An integrated process for utilization of pomegranate peels

Kyriakos Kaderidis[1], Athanasia M. Goula[1], Konstantinos G. Adamopoulos[2]

[1]*Department of Food Science and Technology, School of Agriculture, Forestry and Natural Environment, Aristotle University, 541 24 Thessaloniki, Greece*

[2]*Department of Chemical Engineering, School of Engineering, Aristotle University, 541 24 Thessaloniki, Greece*

Keywords: Antioxidants, Encapsulation efficiency, Phenolic extract, Pomegranate peels, Spray drying, Ultrasound extraction

Presenting author email: kaderidisk@gmail.com

Pomegranate (*Punica granatum* L.) is one of the oldest known edible fruit that contains the highest concentration of total polyphenols in comparison with other fruits studied. During the industrial processing of pomegranate, large volumes of industrial wastes (i.e. peels and seeds) are produced, disposal of which has become an environmental problem. Pomegranate peel is the main waste fraction of pomegranate fruits, which have been widely studied, because it contains numerous biologically active compounds, including natural antioxidants such as phenolic acids and flavonoids. Phenolic compounds have attracted more and more attention for their antioxidant behavior and beneficial health-promoting effects in chronic and degenerative diseases. Recent studies have demonstrated higher antioxidant capacity of the peel as compared to the aril juice. Thus, pomegranate peel attracts attention due to its apparent wound-healing properties, immunomodulatory activity, antibacterial activity and antiatherosclerotic and antioxidative capacities. Due to the above-mentioned pharmaceutical and nutraceutical properties of pomegranate peels and also due to their large annual production as by-product of the juice and concentrate industries, the pomegranate peels could have several financially attractive applications in food industries, instead of being used as animal feed.

Thus, the objective of this work is to optimize a new method for pomegranate peels application in food industries based on the ultrasound-assisted extraction of phenolics compounds and their subsequent encapsulation by spray drying using different wall materials. The effects of various parameters on extraction yield and kinetics, on encapsulation efficiency/yield and on the main physical properties of the microcapsules (moisture content, bulk density, solubility) were studied. In addition, the efficiency of this encapsulated extract in improving the shelf life of hazelnut paste by inhibiting its oxidation was studied.

Solvent type, extraction temperature, solvent/solid ratio, amplitude level, and pulse duration/pulse interval ratio were the factors investigated with respect to extraction yield. The maximum extraction yield was 13.85 g gallic acid equivalents/100 g of dry peels. The efficient extraction period for achieving maximum yield of pomegranate phenolics compounds was about 10 min. The optimum operating conditions were found to be: solvent type, water; extraction temperature, 34.7 ^{o}C; solvent/solid ratio, 32.2/1; amplitude level, 39.8%; pulse duration/pulse interval ratio, 1.2/1. A second-order kinetic model was successfully developed for describing the mechanism of ultrasound extraction.

Different materials were used as encapsulating agents. Inlet air temperature, drying air flow rate, ratio of core to wall material, drying air flow rate, and feed solids concentration were the factors investigated. The resulting microcapsules were evaluated in terms of moisture content, bulk density, and rehydration ability. The maximum encapsulation efficiency was 99.80% and the optimum operating conditions were found to be: wall material,

maltodextrin/skim milk powder (50:50); inlet air temperature, 150 °C; drying air flow rate, 22.8 m^3/h; ratio of core to wall material, 1/9; feed solids concentration, 30% (w/w).

The crude and the encapsulated extract were mixed with hazelnut paste at a phenolics concentration of 5000 ppm and an accelerated shelf-life test at 60 ^oC was carried out until 51 days. The experimental data of peroxides value obtained during shelf-life studies were used for kinetics interpretation of hazelnut paste oxidation. The encapsulated phenolics extract was found efficient in improving the shelf-life of hazelnut paste by inhibiting its oxidation, in spite of the limited solubility of the crude extract in such a high lipid content matrix.