ω-polyunsaturated fatty acid derivatives production from natural products

Abstract

The PhD thesis addresses the subject of obtaining derivative products of ω-polyunsaturated fatty acid methyl esters (ω-PUFA) as methyl esters concentrates, from a local plant source – the oil extracted from the seeds of *Camelina sativa*. Compared to other oils, camelina oil is less stable (due to the double bonds) and long-term storage leads to oxidation and acidity increase. Experimental research followed several objectives. The first objective of the PhD thesis was to develop a technique to remove the free fatty acids (FFA) from degraded oil with minimal product losses, using a new and environmentally friendly process (molecular distillation). FFA causes soap formation during transesterification reaction and requires large amounts of water to be removed using conventional processes. Optimal operating parameters (deacidification efficiency, evaporation temperature, wiper rolling speed and feed flow rate) were determined by response surface method based on experimental data regression obtained from 27 molecular distillation experiments. The deacidified oil was used to obtain fatty acid methyl esters (FAME) by a transesterification reaction, which will be further used in experimental research. The second objective of the PhD thesis deals with the physico-chemical characterization of FAME, which are thermo-sensitive compounds with few experimental data presented in literature. Vapor pressures (in the range 0.1-30 mbar), density and viscosity (298.15-363.15 K and atmospheric pressure) were experimentally measured, and regression models were used to fit the data. Different models based on group contribution methods were also used to compare the experimental data, and the errors were acceptable. The last PhD thesis objective was to obtain ω-PUFA ester concentrates using advanced separation methods such as molecular distillation and high vacuum distillation ($p \leq 1$Pa). Four separation strategies were developed using different distillation steps (based on 30 molecular and high vacuum distillation experiments) and optimal separation parameters (obtained by experimental trials, starting from the properties estimated using regression models), for which separation products were obtained and characterized by GC-MS methods. Valuable concentrated products obtained from experimental research of this PhD thesis are: 73.32% ω-PUFA methyl ester concentrate with a yield of 60.04%, 96.10% methyl palmitate and a mixture of methyl eicosenoate and methyl docosenoate of about 89.20%.