IN VITRO RELEASE OF PHENOLIC COMPOUNDS FROM ALGINATE/CHITOSAN MICROPARTICLES

Josipa Martinović, Gabriela Perković, Gordana Šelo, Ana-Marija Klarić, Mirela Planinić, Marina Tišma, Ana Bucić-Kojić*

Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 18, HR-31000 Osijek, Croatia, *corresponding author: abucic@ptfos.hr

INTRODUCTION

Phenol-rich microparticles loaded with grape pomace extract were prepared by the ionic gelation method using sodium alginate and chitosan as coatings and $CaCl_2$ as curing agent. Two methods of adding chitosan were used:

- Method (A): chitosan mixed with $CaCl_2$
- Method (B): alginate hydrogels immersed in chitosan,

and their influence on the encapsulation efficiency (*EE*) and *in vitro* release of phenolic compounds (TPC) from microbeads (MB) was studied. The hydrogels obtained were freeze-dried, and the dried MB were then used to study the release of TPC during simulated enzyme-free digestion *in vitro* in the mouth, stomach, and intestine for 243 min.

MATERIALS & METHODS

SAMPLE

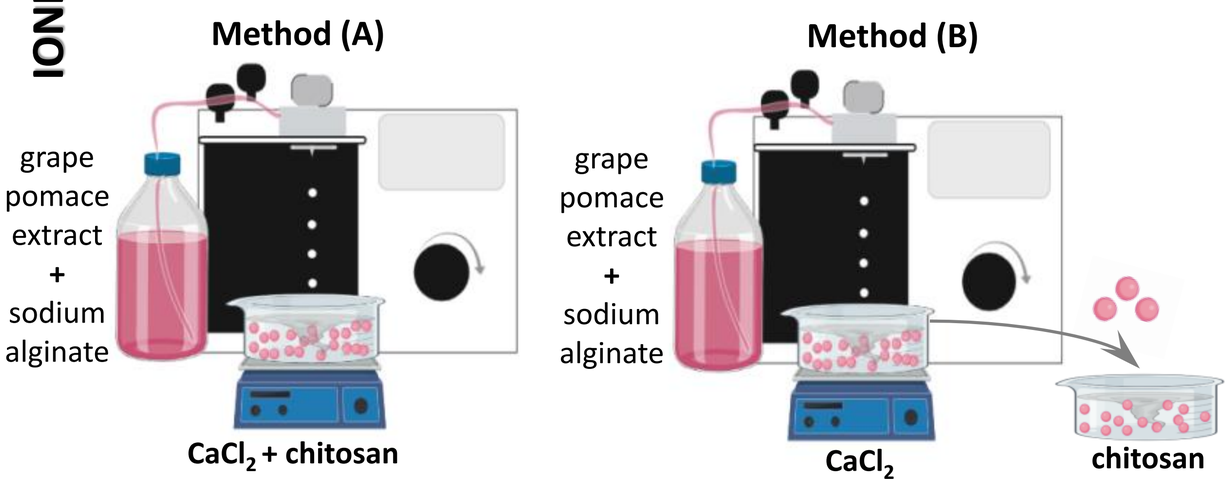
- grape pomace Cabernet Sauvignon variety (Erdut winery, Croatia, harvest 2018)
- dry matter content: 92.91 %
- particle size: 1 mm

EXTRACT PREPARATION

- solvent: 50 % aqueous ethanol
- solvent-sample ratio: 40 mL/g
- extraction by shaking water bath at conditions:
  - T = 80 °C
  - n = 200 rpm
  - t = 120 min
- extract concentration by rotary evaporation at conditions:
  - T = 50 °C
  - p = 48 mbar
- dry extract dissolved in mixture of 30 % ethanol and distilled water

IONIC GELATION

- encapsulation were performed by encapsulator Büchi B-390
- c (sodium alginate) = 3 % (*w/v*)
- c (calcium chloride) = 0.25 M
- c (chitosan) = 1.5 %; 1.0 %; 0.5 %
- hydrogels were dried by freeze drying

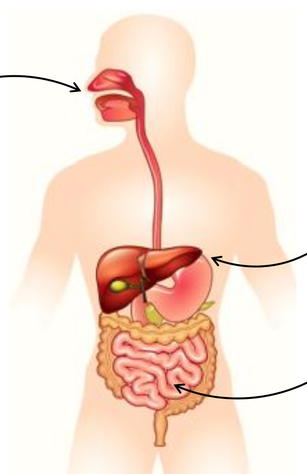


- encapsulation efficiency: $EE, \% = \frac{m_{TPC}\,(\text{extract}) - m_{TPC}\,(CaCl_2)}{m_{TPC}\,(\text{extract})} \cdot 100$

DIGESTION SIMULATION

- *in vitro* digestion simulation without enzymes

ORAL PHASE
- electrolyte solution
- pH = 7
- T = 37 °C
- t = 3 min



GASTRIC PHASE
- electrolyte solution
- pH = 3
- T = 37 °C
- t = 120 min

INTESTINAL PHASE
- electrolyte solution
- pH = 7
- T = 37 °C
- t = 120 min

RESULTS

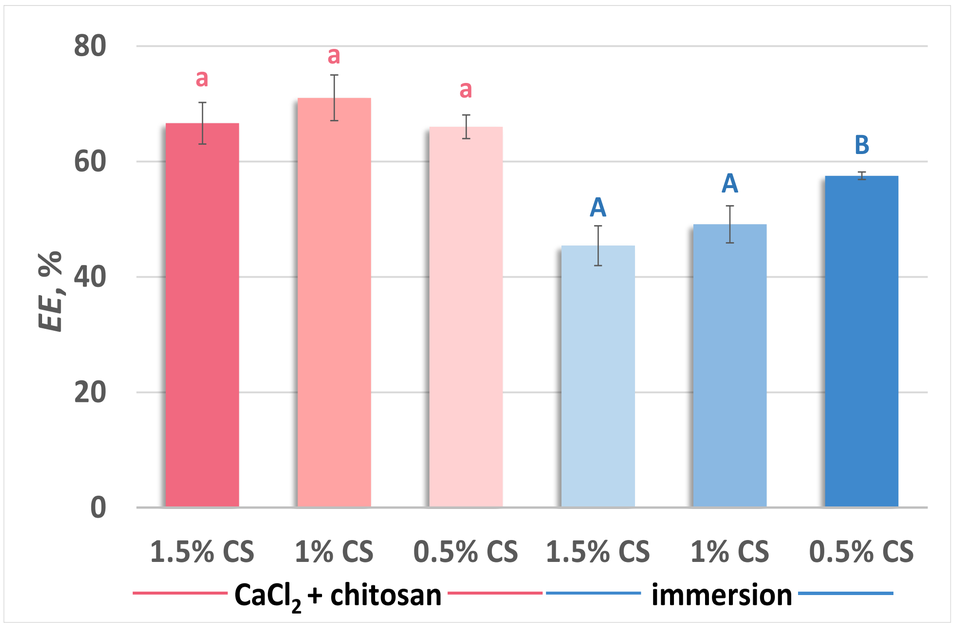


Figure 1 The influence of chitosan (CS) addition on the encapsulation efficiency (*EE*, %) of phenolic compounds from grape pomace extract. The same letter indicates no significant differences (Duncan's test, $p < 0.05$)

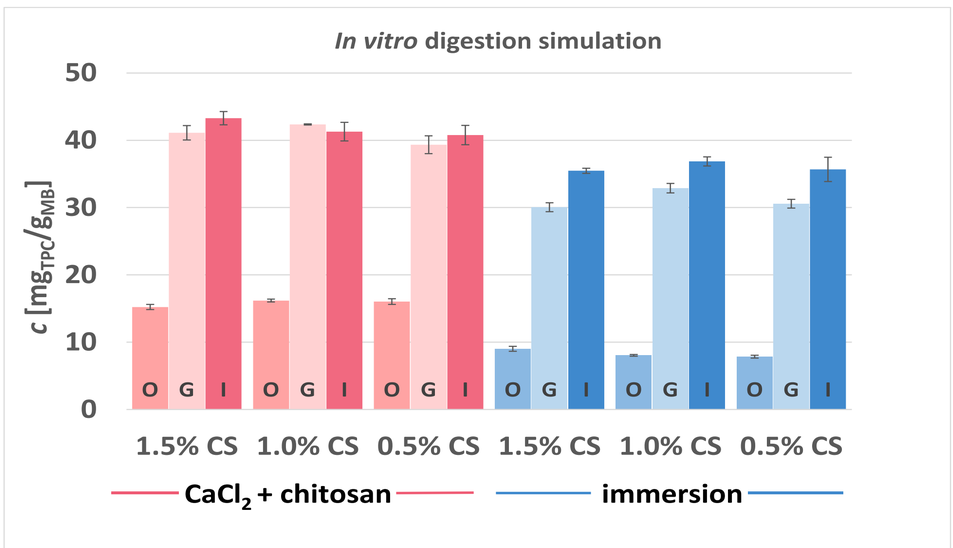


Figure 2 The influence of chitosan (CS) addition on *in vitro* release of phenolic compounds from microparticles (**O** – oral phase, **G** – gastric phase, **I** – intestinal phase)

CONCLUSIONS

- Addition of chitosan to the curing agent (method A) resulted in the highest encapsulation efficiency (71.02 %), which was at a chitosan concentration of 1.0 %. The ANOVA test ($p < 0.05$) showed that there is no statistically significant difference between the applied concentrations of chitosan.
- Immersing the alginate microparticles in chitosan (method B) and decreasing the chitosan concentration increased the encapsulation efficiency. When 0.5% chitosan was used, the highest efficiency of 57.52% was obtained. The ANOVA test showed that there is a statistically significant difference between *EE* when 0.5 % chitosan was used compared to chitosan concentrations of 1.5 % and 1 %, which are not statistically different from each other (Duncan's test, $p < 0.05$).
- *In vitro* release of phenolic compounds from freeze-dried microparticles revealed that the encapsulated phenolic compounds were released more rapidly from microparticles prepared by adding chitosan to $CaCl_2$.
- Most total phenolic compounds were released in the gastric phase, 92.23 – 99.01 % in the method (A) and 84.85 – 93.17 % in the method (B).
- The cumulative total phenolic content after 243 min of digestion ranged from 41.59 – 44.58 mg_{TPC}/g_{MB} for the method (A) and 34.08 – 36.03 mg_{TPC}/g_{MB} for the method (B).

19. međunarodni znanstveno-stručni skup Ružičkini dani
DANAS ZNANOST – SUTRA INDUSTRIJA
21. – 23. rujna 2022. | Vukovar, Hrvatska

This work was supported by the Croatian Science Foundation under the project (IP-2018-01-1227) „Development of a sustainable integrated process for the production of bioactive isolates from food industry residues" (POPI-WinCEco)