Emulsifying triglycerides with dairy phospholipids instead of soy lecithin modulates gut lipase activity

A high energy supply and appropriate amount of polyunsaturated fatty acids is crucial for proper growth and development in neonates. The capacity for fatty acid absorption in newborns is however hampered due to an undeveloped pancreatic function combined with a low bile output. This seems in particular to limit fatty acid absorption in babies given infant formulas. Since interaction between the lipid droplet and the gastric and duodenal lipases occur through the hydrophobic/hydrophilic interface, the composition of the emulsifier may be crucial for efficient hydrolysis. We therefore determined hydrolytic rate of gastric lipase and pancreatic lipase, on their own or pancreatic lipase after gastric lipase on TAG droplets of similar size emulsified in either soy lecithin (SL) or in bovine milk phospholipids (MPL), more similar to human milk globule membrane lipids than soy lecithin. Gastric lipase activity was substantially higher on MPL-emulsified particles, while SL emulsification caused a higher rate of pancreatic lipase hydrolysis, on particles that had not been pre-treated with gastric lipase. MPL emulsification did however cause higher pancreatic lipase activity, when the particles had been pre-treated with gastric lipase. The attenuating effect of MPL-emulsification on pancreas lipase activity was validated in vivo in mice.

Practical application: Our results show that the activity of gastric lipase, a key enzyme in lipid absorption in neonates, is highly dependent on the phospholipid composition of the surface layer on the emulsion droplets. We furthermore show that increasing gastric lipase activity by modifying the phospholipid composition on the droplet surface, also enhance the subsequent activity of the pancreatic lipase acting in the duodenum. This implies that it is possible to strategically design the surface layer of lipid droplets in infant formulas to maximize gastric lipase activity, and that this could improve total fatty acid absorption in formula-fed neonates. This is of particular importance in the development of formula aimed at pre-mature babies, but is also highly relevant for formulas for term-born infants.