Characterization of omega-3-rich algae oil microcapsules: pea protein isolate vs. chitosan-maltodextrin as wall materials

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19th Euro Fed Lipid Congress and Expo
17–20 September 2023
Poznań · Poland

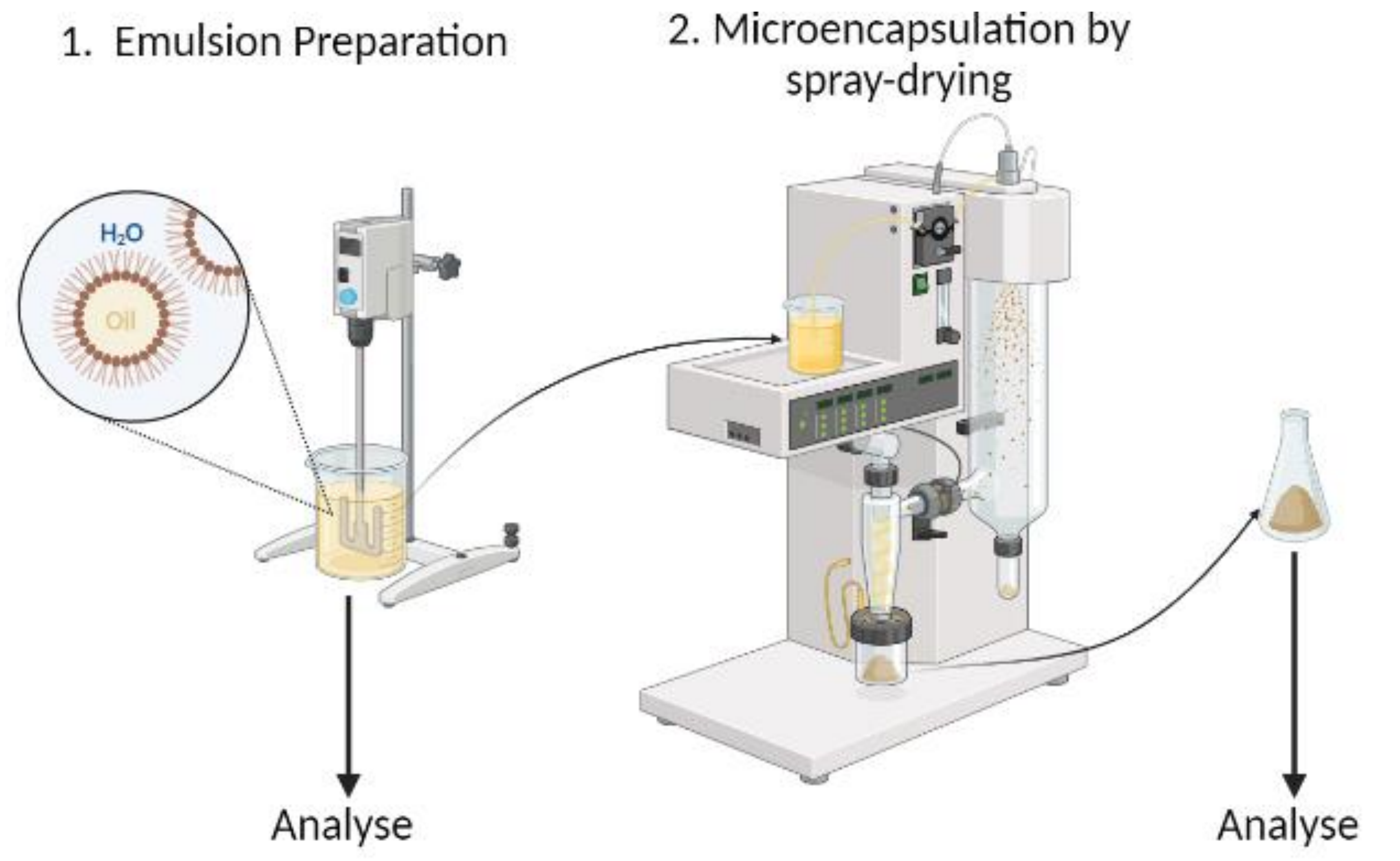
Introduction

The consumption of omega-3 fatty acids has been associated with numerous health benefits, including the prevention of cardiovascular diseases, diabetes or cancer. However, a deficiency in the intake of the primary sources of these fats, mainly fish products, is prevalent in most western diets. Consequently, there is a growing need to fortify most consumed products, such as bread, milk or meat products, with oils rich in eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)[1]. The microencapsulation of oils rich in these bioactive compounds, mainly fish oil, seems to be an appropriate strategy to enrich food in omega-3 fatty acids, protecting them from oxidation and avoiding the formation of undesirable odors and flavors[2].

Objetive

The objective of this study is the microencapsulation of algae oil by spray-by testing two different wall materials: pea protein isolate (PPI) and a combination of chitosan and maltodextrin (CM).

Methods



Following the methodology of Solomando et al. (2020)

Results

Most quality characteristics of emulsions and microcapsules were influenced by the type of wall material (Table 1), i.e., higher pH and lower viscosity in emulsions, and lower solubility and higher yield and total oil in microcapsules were found with PPI. It is also remarkable the higher EPA and DHA quantities and lower lipid oxidation levels in PPI microcapsules, although their microencapsulation efficiency was a bit lower (Figure 1)

Table 1 – Principal results of the analysis of algae oil emulsions (dark blue) and microcapsules (light blue). Significance is indicated by *p* in Student's t-test.

Analyse	CM	PPI	*p*
pH	4.15 ± 0.06	7.42 ± 0.02	<0.0001
Density (g/mL)	1.052 ± 0.006	1.018 ± 0.0002	<0.01
Viscosity (cSt)	22.13 ± 1.71	11.56 ± 0.21	<0.01
Creaming index (%)	88.33 ± 1.07	97.89 ± 0.26	<0.0001
Yield (%)	41.44 ± 1.620	52.92 ± 1.541	<0,001
Moisture Content (%)	2.13 ± 0.399	1.21 ± 0.284	0.099
Water Activity	0.22 ± 0.006	0.24 ± 0.010	0.144
Solubility Rate	0.25 ± 0.012	0.09 ± 0,004	<0.0001
Colour L*	99.26 ± 0.164	93.71 ± 0.365	<0.0001
Colour a*	-0.10 ± 0.016	1.21 ± 0.086	<0.0001
Colour b*	4.16 ± 0.275	9.25 ± 0.159	<0.0001
Bulk Density (g/mL)	0.37 ± 0.009	0.22 ± 0.004	<0.0001
Tapped Density (g/mL)	0.74 ± 0.011	0.37 ± 0.006	<0.0001
Carr Index	49.56 ± 1.782	39.53 ± 1.384	<0,001
Hausner Ratio	2.00 ± 0.064	1.66 ± 0.039	<0,001
External Fat (%)	3.00 ± 0.088	9.06 ± 0.549	<0.0001
Total Fat (%)	11.05 ± 0.153	21.14 ± 0.261	<0.0001

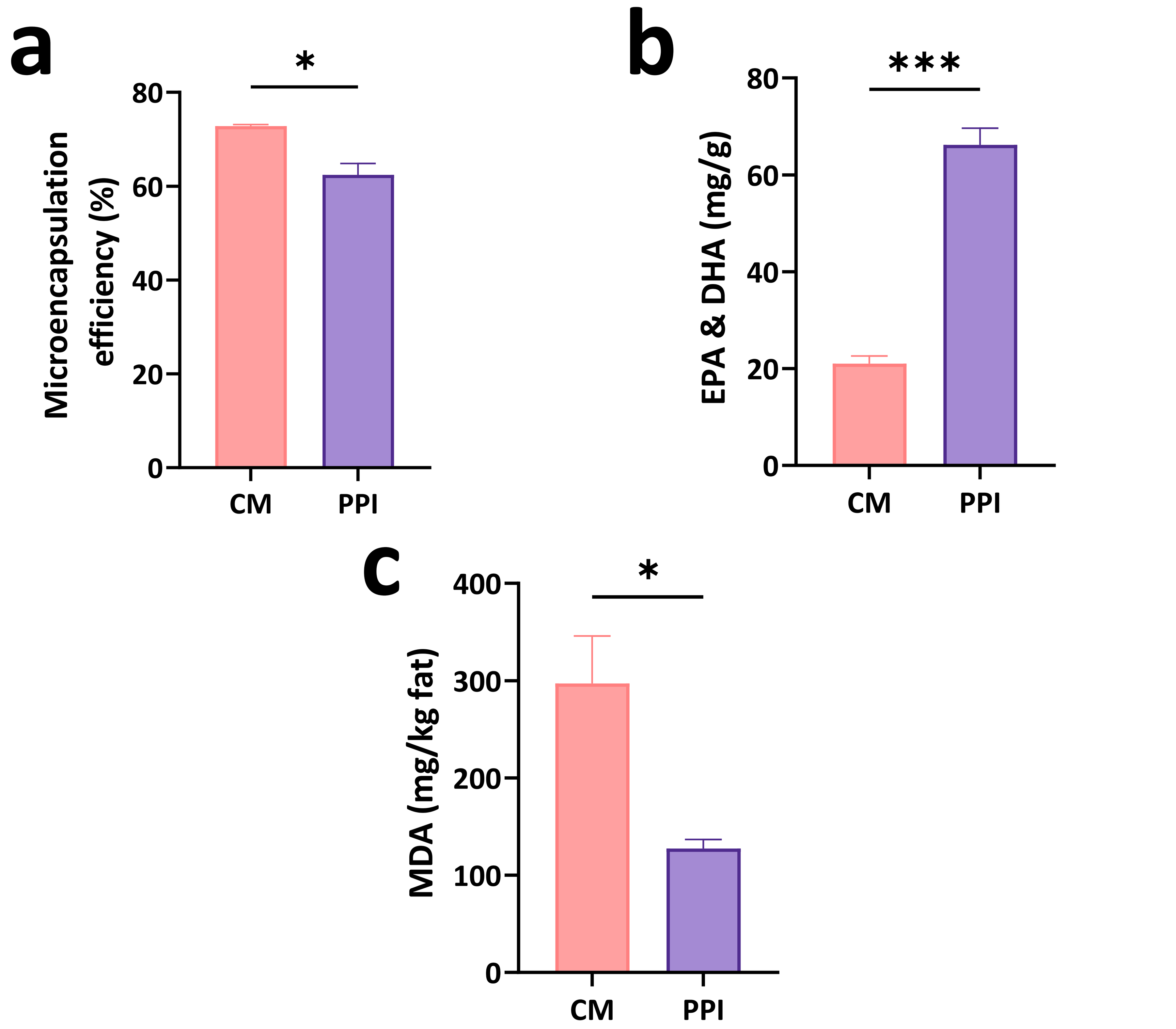


Figure 1 – Main results of microcapsule characterization analyses: (a) Percentage efficiency of algal oil microencapsulation, (b) EPA and DHA content per gram of microcapsules and (c) Lipid oxidation determinated by TBARS. Significant differences are indicated by *, ** or *** ($p < 0,05$, $p < 0,01$ or $p < 0,001$ in Student's t-test, respectively).

Conclusions

Pea protein isolate seems to be an appropriate wall material to keep on the oxidation stability of the microcapsules, but its microencapsulation efficiency should be improved by optimizing the emulsification procedure.

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Acknowledgments

Unión Europea - Fondo Europeo de Desarrollo Regional (FEDER), Junta de Extremadura - Consejería de Economía, Ciencia y Agenda Digital and Universidad de Extremadura - Plan Propio de Iniciación a la Investigación, Desarrollo Tecnológico e Innovación for funding this study, which was supported by the project IB20138.

JUNTA DE EXTREMADURA
Consejería de Economía, Ciencia y Agenda Digital

Fondo Europeo de Desarrollo Regional "Una manera de hacer Europa"
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