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Microbiota can be affected by the lipid composition of infant formulas

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Objectives and study: Microbiota is known to be positively influenced by breastfeeding. Differences in the quality and structure of dietary lipids between maternal milk and infant formulas may contribute to microbiota modification. Incorporation of milk fat in infant formulas is a promising way to get closer to the composition and structure of human milk fat globules. However, little is known on the consequences of such addition on gut microbiota and physiology.

Methods: Two formulas were processed containing either vegetable lipids (VL) or a mixture of milk and vegetable lipids (ML) including milk fat globule membrane fragments. Formulas were automatically distributed to newborn piglets until 28 days of age. Feces and ileal tissue were sampled at slaughter at 28 days. The bacterial composition expressed as the percentage of assigned sequences at each taxonomic level as well as Shannon diversity and Chao richness indices were determined. Weight and mucosal density of empty ileum were measured. Ileal barrier function was evaluated *ex vivo* using Ussing chamber. Mononuclear immune cells isolated from mesenteric lymph nodes were cultured to evaluate their secretory cytokine profiles..

Results: No difference in bacterial diversity indices was observed between VL and ML groups. The analysis of dominant phyla revealed a greater proportion of Proteobacteria in ML than in VL microbiota (13.4 % vs. 5.4 % respectively) at the expense of Firmicutes that were reduced (62.1 % vs. 74.5 % respectively). No difference in sub-dominant phyla was significant. Abundance of five bacterial families and genus was modulated with the dietary treatment. Increased Porphyromonadaceae family (Bacteroides phylum) consisted of a higher proportion of Parabacteroides, and increased Enterobacteriaceae family (Proteobacteria phylum) consisted of greater number of Escherichia/Shigella and Klebsiella genus in feces of ML piglets compared to VL piglets. In addition, Clostridiales Family XIII and Veillonellaceae explained the decrease of Firmicutes in ML piglets. Interestingly, significant correlations between microbiota composition and gut physiological and immunological parameters were highlighted. Relative abundance of Klebsiella and Parabacteroides was negatively correlated with ileal pH (ρ value = -0.56, $P < 0.01$ and -0.45, $P < 0.04$, respectively). Relative Escherichia/Shigella and Klebsiella abundances were correlated with the higher mucosal density observed in ML ileum (ρ value = 0.44, $P < 0.03$). Those bacteria were also correlated with IL-10 cytokine secretion of immune cells (ρ value = -0.49, $P < 0.02$, -0.45, $P < 0.03$, respectively).

Conclusion: Incorporation of milk fat in infant formula changed the microbiota composition in feces. These changes were associated with modifications in ileal physiology and secretory activity of mesenteric lymph node immune cells. Long-term effects of these early physiological and bacterial modifications on health warrant further investigations..

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