Microencapsulation of olive oil by spray drying using membrane emulsification

Donia Chaabane*, Asma Yakdhane , Moh Moh Zin, Arijit Nath, András Koris, Gyula Vatai
Department of Food Engineering, Institue of Food Technology and Biotechnology, Hungarian University of Agriculture and Life Sciences, Ménesi st 44, HU-1118 Budapest, Hungary
** Donia chaabane: donia.chaaben@gmail.com*

INTRODUCTION

Olive oil has been increasingly popular among consumption oils as it provides several health benefits such as antioxidant, anti-inflammatory, prevention of many modern life-style diseases, like some kinds of cancer and cardiovascular diseases. However, oxidative deterioration and stabilization of olive oil provide short shelf-life storage with poor consumer acceptance. Microencapsulation of active compounds has been extensively used during the past decades in the cosmetics, drugs industry as well as food industry to provide protection against oxidative deterioration. It has been adopted as an effective and important tool to protect the olive oil against oxidation during storage. Emulsification technology is a key step in the microencapsulation of oils followed by a spray drying technique to obtain olive oil powder.

Thus, our research is directed toward the use of microencapsulation technology to encapsulate olive oil. In first stage, membrane emulsification was adopted to prepare the olive oil emulsion using combinations of different wall materials such as maltodextrin, gum Arabic and carboxymethylcellulose. In second step, spray drying has been applied as downstream process for powder formulation. As result, characterization of microcapsules from different aspects, particle sizes and distributions, encapsulation efficiency and ingredient protection had been discussed.

MATERIAL AND METHODS

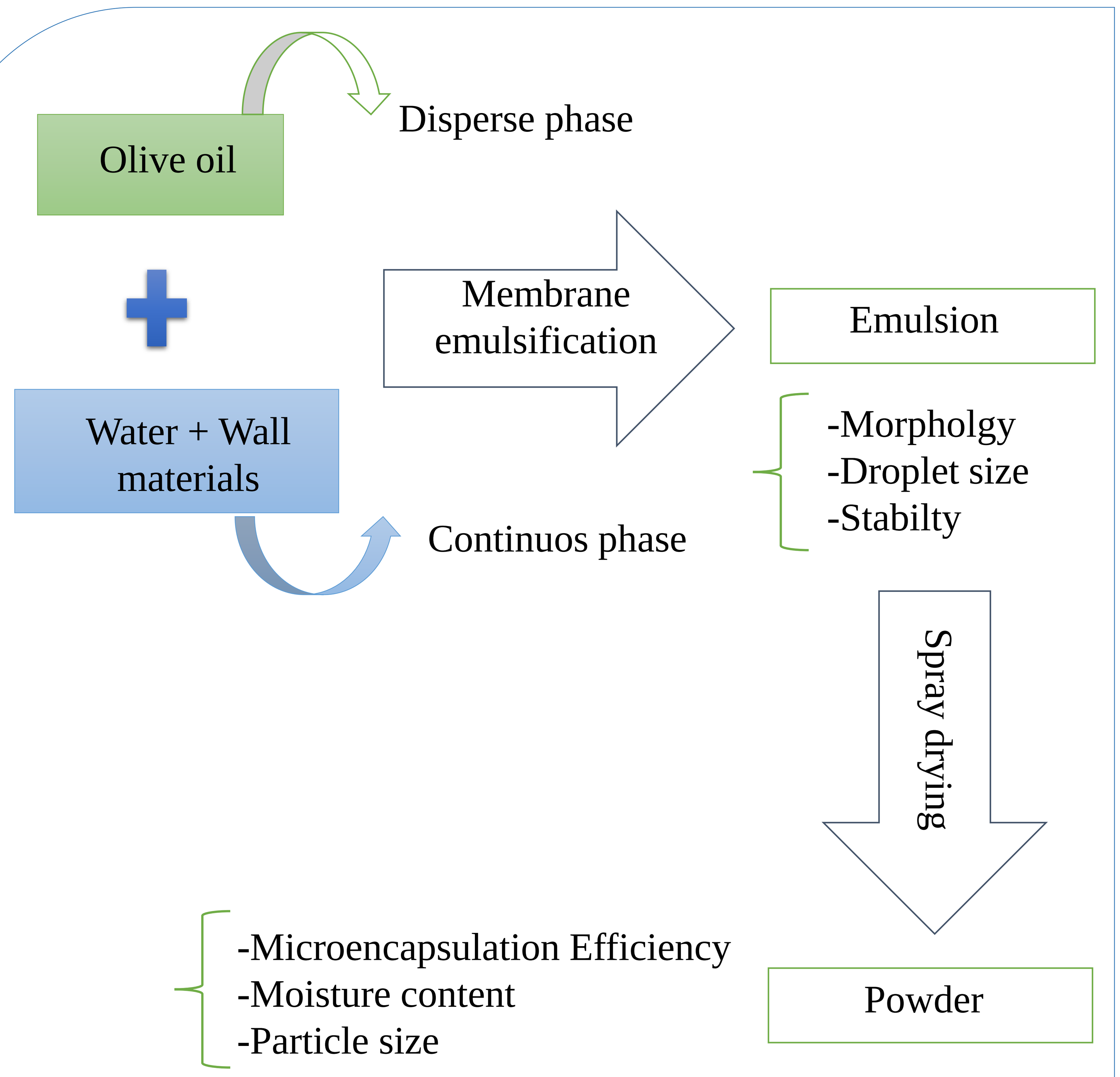

Fig. 1 Flow diagram of the microencapsulation process.

Table. 1 Description of formulation

	A	B
Maltodextrin (g)	15	30
Gum Arabic (g)	15	21.48
Carboxymethylcellulose (g)	5.7	5
Olive oil (g)	40	60
Tween 80 (g)	2	2
Deionized water (g)	700	650
Solid % w/v[a]	10	15.41
O/W Ratio (g/g)[b]	0.11	0.18
Wall material/oil ratio (g/g)	0.9	0.94

RESULTS AND DISCUSSION

The results are summarized in table 2, table 3 and figure 2.

Table. 2 Results of Membrane Emulsification

	A	B
Zeta potential (mV)	-7.42	-4.39
Fritcsh: Span value	0.484	0.398
Droplet Mean diameter D_{32} (µm)	11.66	9.16

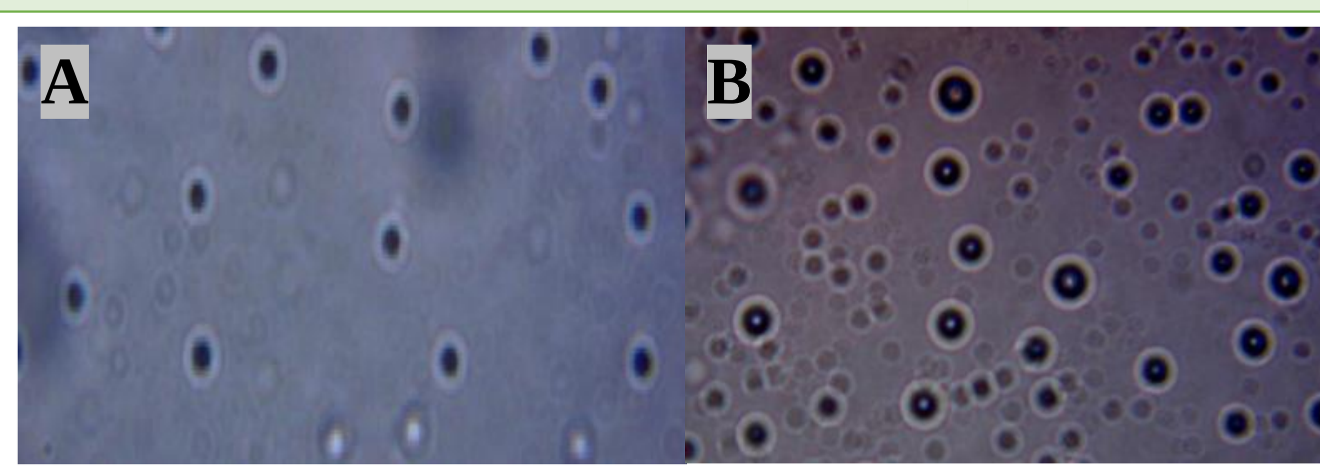

Fig. 2 Microscopic image of the samples after membrane emulsification.

Table. 3 Spray drying results

	A	B
Droplet size µm	6.72	5.48
Microencapsulation Efficiency	60%	72%
Moisture content	1.45%	1.39%

→Zeta potential: Emulsion A is more stable than emulsion B.
→Span: In this case B is more monodisperse compared to A.
→In sample B the viscosity is visibly higher which affected the size of the droplets impliying smaller droplets : higher viscosity → greater resistance to droplet movement, avoiding coalescence.
→Microencapsulation efficency is influenced by the wall material concentrations which expalins the higher efficiencey in sample B.
→ High moisture content → oil oxidation + flowability of powder.

CONCLUSIONS

In this work it was possible to evaluate the performance of varying the wall materials concentrations in the olive oil microencaosulation process. The membrane emulsification of olive oil resulted in microcapsules with spherical shapes in both cases. Increasing the viscosity of the emulsion resulted into increasing the monodospersity of the emulsion and a narrow droplet size distribution. After spray drying, better encapsulation efficiency has been recorded when using higher concentration of maltodextrin in combination with gum Arabic and CMC giving higher viscosity and when the droplet diameter decreases.

Acknowledgement

This project is funded by the European Union and co-financed by the European Social Fund (Grant agreement number: EFOP-3.6.3-VEKOP-16-2017-00005). We would like to acknowledge the support of Hungarian University of Agriculture and life sciences.