalXpress

Why is breast milk best? It's all in the genes

May 12 2010

Is breast milk so different from infant formula? The ability to track which genes are operating in an infant's intestine has allowed University of Illinois scientists to compare the early development of breast-fed and formula-fed babies. They say the difference is very real.

"For the first time, we can see that breast milk induces genetic pathways that are quite different from those in formula-fed infants. Although formula makers have tried to develop a product that's as much like breast milk as possible, hundreds of genes were expressed differently in the breast-fed and formula-fed groups," said Sharon Donovan, a U of I professor of nutrition.

Although both breast-fed and formula-fed babies gain weight and seem to develop similarly, scientists have known for a long time that breast milk contains immune-protective components that make a breast-fed infant's risk lower for all kinds of illnesses, she said.

"The intestinal tract of the newborn undergoes marked changes in response to feeding. And the response to human milk exceeds that of formula, suggesting that the bioactive components in breast milk are important in this response," she noted.

"What we haven't known is how breast milk protects the infant and particularly how it regulates the development of the intestine," she said.

Understanding those differences should help formula makers develop a product that is more like the real thing, she said. The scientists hope to

develop a signature gene or group of genes to use as a biomarker for breast-fed infants.

Many of the differences found by the scientists were in fundamental genes that regulate the development of the intestine and provide immune defense for the infant.

In this small proof-of-concept study, Donovan used a new technique patented by Texas A&M colleague Robert Chapkin to examine intestinal gene expression in 22 healthy infants—12 breast-fed, 10 formula-fed.

The technique involved isolating intestinal cells shed in the infants' stools, then comparing the expression of different genes between the two groups. Mothers in the study collected fecal samples from their babies at one, two, and three months of age. Scientists were then able to isolate high-quality genetic material, focusing on the RNA to get a gene expression or signature.

Donovan said that intestinal cells turn over completely every three days as billions of cells are made, perform their function, and are exfoliated. Examining the shed cells is a noninvasive way to examine intestinal health and see how nutrition affects intestinal development in infants.

Understanding early intestinal development is important for many reasons, she said.

"An infant's gut has to adapt very quickly. A new baby is coming out of a sterile environment, having received all its nutrients intravenously through the placenta. At that point, babies obviously must begin eating, either mother's milk or formula.

"They also start to become colonized with bacteria, so it's very important that the gut learns what's good and what's bad. The baby's body needs to

be able to recognize a bad bacteria or a bad virus and fight it, but it also needs to recognize that even though a food protein is foreign, that protein is okay and the body doesn't want to develop an immune response to it," she said.

If anything goes wrong at this stage, babies can develop food allergies, inflammatory bowel disease, and even asthma. "We're very interested in frequent sampling at this early period of development," she added.

Donovan also would like to learn how bacteria in the gut differ in formula- and breast-fed babies, and this technique should make that possible. "Now we'll be able to get a complete picture of what's happening in an infant—from the composition of the diet to the microbes in the gut and the genes that are activated along the way."

Of potential clinical importance: The gene expressed most often in breast-fed infants is involved in the cell's response to oxygen deprivation. Lack of oxygen is a factor in the development of necrotizing enterocolitis (NEC), a kind of gangrene of the intestine that can be fatal in premature babies. NEC is a leading cause of disease and death in neonatal intensive care units, with a reported 2,500 cases occurring annually in the United States and a mortality rate of 26 percent.

More information: The study will appear in the June 2010 issue of the American Journal of Physiology, Gastrointestinal and Liver Physiology.

Provided by University of Illinois College of Agricultural, Consumer and Environmental Sciences