From fundamental insights to economic viability: valorization of minors from deodorizer distillates

Alexandra Bouriakova[a], E. D'Hondt[b], K. Elst[b], H. Benats[c], S. De Schepper[d], W. De Weirdt[e], J. Geuens[f], P. Gonry[g], K. Schatteman[h], S. Tavernier[i], J. De Clercq[a], J. Thybaut[a]
[a] University of Ghent, CaRE/INKAT, Ghent, Belgium
[b] Flemish Institute for Technological Research, SCT, Mol, Belgium
[c] Cargill Global Edible Oil solutions, Schiphol, The Netherlands
[d] Indinox, Lokeren, Belgium
[e] Tectero, Sint-Amandsberg, Belgium
[f] Karel de Grote Hogeschool, Antwerp, Belgium
[g] Gova, Antwerp, Belgium
[h] Ecotreasures, Lokeren, Belgium
[i] University of Antwerp, Antwerp, Belgium
Alexandra.Bouriakova@UGent.be

1. Introduction

Edible oil production requires the 'stripping' of undesirable components to guarantee adequate taste and color quality. The resulting Oil Deodorizer Distillate (ODD) comprises triglycerides, free fatty acids and methyl esters as well as some high value 'minor' components such as tocopherols, sterols and squalene. The isolation of these minor components, which are of particular interest for cosmetic, food and pharmaceutical industries, can be achieved via supercritical CO_2-extraction after (trans)esterification of the triglycerides and free fatty acids. The produced ester mixture, on the other hand, can be used in high-grade industrial applications, e.g., biodegradable lubricants, biosolvents and biosurfactants.

2. Approach and results

CATALISTI's "SUCCeSS" project (Supercritical solutions for side-stream valorization), has adopted a systematic methodology for the development of a minor component recovery process from an ODD stream, as shown in Figure 1.

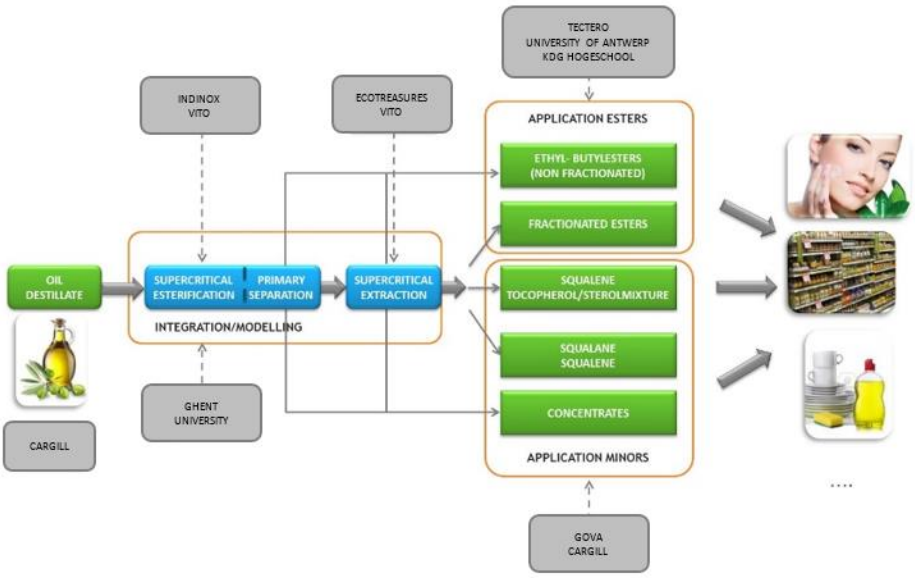

Figure 1. Overall chain approach of "SUCCeSS" project.

Ethanol and, alternatively, butanol, are considered as esterifying alcohols for sunflower and soybean ODD's, ensuring the 100% renewable character of the process and its products. On lab-scale, conversions of 92% were obtained for the esterification with ethanol and ester recovery degrees of 60%.
Reaction kinetics and extraction models have been validated against experimental data and used in the simulation of an optimized process configuration allowing to treat feeds with variable composition (1 kTonne/year). The results are analyzed in terms of capacity and economic viability. A maximum return on investment is calculated for the soybean ODD, exceeding that obtained with the sunflower ODD with a factor of four. Pilot trials on the esterification along with extraction have been performed, indicating the reliability of the scaled up simulations.

3. Conclusion

Sunflower and soybean deodorizer distillates are investigated as ‘green’ alternatives for valuable, natural components such as squalene, tocopherols and sterols. Employing a fundamental representation of the physicochemical phenomena involved, an economically versatile process configuration was proposed.