

Supercritical carbon dioxide extraction of oil from Andean lupin seeds

Miao Yu¹, Kai Kniepkamp¹, Juliette Rudzick², Jan Pieter Thie¹, Geert-Jan Witkamp³, Rob van Haren¹

¹Hanze University of Applied Sciences, Groningen, Netherlands. ²German Institute of Food Technologies, Quakenbrück, Germany. ³King Abdullah University of Science and Technology, Thuwal, Saudi Arabia

Abstract

The Andean lupin (*Lupinus mutabilis*) is one of the lost crops of Incas and has been grown in South America and as a food crop for thousands of years. The seeds are the main source of commercial value regarding the high content of oil (about 20%), protein (about 43%) and carbohydrates (about 33%). A European Union H2020 project, LIBBIO, aims to develop and optimize the breeding and cropping of the Andean lupin in the Europe, and to process the lupin seeds for new and high-value products for consumers and for incorporation into other products. This study works at optimizing the oil extraction from the lupin seeds using supercritical carbon dioxide (scCO₂), which has been tested for lupin oil extraction and is advantageous over organic extractants due to the mild operating temperature, cost-effectiveness, nontoxicity, and easy post-separation.

In the study designed by response surface methodology, the operating pressure, temperature, scCO₂ flowrate, and sample mesh size, were investigated on their effect on the oil extraction efficiency. The pressure, scCO₂ flowrate and mesh size were found to affect the extraction efficiency significantly. The higher the pressure and the smaller the mesh, the more oil was extracted over a specific period. Optimally about 85% of the oil was extracted by scCO₂ compared with conventional Soxhlet extraction using hexane as the extractant. Oleic acid (46%) and Linoleic acid (32%) are the two main fatty acids in the extracted oil. About 80% of the fatty acids are unsaturated. The stearic acid is one of the main saturated fatty acids, which has relatively positive effects on human health to others. The pressure was found to significantly affect the fractions of the saturated and unsaturated fatty acids. The content of tocopherols in the extracted oil ranged from 1 to 20 mg/100g oil, which is comparable with literature value.