Understanding the Facts About Structured Lipids

Highlights

- Structured lipids currently available in enteral formulas are produced using a random re-esterification process, i.e., fatty acids are randomly placed on the glycerol backbone.
- The middle (sn-2) position on the backbone has been shown to be the preferential position for absorption.[4-5] Hence, it is unclear how it can be guaranteed that the body will utilize randomly re-esterified lipids in the most beneficial way.
- Claims of improved absorption and tolerance of structured lipids in enteral formulas are based on studies which did not use the same lipid blends as those found in the enteral formulas marketed today.
- The research cited includes predominantly animal studies, which are useful for generating hypotheses but do not conclusively support claims of human benefits.

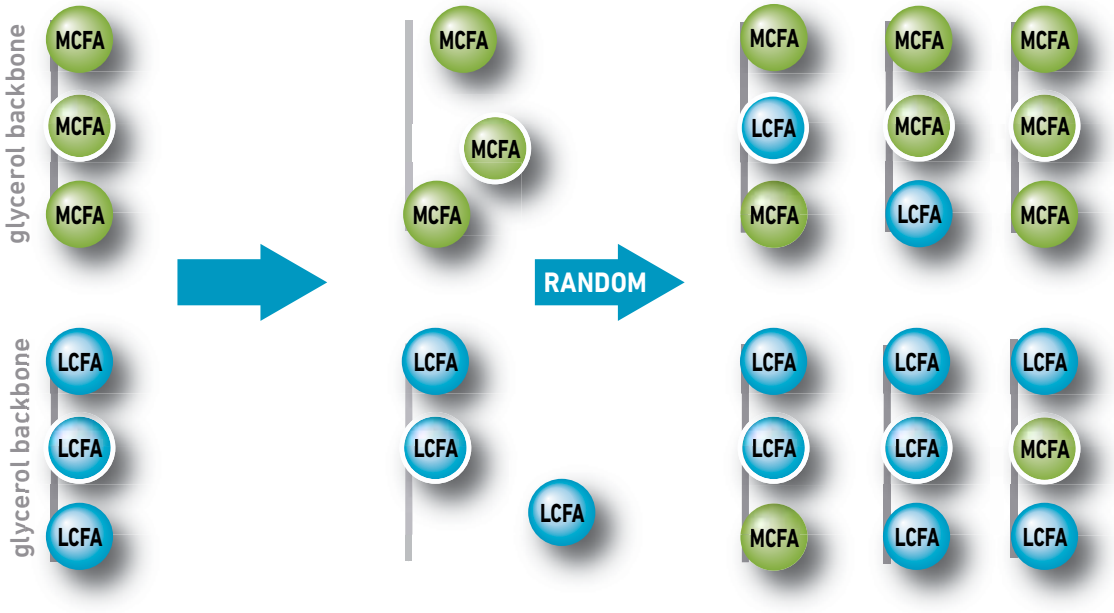
Introduction

Structured lipids have been used for several years in European parenteral formulas, as well as in many food products ranging from enteral formulas to confections and reduced-calorie fat substitutes. In parenteral formulas, structured lipids have generated interest because they may offer a way to deliver desirable fatty acids, such as omega-3 fatty acids, while reducing negative side effects associated with parenteral formulas containing standard high omega-6 fatty acids.[6]

Lately, increased publicity has been given to structured lipids in enteral formulas. Therefore, it may be helpful to review the mechanics of, and evidence for, these fats in enteral products.

What are structured lipids?

Structured lipids are mixtures of long chain fatty acids (LCFA) and medium chain fatty acids (MCFA) which have been rearranged on a glycerol backbone, using either a chemical or enzymatic process.



STAGE 1:
Specific proportions of MCTs (medium chain triglycerides) and LCTs (long chain triglycerides) are mixed together. Triglycerides consist of 3 fatty acids on a glycerol backbone.

STAGE 2:
Fatty acids are broken apart from the glycerol backbone (de-esterified).

STAGE 3:
The pieces are randomly reassembled (re-esterified) into triglycerides. Ease of digestion varies by final structure and condition of the patient.

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What are the potential shortcomings of structured lipids?

The structured lipids available in enteral formulas today are **randomly** re-esterified.[1-3] As a result, multiple configurations of fatty acids are possible, as illustrated above.

Studies indicate the absorption and metabolism of a lipid is influenced by its constituent fatty acids and by the position of the fatty acids on the glycerol backbone.[5] The middle position, or "sn-2" position, has been shown to be the preferential position for absorption.[6]

With a random re-esterification process, **there is no guarantee as to which fatty acid will occupy which location.** Therefore, it is unclear how it can be guaranteed that the body will utilize the fatty acids in the most beneficial way.

What is the evidence for structured lipids in enteral formulas?

Enteral structured lipids are sometimes claimed to provide better absorption and tolerance compared to physical mixtures of MCT and LCT.[2-4]

When evaluating these claims, it is important to note, first of all, that **none of the studies cited in support of the claims used the same structured lipid blends found in the formulas for which the claims are being made.** A closer look at the evidence raises further questions.

Conclusions

Though structured lipids are an interesting and potentially useful fat source, a look at the evidence indicates it is premature to claim superiority over physical fat blends in enteral formulas. While some clinical benefits have been demonstrated in animals, benefits have yet to be convincingly demonstrated in humans.

By contrast, the benefits of PEPTAMEN® formulas, with their physical blend of fats and the highest available ratio of MCT to LCT among peptide-based formulas, have been documented in over 50 published clinical studies in human subjects. MCT in its native form (i.e. not part of a structured lipid) has been shown to be rapidly absorbed and utilized by the body.[17, 18]

When evaluating enteral formulas for seriously ill patients, the prudent choice is a formula which has been shown in multiple human studies to promote positive patient outcomes.

Structured Lipid Claim	Discussion
• Better absorbed and tolerated (Tso, 1995; Tso, 1999; Kenler, 1996; McKenna, 1995)[7-10] • Readily available energy source for peripheral tissues (Tso, 1995)[7] • Associated with fewer GI complications (Kenler, 1996)[9]	• Two of the four supporting studies (Tso) are rat studies. The digestive system of rats differs in many ways from the human system; hence, rat studies provide inconclusive support for claims of better absorption and tolerance in humans. • One of the human studies, Kenler, used **non-comparable control groups**. – 18 of 35 subjects received a physical mixture of MCT, corn and soybean oil (Osmolite® HN). Of these, 13 had undergone surgeries that were associated with high potential for fat malabsorption, even when fed jejunally, such as Whipple procedures or bile duct resection. – The other 17 received a fish oil-MCT structured lipid. Of these, only 5 had undergone surgeries that were associated with high potential for fat malabsorption, even when being fed jejunally. – Furthermore, while safety of structured lipids was shown, **metabolic advantages were not detected**. Lab results and nitrogen balance studies were similar between the two groups. • In the other human study, McKenna, subjects with cystic fibrosis (CF) consumed an oral nutritional supplement in which various fat blends were added. The fats were either safflower oil, Microlipid® (a safflower-oil based emulsion), or MCT-sunflower oil structured lipids. – The authors' conclusion was not that structured lipids were superior, but rather that adequate levels of linoleic acid can be absorbed by CF patients if adequate calories are given and supplemental linoleic acid is used. – All of the fat preparations were well tolerated and did not promote GI upset. **The study did not conclude that structured lipids are better tolerated.**
• 30% - 40% more absorption of fat-soluble vitamins and antioxidants (Tso, 2001)[11]	• This was a rat study, not a human study. It was postulated that rats will increase their absorption of fat soluble vitamins and antioxidants if there is an increased absorption of long chain fatty acids from the structured lipid blend.
• 40% - 50% better delivery of total fat and EFA's to peripheral organs and skeletal muscle (Tso, 1999)[8]	• This rat study claim is based on measurements of lymphatic absorption of fatty acids only, not skeletal or peripheral absorption. The animals were not sacrificed for skeletal muscle biopsies. The structured lipid was made from MCT and fish oil, not canola oil.
• Reduced muscle catabolism and improved nitrogen balance during metabolic stress (DeMichele, 1988; DeMichele, 1989; Swenson, 1991; Teo, 1989; Teo, 1991)[12-16]	• These studies were done in rats or guinea pigs.

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