Why is breast milk best? It's in the genes, scientists say

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Is breast milk so different from infant formula? Yes, say scientists, who in a new study have compared breast-fed and formula-fed babies by tracking which genes are operating in their intestines.

It turns out that breast milk stimulates "genetic pathways that are quite different from those in formula-fed infants," said University of Illinois nutritionist Sharon Donovan, who with colleagues conducted the study. "Although formula makers have tried to develop a product that's as much like breast milk as possible, hundreds of genes were expressed [activated] differently in the breast-fed and formula-fed groups."

Although both breast-fed and formula-fed babies gain weight and seem to develop similarly, studies have found that breast milk contains immune-protective components that make a breast-fed infant's risk lower for many illnesses. (Image courtesy Idaho Dept. of Health & Welfare)

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."

Understanding those differences should help formula makers develop a product 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 genes known to regulate the development of the intestine and provide immune defense. Donovan used a new technique patented by Texas A&M University colleague Robert Chapkin to examine intestinal gene activation in 22 healthy infants—12 breast-fed, 10 formula-fed. The technique involved isolating intestinal cells shed in the infants' poop. In these cells, chemical traces of differing gene activation levels could be found.

Understanding early intestinal development is important for many reasons, Donovan 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 wants learn how bacteria in the gut differ in formula- and breast-fed babies. "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, a kind of gangrene of the intestine that can be fatal in premature babies and is a leading cause of disease and death in neonatal intensive care units.