Supercritical CO_2 Extraction of High Added Value Products from Rice Bran

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This work is intended to present a revaluation project of waste material from the food industry using supercritical carbon dioxide ($scCO_2$) as a green solvent to obtain high added value compounds. Nowadays the food industry wastes are estimated to be around 90 million tonnes every year[1] , most of them are converted in energy, however they still contain high added value chemical compounds. The aim of this study is to extract these valuable compounds with a green extraction method without using organic solvents.

The research is conducted next Exenia Group, an Italian company working with $scCO_2$ since 1995; in these years it had dealt with many different $scCO_2$ fields of application: from pasteurization to supercritical fluid extraction (SFE). In particular, Exenia Group is set on the research and development of new $scCO_2$ industrial applications, feasibility studies and processes optimization.

Edible white rice is only 65% of total grain weight, so the milling process produces a lot of by-products. Despite rice bran is a waste in the rice production chain, it contains most of the rice nutrients including bioactive phytochemicals such as γ-oryzanol, tocopherols, and tocotrienols[2].

Goal of the present research work was the optimization of the extraction process of rice butter which contains γ-oryzanol, well known for is antioxidant, anti-inflammatory and anti-hypercholesterolemic activities. For this reason, it is used in pharmaceutic, cosmetic and food industry. This product is known to be a complex mixture of ferulic acid esters of phytosterols and triterpenoids[2].

The extractions are conducted with a semi-industrial supercritical CO_2 extractor following a Composite Face-Centered (CCF) design of experiments and a response surface methodology.

During the extraction experiments, pressure and temperature have been varied, monitoring the yield in γ-oryzanol by a HPLC methodology,[3] based on acetonitrile (45 v/v), methanol (52 v/v) and 0.03% acetic acid (3 v/v) mixture as mobile phase, reverse phase column (Ascentis C18 25cm x 4.6 mm, 5µm) thermostated at 50°C, flow rate of 0.8 ml/min and detection wavelength of 325nm. The results show that the yield in γ-oryzanol is more influenced by temperature than pressure at these conditions. Although experiments are still ongoing, these results show that this is a high-performance extraction.

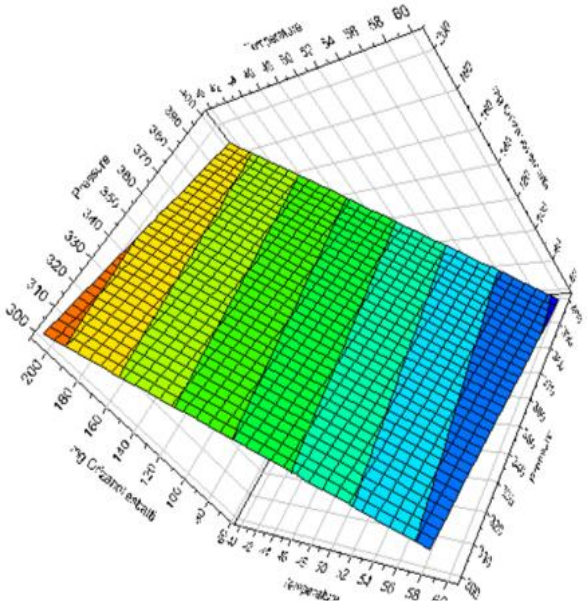

Figure 1: Experimental design surface

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[2] A. Moongngarm, N. Daomukda and S. Khumpika, Chemical Compositions, Phytochemicals, and Antioxidant Capacity of Rice Bran, Rice Bran Layer, and Rice Germ, *APCBEE Procedia*, 2012, **2**, 73–79.

[3] Z. Xu and J. S. Godber, Purification and Identification of Components of γ-Oryzanol in Rice Bran Oil, *J. Agric. Food Chem.*, 1999, **47**, 2724–2728.