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Does the structure of infant formula and human milk influence their digestibility?

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Beside differences in composition, breast milk (BM) and infant formula (IF) still exhibit differences in the structure of their fat globules and proteins (native/denatured). Little is known about the influence of these structural differences on the digestibility of BM and IF.

The objectives of this work were to compare the kinetics of protein and lipid digestion of (1) raw/pasteurized BM, (2) liquid/powder IF, (3) IF with milk fat/vegetable oil. Experiments were performed using either an in vitro dynamic digestion model or piglets. Samples were collected throughout digestion, lipolysis and proteolysis monitored by chromatography and SDS-PAGE respectively. Structural changes were evaluated by confocal microscopy and laser light scattering. The possible consequences of the nature of fat in IF on the neonate's gut morphology, permeability and local immunity was also investigated.

Pasteurization (63°C/30min) of BM increased the aggregation of milk proteins at the periphery of the milk fat globule accelerating the kinetics of proteolysis during the gastric phase. In contrast, gastric lipolysis was slower in pasteurized than raw BM probably because of the heat inactivation of endogenous human milk lipase.

Liquid formula exhibited smaller fat globules than the spray-dried one. Viscosity of liquid/powder formula was similar before digestion but increased dramatically for the liquid formula at 120 min of gastric simulated digestion. Caseins were hydrolyzed more rapidly than whey proteins.

Finally, piglets were fed 28d an IF containing milk fat (MF) or vegetable oil (VO). Concentration of caseins and β -lactoglobulin in the jejunum and ileum was higher for the MF formula. Higher intestinal thickness observed with MF formula was not associated with changes in permeability. MF formula increased IFN γ secretion suggesting an improved intestinal immune system maturation such as observed in sow suckling piglets.

This work allowed emphasizing the role of the structure of BM and IF on the protein and lipid digestion kinetics.