Particle formation from roseroot extracts using supercritical antisolvent process

M. Sajfrtová, M. Topiař, M. Cerhová, V. Jandová

Institute of Chemical Process Fundamentals of the ACS, v.v.i., Rozvojová 135, 165 02 Prague 6, Czech Republic

Natural extracts are marketed in the form of liquid, viscous preparations or as powders resulting from the drying of the liquid extract. Formation of powdered extracts helps to decrease the storage costs and increase the concentration and stability of active substances. However, conventional drying methods (spray drying, lyophilization etc.) have several disadvantages, such as the degradation of the product, contamination with organic solvents, and the production of large sized particles. More gentle technic for precipitation and particle formation is a supercritical antisolvent process (SAS)[1]. In the SAS process, a liquid solution of a solvent and a bioactive substance is injected into a supercritical fluid, which acts as antisolvent. This leads to supersaturation of the solute, which is compensated by nucleation and particle growth.

In this work the SAS was used to particle formation from roseroot (*Rhodiola rosea* L.) extracts. Roseroot, also called "golden root", belongs to plants revealing adaptogenic properties, which are attributed to the presence of specific phenolic compounds. Its underground organs (rhizomes and roots) have been used for ages in the Far East as a natural remedy to eliminate fatigue, improve memory, and enhance physical and mental performance as well as to prevent high-altitude sickness. It has been used also in the treatment of heart diseases, depression, and anxiety, and is especially recommended for hard-working people, convalescents, and elderly people[2]. This raw material is mainly rich in phenylethanoids, phenylpropanoid glycosides, and other phenolic compounds, including phenolic acids, flavonoids, and tannins.

Fine particles were formed from roseroot extracts obtained by various extraction methods (supercritical extraction using CO_2 modified by 20 % w/w of ethanol, by pressurized liquid extraction with water, ethanol and a hydroalcoholic mixture and by conventional ethanol extraction). The effects of SAS operating parameters (pressure, temperature, concentration of dissolved substance, type of injection needle, etc.) on the properties of produced particles from particular plant extract were evaluated. The total phenolic and flavonoid contents in the extracts were determined by UV spectrometry. Characterization of the quality of the unprocessed and processed roseroot extract particles was performed using an electron microscope.

The precipitation temperature, pressure, CO_2 flow rate, and nozzle type had a significant effect on size and shape of final particles. The particle size decreased as the temperature and pressure increased. The use of the coaxial nozzle combined with temperature of 60 °C and pressure of 15 MPa represents the best conditions for production of small spherical particles. The product obtained was a dry powder with a particle diameter from 0.5 to 2.5 μm.

References:

[1] Temelli F. (2018) J. Supercrit. Fluids 134, 244.

[2] Panossian, A. et al. (2010); Phytomedicine 17, 481.

Acknowledgements. The financial support of the Ministry of industry and trade (project no. FV 40252) is gratefully acknowledged.