POCER 1927: Microencapsulation by Spray Drying Enhanced Powder Recovery and Mangiferin Stability of *Phaleria macrocarpa*'s Extracts

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Abstract

A microencapsulation via spray-drying was evaluated for encapsulation of mangiferin extracted from *Phaleria macrocarpa*. The microencapsulation was performed using maltodextrin, whey protein isolate and a mixture of these components in a ratio of 9:1. The mangiferin was quantified using an ultra performance liquid chromatography coupled to the tunable UV detector and quadrupole time of flight mass spectrometer (UPLC TUV QTOF MS) and high performance liquid chromatography with diode array UV detector. It was found that encapsulation with maltodextrin yielded the lowest moisture content (7.3%) and yielded the highest powder yield (38.6%).

Keywords: *phaleria macrocarpa*; spray drying; microencapsulation; maltodextrin; whey protein isolate.

1. Introduction

Phaleria macrocarpa is a traditional herb with many medicinal properties, such as anti-cancer, anti-diabetic, antimicrobial and anti-hyperglycemic due to its polyphenolic content (Faried et al., 2007; Lay et al., 2014). The plant extracts in liquid form has a short shelf-life, difficult to transport and not convenient for user consumption. Moreover, the polyphenols are susceptible towards degradation process during processing and storage due to the presence of light, moisture, oxygen, undesirable pH and temperature (Fang & Bhandari, 2011). The aforesaid issue can be alleviated by having a product in powder form which can be produced by spray-drying (Kalušević et al., 2016). However, spray-drying involves high temperature operating in excess of 140 °C which can cause a degradation of polyphenolic compound, hence affecting the quality of the final product. In addition, product loss may occur due to low powder recovery from spray dryer (Ferrari, Germer, & de Aguirre, 2012; Tonon, Brabet, & Hubinger, 2008). The aforesaid drying issue can be resolved by the addition of an encapsulant such as maltodextrin (MD) and whey protein isolate (WPI). No previous work on microencapsulation by spray drying of *P. macrocarpa* extracts, hence this work aims to increase the powder recovery and to minimize the degradation of mangiferin during spray-drying (Araujo-Díaz, Leyva-Porras, Aguirre-Bañuelos, Álvarez-Salas, & Saavedra-Leos, 2017).

2. Methodology

Several types of encapsulation material (i.e., WPI, MD and WPI:MD 1:9) was tested. Mangiferin content in the sample was determined using an ultra-high-pressure liquid chromatography quadrupole time of flight mass spectrometry coupled with UV detector as well as via mass spectrometry analysis (Figure 1). Mangiferin content in the spray dried powder was compared with the ones in the liquid extracts to determine its stability.

3. Results and Discussion

The particle size distribution, morphology (Figure 2) and moisture content were determined and correlated to the powder recovery and product quality. The results showed that maltodextrin presented the lowest moisture content (7.30%) and mean particle size of 6.3 µm. The results indicated that the increase of viscosity of feed solution produced larger particle size and promoted an increase of moisture content of spray dried powder. This could be due to large atomized droplet formed at the high viscosity so it possessed a high drying rate (Samborska, Gajek, & Kamińska-Dwórznicka, 2015). The particles of spray dried extract without encapsulation presented spherical structures with extensive extent of indentation and some small holes formed on the surface while the encapsulated particles showed irregularities and deformations but they were free from apparent fissure or cracks. Therefore, the encapsulated powders are avoided from air exposure, thus more resistant against compound degradation (Di Battista, Constenla, Ramírez-Rigo, & Piña, 2015; Tan, Kha, Parks, Stathopoulos, & Roach, 2015). The highest powder recovery of 38.6% with MD encapsulation compared to 14.9% without encapsulation. The stability of mangiferin has improved by 12% with microencapsulation.

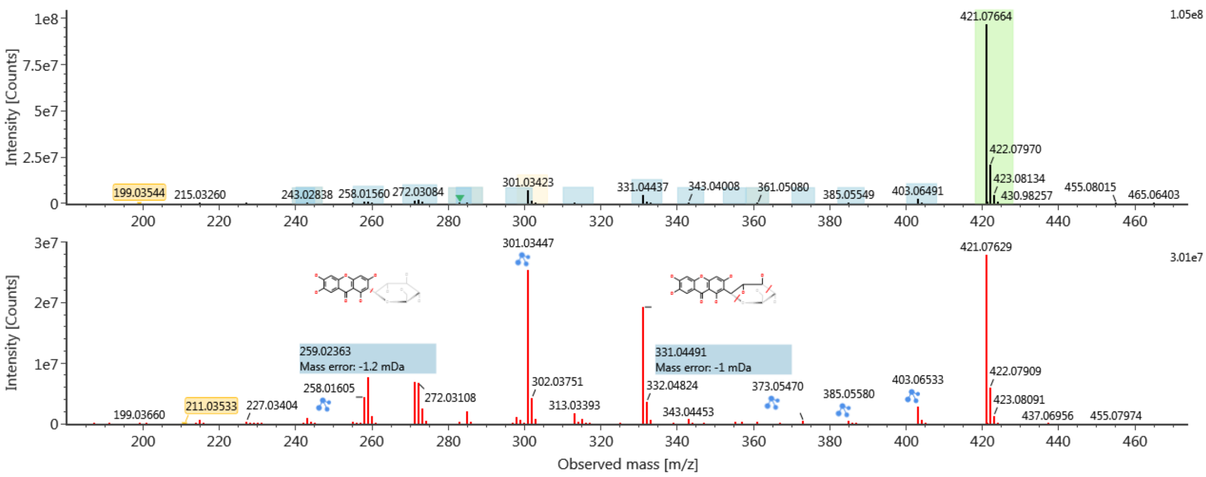

Figure 1: Mass spectrum of mangiferin in extract

4. Conclusions

Microencapsulation of *P. macrocarpa* by spray-drying using WPI, MD and mixture (WPI:MD 1:9) has successfully produced higher retention of mangiferin. The highest powder yield (38.6%) and mangiferin retention was achieved using maltodextrin for encapsulation.

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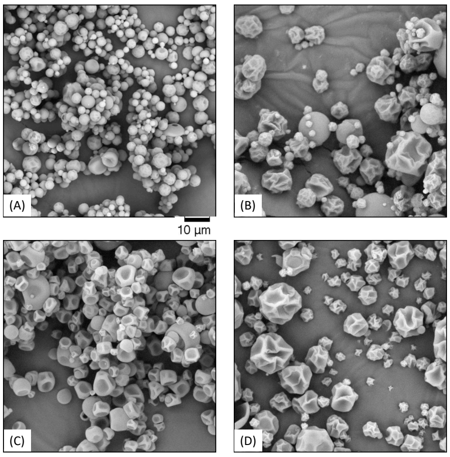

Figure 2: SEM image of extract (A), MD (B), WPI (C) and mixture of WPI and MD (1:9) (D)

References

Araujo-Díaz, S., Leyva-Porras, C., Aguirre-Bañuelos, P., Álvarez-Salas, C., Saavedra-Leos, Z., 2017. Evaluation of the Physical Properties and Conservation of the Antioxidants Content, Employing Inulin and Maltodextrin in the Spray Drying of Blueberry Juice. Carbohydrate Polymers. 167: 317-325.

Di Battista, C. A., Constenla, D., Ramírez-Rigo, M. V., Piña, J., 2015. The Use of Arabic Gum, Maltodextrin and Surfactants in the Microencapsulation of Phytosterols by Spray Drying. Powder Technology. 286: 193-201.

Fang, Z., Bhandari, B., 2011. Effect of Spray Drying and Storage on the Stability of Bayberry Polyphenols. Food Chemistry. 129 (3): 1139-1147.

Faried, A., Kurnia, D., Faried, L., Usman, N., Miyazaki, T., Kato, H., Kuwano, H., 2007. Anticancer Effects of Gallic Acid Isolated from Indonesian Herbal Medicine, Phaleria macrocarpa (Scheff.) Boerl, on Human Cancer Cell Lines. International Journal of Oncology. 30 (3): 605-613.

Ferrari, C. C., Germer, S. P. M., de Aguirre, J. M., 2012. Effects of Spray-Drying Conditions on the Physicochemical Properties of Blackberry Powder. Drying Technology. 30 (2): 154-163.

Kalušević, A., Veljović, M., Salević, A., Lević, S., Stamenković-Đoković, M., Bugarski, B., Nedović, V., 2016. Microencapsulation of Herbal Extract by Spray Drying. Radovi Poljoprivrednog Fakulteta Univerziteta u Sarajevu (Works of the Faculty of Agriculture University of Sarajevo). 61 (66 (1)): 151-155.

Lay, M. M., Karsani, S. A., Banisalam, B., Mohajer, S., Malek, A., Nurestri, S., 2014. Antioxidants, Phytochemicals, and Cytotoxicity Studies on Phaleria macrocarpa (Scheff.) Boerl Seeds. BioMed Research International, 2014.

Samborska, K., Gajek, P., Kamińska-Dwórznicka, A., 2015. Spray Drying of Honey: the Effect of Drying Agents on Powder Properties. Polish Journal of Food and Nutrition Sciences. 65 (2): 109-118.

Tan, S., Kha, T., Parks, S., Stathopoulos, C., Roach, P., 2015. Optimising the Encapsulation of an Aqueous Bitter Melon Extract by Spray-Drying. Foods. 4 (3): 400-419.

Tonon, R. V., Brabet, C., Hubinger, M. D., 2008. Influence of Process Conditions on the Physicochemical Properties of Açai (Euterpe oleraceae Mart.) Powder Produced by Spray Drying. Journal of Food Engineering. 88 (3): 411-418.