The Introduction of Plant-Derived Glycans in Exclusively 6-Month Old Breastfed Infants Alters Fecal Glycan Profiles and Microbial Metabolism (IMiND Study)

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Objectives: Very little is known about dietary carbohydrate and intestinal microbe interactions during the introduction of solid foods in exclusively breastfed infants. The objective of the UC Davis IMiND study is to discover the relationships between plant-derived complementary foods commonly used in the early weaning period and the gut microbiome in a prospective feeding-trial in exclusively breast milk-fed infants.

Methods: In a randomized, crossover study, 6-month old, exclusively breastfed infants ($n = 99$) entered a 7-day lead-in period of exclusive breast milk, followed by 7 days of either study food (pear or sweet potato) plus breast milk. This was followed by a 4-day washout period of exclusive breast milk, then 7 days of the alternate study food, followed by a 4-day follow-up period of exclusive breast milk. The infant gut microbiome was measured by 16 s rRNA amplicon sequencing ($n = 39$). Fecal monosaccharides and short chain fatty acids were measured in a subset of mother-infant dyads ($n = 20$) by liquid chromatography-mass spectrometry.

Results: There was no significant difference in gut alpha diversity (Shannon index) but a significant difference in beta diversity (unweighted UniFrac, $P = 0.03$, $R^2 = 0.02$) between pre- and post-first food. Free fecal monosaccharide composition was similar across all feeding periods. Total bound fecal monosaccharides, including arabinose and xylose were 2-fold higher in response to pear consumption compared with the other feeding periods ($P < 0.05$). Infant fecal lactic acid was lower and succinic acid was higher by 2-fold during pear consumption compared with all other feeding periods ($P < 0.05$).

Conclusions: The change in gut microbiome beta diversity suggests a change in microbial composition with the introduction of solid foods despite the unchanged alpha diversity. The change in fecal short chain fatty acids in response to pear consumption suggests a change in microbial metabolism. These effects may be explained by the appearance of undigested, bound glycans in the colon during pear consumption. These data suggest a novel approach in using chemical analysis to document the diversity and complexity of dietary carbohydrates during weaning that influence gut microbial metabolism.

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