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Current trends in applications of enzymatic interesterification of fats and oils: A review

Subajiny Sivakanthan [a], Terrence Madhujith [b,c,*]

[a] Department of Agricultural Chemistry, Faculty of Agriculture, University of Jaffna, Sri Lanka
[b] Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka
[c] Department of Food Science and Technology, University of Georgia, Athens, GA, 30606, USA

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ABSTRACT

Development of modified lipids with improved nutritional and functional properties has gained mounting interest among scientists and technologists over the recent past. Properties and applications of lipids not only depend on the composition but also on the structure of triacylglycerols (TAGs). Therefore, modifications in TAGs of lipids is a way to synthesize tailored lipids to widen their applications. Adverse health effects associated with *trans* fats originated primarily from partial hydrogenation have led to the use of alternative technologies and interesterification has emerged as the main alternative technology. Interesterification catalyzed either by chemicals or enzymes is a process of rearrangement of fatty acids in the glycerol backbone resulting in structured lipids with modified physico-chemical and nutritional properties. Despite the high cost, enzymatic interesterification offers more advantages such as milder processing conditions, less by-products and easier product recovery compared to chemical interesterification. Currently, enzymatic interesterification is used commercially to produce a variety of modified lipids such as zero-*trans* margarines and shortenings, cocoa butter substitutes and cocoa butter equivalents, human milk fat substitutes, low calorie structured lipids and edible films and coatings. This review presents recent developments and current trends of enzymatic interesterification, its novel applications and limitations.

1. Introduction

Natural oils and fats are composed mainly of triacylglycerols (TAGs) and the composition and molecular structure of the TAGs determine the physico-chemical properties, functional and nutritional qualities of lipids (Mensink et al., 2016). Saturated fatty acids, monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) are attached to the three positions (*sn*-1, *sn*-2 and *sn*-3) of the glycerol molecule (Kadhum & Shamma, 2017) and the proportion of each of these fatty acid groups varies with the source of the lipid. Interesterification is a process of exchange of fatty acid molecules in the same TAG or among different TAGs and resulting lipids are termed modified lipids, structured lipids, tailor-made lipid" or designer lipids (Osório, Dubreucq, Fonseca, & Ferreira-Dias, 2009; Reena, Reddy, & Lokesh, 2009).

Natural oils need some modifications in their structure in order to make them suitable for various applications. Few decades ago, transformation of unsaturated fatty acid rich oils into semi solid fat and improving oxidative stability of unsaturated oils were achieved by partial hydrogenation. As a consequence of the recommendation to limit the amount of saturated fats in the diet in 1960s, the use of partially hydrogenated vegetable fats instead of animal fats increased during the 1960s–1980s (Berry et al., 2019). A large volume of oil was hydrogenated annually in the world until early 2000. During the partial hydrogenation process, some of the *cis* fatty acids are transformed into *trans* fatty acids. Understanding the negative health impact of *trans* fatty acids led to exploration of alternative methods for partial hydrogenation and interesterification emerged as a promising alternative (Viriato, Queirós, da Gama, Ribeiro, & Gigante, 2018). Numerous health issues, importantly, cardiovascular diseases associated with the intake of these industrially produced *trans* fats and regulations related to *trans* fat levels in the foods have led the food industry to develop an alternative technology for partial hydrogenation (Xie, Yang, & Zang, 2015). In addition, interesterification has found various other applications such as production of tailor-made lipids; cocoa butter equivalents, human milk fat substitutes and low calorie fats by modifying the TAGs to contain

* Corresponding author. Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Sri Lanka.
E-mail addresses: ssubajiny@univ.jfn.ac.lk (S. Sivakanthan), tmadhujith@agri.pdn.ac.lk (T. Madhujith).

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