# INFLUENCE OF DIFFERENT COMBINATIONS OF WALL MATERIALS ON THE ENCAPSULATION OF BUTTERNUT SQUASH WASTE EXTRACT

**Slađana Stajčić, Jasna Čanadanović-Brunet, Gordana Ćetković, Vesna Tumbas Šaponjac, Jelena Vulić, Vanja Šeregelj**

*University of Novi Sad, Faculty of Technology Novi Sad,*
*Bulevar Cara Lazara 1, 21000 Novi Sad*
*e-mail: sladja@uns.ac.rs*

## Abstract

The aim of this study was to evaluate the effect of different amounts of carrier agents (maltodextrin, inulin and pea protein) on the content of phenolics and carotenoids from butternut squash waste extract in encapsulates obtained by freeze-drying technique**.** Using Simplex-Centroid experimental design and response surface methodology (RSM), the highest content of both phenolics and carotenoids in the encapsulate was determined for a wall blend ratio 53.9 % pea protein, 46.1 % maltodextrin and 0% inulin.

## Introduction

The fruits and vegetables processing industry produce very large amounts of waste materials, which are promising sources of bioactive compounds, such as phenolics and carotenoids. The applications of bioactive compounds from waste have recently attracted great interest in the food and pharmaceutical industries. However, the effectiveness of bioactive compounds depends on preserving their stability, bioactivity and bioavailability. Encapsulation, technique by which sensitive ingredients are packed within a coating or wall material, can effectively alleviate these deficiencies. Different encapsulation techniques and/or wall materials have been applied in order to achieve desired properties of encapsulates.

## Experimental

Freeze-dried butternut squash waste was extracted with acetone:ethanol mixture (36:64 v/v) in solid to solvent ratio 1:10 w/v according to the procedure of Šeregelj et al. (1). The content of carotenoids in the butternut squash waste extract was analyzed by the method of Nagata and Yamashita (2). The amount of total phenolics in extract was determined according to the Folin-Ciocalteau method (3). Three carrier agents, including maltodextrin (M), inulin (I) and pea protein (P) were used as wall materials for freeze-drying encapsulation of phenolics and carotenoids from butternut squash waste extract. The composition of the wall materials mixture was optimized using response surface methodology (RSM) in order to obtain the optimum encapsulate (OE) with the highest content of both phenolics and carotenoids. The encapsulates were prepared according to the modified method developed by Indrawati et al. (4). Contents of total phenolics and carotenoids in the encapsulates were determined spectrophotometrically by following a modified Saénz et al. and Barbosa et al. methods, respectively (5, 6). The characterisation in terms of water activity, hygroscopicity, water solubility, bulk density, tapped density and color properties of the optimum encapsulate was also conducted (7).

## Results and discussion

Total phenolic and carotenoid content in extract were 294.69 mg/100 g and 14.26 mg/100 g dried squash waste, respectively. The content of total phenolics from squash waste in the encapsulates ranged from 24.57 to 65.16 mg/100 g. The content of total carotenoids in the encapsulates were in range from 2.39 to 3.08 mg/100 g. Using RSM, the highest content of both phenolics and carotenoids in the encapsulate was determined for a wall blend ratio 53.9 % P, 46.1 % M and 0 % I. The total phenolic and carotenoid content in the OE (63.41 mg/100 g and 3.08 mg/100 g, respectively), prepared using the calculated optimum wall materials mixture, did not differ significantly from the predicted values. OE was characterised in terms of water activity (0.014), hygroscopicity (12.30 g of moisture per 100 g dry solids), water solubility (60.00 %), bulk density (0.21 g/ml), tapped density (0.33 g/ml) and color properties (L*= 62.65, a*= 0.88 and b*= 34.47).

## Conclusion

The experimental mixture design and response surface methodology was adequate, allowing for the selection of the best mixture of wall materials. The maltodextrin/pea protein interactions can give the improvement in preservation of both phenolics and carotenoids from butternut squash waste extract in encapsulate during freeze-drying encapsulation**.**

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