Full Paper _____ *Thematic Section:* Physicochemical Research.
Reference Object Identifier – ROI: jbc-01/17-49-3-22 *Subsection:* Physical Organic Chemistry.
The Digital Object Identifier – DOI: 10.37952/ROI-jbc-01/17-49-3-22
Submitted on Marth 11, 2017.

Methodology of optimization of supercritical CO_2 extraction of resveratrol from berries of mulberry

© **Bahodir T. Muhammadiev**, **Firuza S. Kuldasheva**, and **Shokhista U. Mirzaeva***+
Department of Information and Communication Process Control Systems. Bukhara Engineering Technology Institute. K. Murtazoyev St., 15. Bukhara, 200100. The Republic of Uzbekistan.
Phone: +998 914-017-905. E-mail: shohista.m@rambler.ru

*Supervising author; +Corresponding author

Keywords: Berries of mulberry, organic acids, glucose, fructose, essential oils, vitamins, carotenes, micro- and macro elements.

Abstract

This study used a supercritical (SC) of CO_2-extraction to extract resveratrol (RT) from the mulberry. To do this, define the conditions (preliminary experiments) of the extraction process, namely, the temperature, pressure and fluid flow SC (CO_2). Given that this process is multifactorial, the method RSM (response surface methodology) and CCRD (central composite rotatable design) used to determine the optimum operating conditions of the process. The effectiveness of the established SC-CO_2 extraction conditions, expressed RT content in the extracts as compared with a yield of RT produced by the conventional extraction method, when applied SC-CO_2 modified polar co-solvent (ethanol).

In describing the RT yield predictions using appropriately combined with RSM CCRD, we found that the yield of RT mainly depends on the pressure and quantity of SC-CO_2 used for extraction. It turned out that there is a significant relationship for the linear and quadratic terms of the relationship between the output of the RT and these parameters. Noticeable interaction between the three process parameters (pressure, SC-CO_2 temperature and flow rate) was observed.

Mulberry is subjected to heat pre-treatment. Cooked thereafter pitch used as a raw material for the extraction of by SC-CO_2. Initial studies for a wide spectrum of SC-CO_2 density value (690-780 kg/m^3) indicates that it is possible to set optimum operating conditions for the RT isolation.

According to RSM – analysis of the optimal process conditions: 15.8 MPa, 30.5 ^oC and 20.08 g CO_2/ g.d.m. CO_2 consumption for the extraction of RT from licorice using SC-CO_2. SC-CO_2 density calculated for the optimum pressure and temperature equal to 725 kg/m^3, which was found as a result of a preliminary analysis of the correlation between the output of the RT and CO_2 density. The maximum yield of RT is equal to 0.052 g of 1 g of dried material (about 0.5% of extract) with SC-CO_2 density equal 725 kg/m^3.

Preliminary tests performed at condition resulting in SC-CO_2 density ranging from 690 to 780 kg/m^3 indicated that at some pressure, temperature as well as consumption of supercritical fluids the optimal working conditions for resveratrol isolation could be determined. For this purpose the following range of working conditions of SC-CO_2 were tested by using Central Composite Rotatable Design (CCRD) and Response Surface Methodology (RSM): pressure from 18 to 30 MPa, temperature from 20 to 40 ^oC and consumption of SC-CO_2 from 12 to 24 gCO_2/gd.m.

The results of this investigation indicated that maximum yield RT 158 mg to 1 g materials on dry basis (about 15% of total extract) at 14.6 MPa, 33.5 °C and 21.88 gCO_2/gd.m. could be obtained.

References

[1] A. Bogdanovich et. Al. Supercritical carbon dioxide extraction of Trigonellagoenum-graccum L. Seed`s: process optimization using response surface methodology. *The jour. Super. Fluids.07.* **2016**. P.44-50.
[2] A.F. Safarov, K.H. Gafurov. The use of liquid carbon dioxide as a solvent for extracts from plants (review). *Bukhara.* **2014**. P.117. (russian)
[3] B.T. Muhammadiev, K.H. Gafurov. Perspectives of extraction with CO_2. *The development of science and technology. Beaty.* **2015**. No.4. P.153-159. (russian)
[4] S.M. Ghoreishi et. al. Response surface optimization of essential oil and diosgenin extraction from Inbutisterrestis via supercritical fluid technology. *Chem. Ing. Technol.* **2012**. Vol.35(1). P.133-141.
[5] B. Kauftmann et. al. Influence of plant extraction processes. *Phytohem. Anal. 18.* **2007**. P.70-76.

[6] P. Kraulis, P.R. Venskutionis. Optimization of supercritical carbon dioxide extraction of amaranth seeds by response surface methodology and characterization of extracts is plated from different plant cultivars. *Jour. Supercrit. Fluids.* **2013**. Vol.73. P.178.
[7] H. Matlab, Z. Sadat, A. Hezave. Training cascade-formed back propagation network modeling of spearmint oil extraction in a packed bea using SC-CO_2. *Jour. Supercrit. Fluids.* **2013**. Vol.73. P.108.
[8] K.Kh. Gafurov, Sh.U. Mirzaeva, and B.T. Mukhammadiev. The kinetics of supercritical CO_2 extraction with co-solvent of fat-containing materials from melon seeds. *Butlerov Communications.* **2016**. Vol.48. No.11. P. 35-39. DOI: 10.37952/ROI-jbc-01/16-48-11-35
[9] B.T. Muhammadiev, K.Kh. Gafurov, and Sh.U. Mirzaeva. Supercritical [SC] -CO_2 extraction glycyrrhizic acid from licorice roots. *Butlerov Communications.* **2017**. Vol.49. No.1. P.108-114. DOI: 10.37952/ROI-jbc-01/17-49-1-108