Link 5: Tailor-made structured lipids

The term “structured lipids” or “designer lipids” was first introduced in 1980s. During the initial period, researches in structured lipids are focusing on producing medium chain triacylglycerols (MCT) for use as pre-term infant, parenteral and enteral nutrition to address metabolic disorder. As MCT can be rapidly absorbed, it can provide instant energy to patients with metabolic disorder. Over time, the area of research in food-related structured lipids have expanded rapidly to include baking and confectionary fats, cocoa butter substitute, human milk fat substitute, healthy cooking and salad oil and many more. In fact, today, the area of structured lipids has expanded beyond food application to include usage as biofuels, plasticizers, lubricants and ingredients in various cosmetics and pharmaceutical products.

Structured lipids can be produced through chemical, enzymatic or chemo-enzymatic pathway. Each pathway has its own advantages and disadvantages. Chemical catalysts triumphed in terms of its relatively cheaper price as compared to biocatalysts. Nevertheless, the overall production cost today between the two different pathways does not differ much due to the increasing affordability of biocatalysts. This has also taken into account of the harsher reaction conditions and additional purification steps commonly required for chemical reactions. Biocatalysts; on the other hand, has the upper hand of offering specificity in producing compounds with a specific structure. In fact, industrial scale enzymatic interesterification and transesterification plants have been built globally for manufacturing of various products including margarine fats, human milk fat substitutes and biofuels. In certain cases, a chemo-enzymatic pathway is required for production of structured lipid. This is mainly due to the nature of the raw materials which are unsuitable for enzymatic reaction such as highly acidic substrate. A chemical reaction will then proceed in order to modify the substrates into an intermediate compound which can be subjected to enzymatic reaction.

Solvent engineering is a common feature in production of structured lipid especially in cases whereby solubility of substrates is a problem. For example, organic solvents can be used to enhance the miscibility of hydrophilic glycerol and hydrophobic lipid to increase the reaction rate in glycerolysis [1]. Nevertheless, due to growing awareness for green processes and products, various strategies have been developed to replace organic solvents. One of such strategies is to use the environmental friendly green solvents namely the ionic liquids. Aside from facilitating the solubility of different substrates, ionic liquid can sometimes contribute to higher reaction rate and better reaction efficiency.

The lipid group in Department of Engineering, Aarhus University has long tradition of working in the area of structured lipids. Some of our long-list of structured lipids includes margarine fats [2, 3], human milk fat substitutes [4, 5], medium and long chain triacylglycerols, lipophilic antioxidants [6], ceramide for cosmetics usage [7], biofuels [8] and many more. Our laboratory is well-equipped with equipments necessary for fats and oil modification. At the first stage of designing a structured lipid, we developed model system by working at smaller laboratory scale reactors. During this stage, the model system is used to optimize various reaction conditions affecting the process. Some of the tools that we used for optimization and prediction include Modde [9, 10], Chemcad and Cosmo-RS [11]. Once the model system has been established, we move on to test the system on larger scale reactors (Batch and Packed-bed reactors). Usually, purification steps are seldom required for structured lipid produced through biocatalytic pathway. Nevertheless, in the event of required purification, we have the capability of using our short path distillation for separation of compounds with different volatility.

References

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