Comparison of *in vitro* digestion of infant formula with cow's milk fat and vegetable fat

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Background

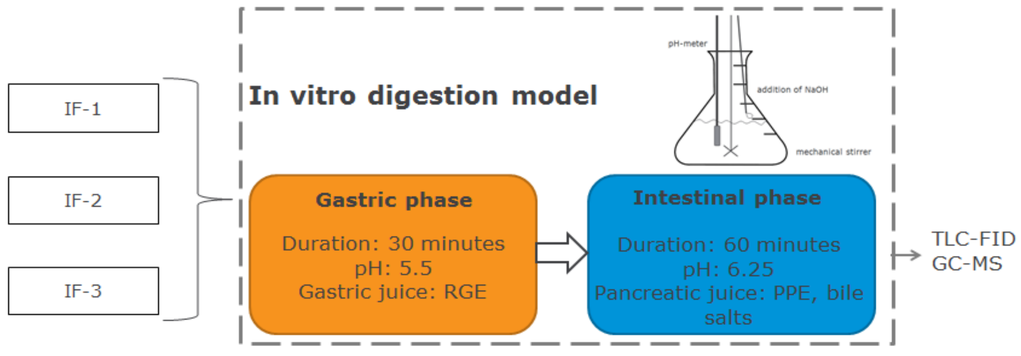
Fat is an important nutrient in human milk and infant formulas (IFs). The current vegetable fat blend used in IF is tailored to the fatty acid composition of human milk. However, studies have shown that also structure, the position of fatty acids at the glycerol backbone, seems important for digestibility of fat [1-4]. The fatty acids at the sn-2 position remain attached at the glycerol backbone, while those at the sn-1 and sn-3 position are released. It is known that there is a difference in triglyceride structure between vegetable and animal fat. There are indications that addition of cow's milk fat to infant formula might be beneficial for digestibility [5].

Objective

The aim of this study was to investigate the digestion kinetics of infant formulas containing fat with different triglyceride structures.

Methods

The triglyceride structures of human milk, cow's milk fat and a typical vegetable fat for infant formula were compared.



The rate of lipolysis of three different infant formulas (IFs), differing from each other in fat composition (IF-1 contains 100% vegetable fat blend, IF-2 contains 1/3 cow's milk fat and 2/3 vegetable fat and IF-3 contains 2/3 cow's milk fat and 1/3 vegetable fat) were investigated using a static *in vitro* digestion model, consisting of two phases. Lipolysis was studied using TLC-FID, the individual free fatty acids were analysed with GC-MS.

Results

Sn-2 fatty acid composition

The triglyceride structure of human milk fat, cow's milk fat, and a typical vegetable fat blend for infant formula were studied. Cow's milk and human milk contain mostly long-chain saturated fatty acids (C12:0-C18:0) along with some unsaturated fatty acids at the sn-2 position, while vegetable fat contains mostly unsaturated fatty acids (C18:1 and C18:2) at the sn-2 position.

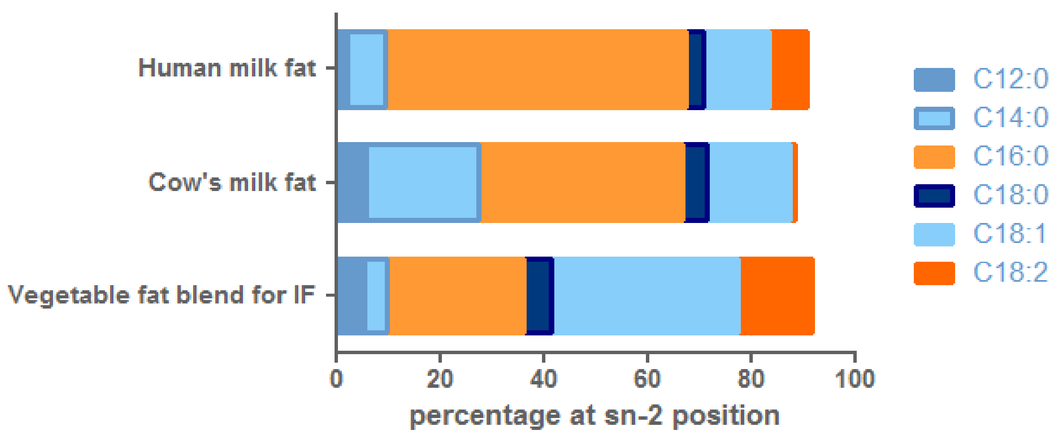


Figure 1. *Percentage of fatty acids present at the sn-2 position in triglycerides from human milk, cow's milk fat, and a typical vegetable fat blend for infant formula*

In vitro digestion

The three different IFs showed comparable rates of lipolysis, with similar kinetics. In the gastric phase only a small amount of fat was being digested, while in the intestinal phase the digestion proceeded quite rapidly.

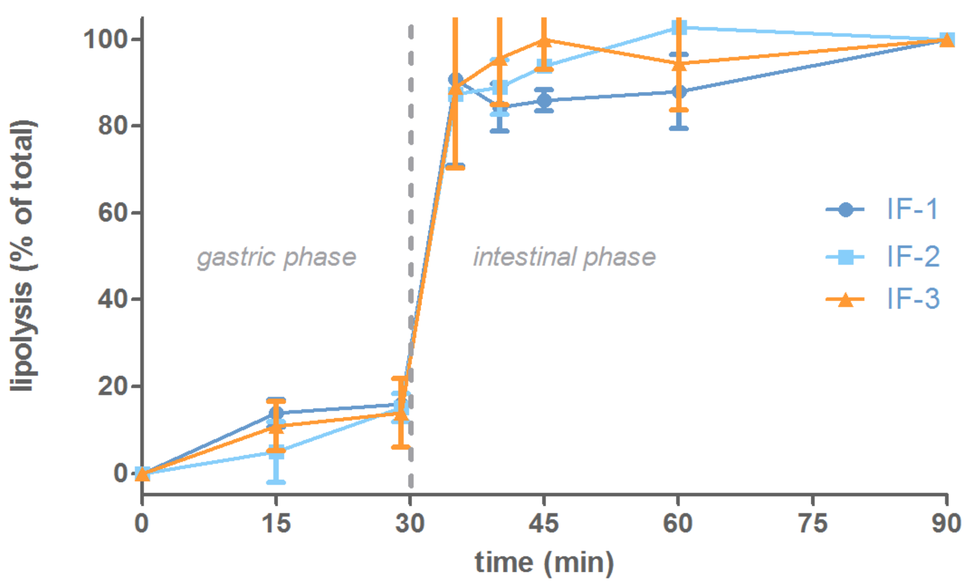


Figure 2. *Lipolysis kinetics of the three different infant formula blends (presented as mean±SD)*

The IF with standard fat blend (IF-1) released the highest percentage of long-chain saturated fatty acids (C12:0-C18:0). The IFs containing cow's milk fat showed a higher release of short-chain fatty acids (C4:0-C5:0) and medium-chain fatty acids (C6:0-C10:0).

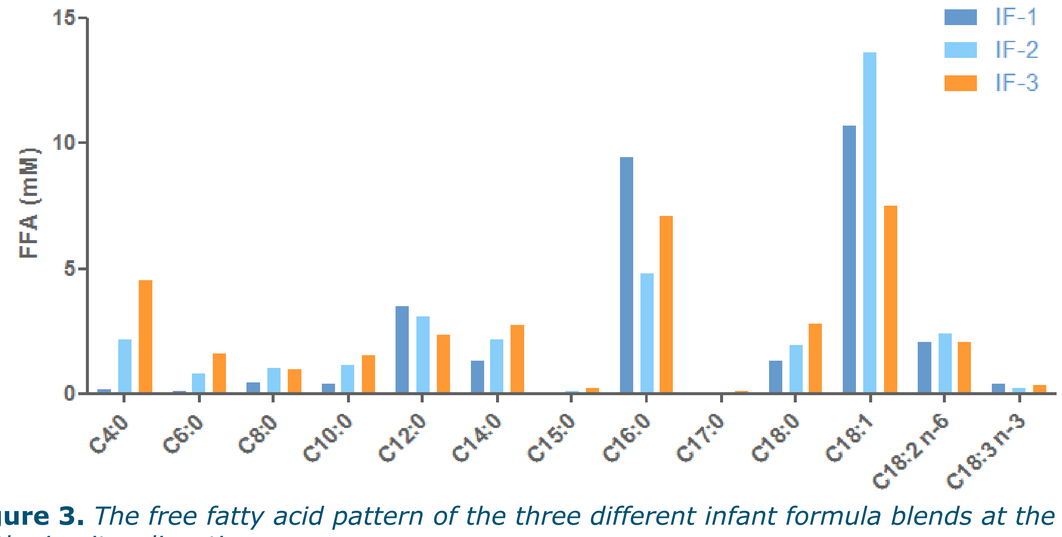


Figure 3. *The free fatty acid pattern of the three different infant formula blends at the end of the in vitro digestion*

Conclusions

Literature has shown that triglyceride structure influences lipid absorption[3–6]. Replacing part of the vegetable fat blend by cow's milk fat will help to optimize triglyceride structure, as shown in figure 1.

According to this *in vitro* digestion model the addition of cow's milk fat will not influence the speed of digestion. However, this is a static model and does not take into account dynamic aspects, like gastric emptying.

The differences in free fatty acids observed at the end of the digestion could lead to differences in absorption and health effects in vivo. Previous studies show that long-chain saturated FFA are for example linked to the formation of calcium soaps and hard stools [1,3,6], while short- and medium-chain FFA are easily absorbable, and can deliver energy fast [7]. Furthermore, some show pathogen reducing effects [8,9]. Therefore, adding cow's milk fat to standard vegetable fat blends could be beneficial for the infant.

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