

## Lipase-catalyzed glycerolysis of olive oil under ultrasound irradiation

Karina G. Fiametti(PG)<sup>1,2</sup>, Melania M. Sychoski(IC)<sup>2</sup>, Robison P. Scherer(PG)<sup>2</sup>, Agenor Furigo Jr(PQ)<sup>1</sup>, Débora de Oliveira(PQ)<sup>2</sup>, José Vladimir Oliveira(PQ)<sup>2\*</sup>

<sup>1</sup>Chemical and Food Engineering Department, UFSC, C.P. 476, CEP 88040-900, Florianópolis, SC, Brazil

<sup>2</sup>Department of Food Engineering, URI - Campus de Erechim, Av. Sete de Setembro 1621 Erechim, 99700-000, Brazil, vladimir@uricer.edu.br

Keywords: Glycerolysis, ultrasound, lipase, solvent-free system.

### Introduction

Monoacylglycerols (MAG) are nonionic surfactants and emulsifiers containing hydrophilic and hydrophobic parts in molecules with widespread use in food industry, with applications in dairy products, margarines, bakery products and sauces [1]. Diacylglycerols (DAG) are esters of glycerol in which two of the hydroxyl groups are esterified with fatty acids (FA). DAG, particularly 1,3-DAG, have been recently claimed to be able to reduce postprandial serum triacylglycerols (TAG) levels, and may have several beneficial effects on human health, such as obesity and lipemia prevention. Currently, large-scale production of MAG and DAG has been performed by chemical glycerolysis of fats and oils at high temperatures, in the presence of inorganic alkaline catalysts. Because of the high reaction temperature (200-250°C), dark-colored, burn-tasted products are formed. Moreover, the chemical catalysis process is energy intensive, provides low yields (30-40%) and there is the need of product post-purification by molecular distillation [2]. In this context, this work is aimed to report the production of MAG and DAG through enzymatic glycerolysis of olive oil in solvent-free system under ultrasound irradiation using a commercial immobilized lipase as biocatalyst (Novozym 435).

### Results e Discussion

Enzymatic ultrasound-assisted glycerolysis reactions were carried out in an ultrasonic bath. In the first case, mechanically stirred Erlenmeyer flasks (50mL) were immersed in the thermostatic ultrasonic bath and the stirring rate was kept constant for all experimental conditions at 600rpm. The ultrasonic bath was equipped with a transducer having longitudinal vibrations, operating frequency of 37kHz and a maximum rated power output of 132W. Typically, around 30g of the substrates (vegetable oil and glycerol, pH of about 7.0) were charged into the reaction vessel, while the amounts of enzyme (Novozym 435 – Novozymes, initial activity of 45U/g) and surfactant were defined according to pre-established values. The analysis of the substrates/products of the reactions was performed in a gas chromatograph (Shimadzu 2010) with automatic on-column injector and flame ionization detector (FID). The column DB-5 was used. One can see from Table 1 that the absence of the catalyst

and surfactant (blank reaction) did not lead to acceptable reaction yields. When the enzyme was used, important MAG and DAG yields were obtained, around 50wt% in general, even without surfactant addition, hence showing the significant role of the catalyst. It can also be seen from this table that yields were similar for all surfactants, near 50wt%, except for AOT, ~ 38 wt%. Results can be considered relevant once good products yields can be obtained from the use of ultrasound irradiation.

Table 1. Results of ultrasound-assisted glycerolysis in ultrasonic bath at 600rpm, 65°C, 7.5wt% enzyme, glycerol to oil molar ratio of 2:1, ultrasonic power of 132W and 2h of reaction.

Condition	DAG (wt%)	MAG (wt%)	TAG (wt%)
Blank reaction	5.12	7.74	67.24
No surfactant	14.54	38.95	31.24
Triton X-100	16.94	34.06	29.41
AOT	25.90	12.73	41.62
Tween 65	15.33	31.79	33.62
Tween 85	19.67	34.37	26.64

### Conclusions

Results presented in this work indicate a promising perspective to the use of environmental benign technique to produce MAG and DAG without health concerns and unnecessarily costs associated with solvent separation. Appreciable reaction yields of MAG and DAG were obtained under mild conditions. Further experiments comprising glycerolysis reaction kinetics in ultrasound systems are underway by our working group.

### Acknowledgments

Capes, Fapergs and CNPq.

<sup>1</sup> Damstrup, M.L.; Abildskov, J.; Kill, S.; Jensen, A.D.; Sparso, F.V. and Xu, X. *J. Agric. Food. Chem.*, **2006**, *54*, 7113.

<sup>2</sup> Nouredini, H.; Harkey, D.W. and Gutsman, M.R. *J. Am. Oil Chem. Soc.*, 2004, *81*, 203.