# DEVELOPMENT OF A SUITABLE WALL MATERIAL FOR CONTROLLED RELEASE OF CHIA SEED OIL INTO THE DIGESTIVE SYSTEM


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## INTRODUCTION

Recently, consumers have shown greater concern in their diet and regard to consume fatty acids such as omega 3 and omega 6 that are not produced naturally in the human body. Chia seed oil has a high presence of polyunsaturated fatty acids (PUFA), representing 89% of total oil content, of which around 69% corresponds to Omega 3 and the remaining 20% consists of Omega 6 [1]. For this reason, this work sought to develop spray dried capsules with a wall material that would allow effective transport of chia seed oil, preventing it from degrading throughout the digestive system.

## METHODOLOGY

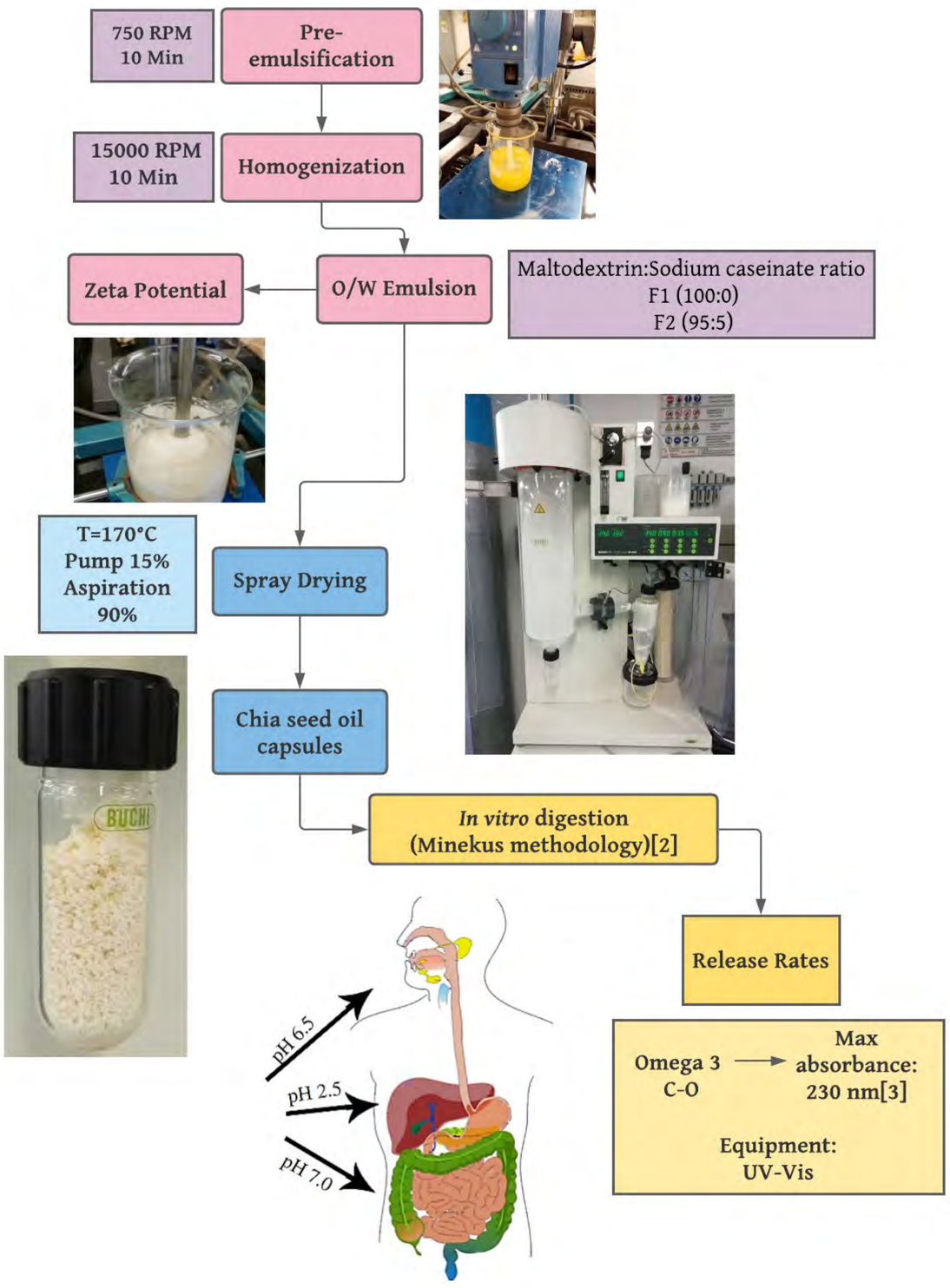


**Figure 1.** Research flowchart.

## RESULTS

### ♦ ZETA POTENTIAL

- The O/W emulsion electrical magnitude was -27.6 mV without wall material, hence it is considered a moderately stable emulsion [4].
- As F2 wall material had sodium caseinate and its isoelectric point (p.I=4.6) becomes positive at a pH lower than 4.6, a higher attraction to the negatively charged core material (chia seed oil) and better resistance to acidic environments such as human stomach were expected.
- The amphiphilic properties of caseinate caused by the κ polypeptide chain allowed a better capsule shell formation avoiding agglomeration in F2 [5].The above and a zeta potential of -1.7 mV (pH=7.0) generated a higher repulsion among capsules and also between core and wall material.

| Formulation | Zeta Potential [mV] At pH=7.0 |
|---|---|
| F1 | -0.2 |
| F2 | -1.7 |

F2 (-1.7) → It becomes positive at pH<4.6 → Greater wall material attraction at gastric conditions (pH 2.5)

**Figure 2.** Zeta potential results.

### ♦ RELEASE RATES

The percentages of released oil were calculated using Beer Lambert's law and equation 1, these values are shown in the following figures.

$$Oil\ relased(\%) = \frac{Oil\ released\ amount\ (g)}{Oil\ encapsulated\ amount\ (g)} \qquad [Equation\ 1]$$

- **Simulated Salivary Fluid (SSF) [pH = 6.5]**

- Maltodextrin (α-1,4-glycosidic bonds) and α-amylase reaction increased oil release within SSF.

- Sodium caseinate reduce release rate due to β-bonds, which not interact with α -amylase.

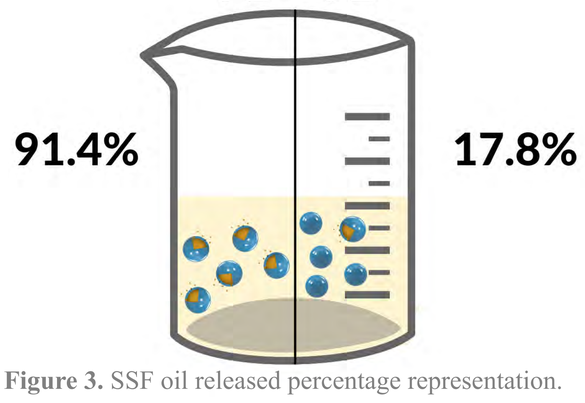


**Figure 3.** SSF oil released percentage representation.

- **Simulated Gastrical Fluid (SGF) [pH = 2.5]**

- The isoelectric point of sodium caseinate (pH 4.6) played a fundamental role in gastric phase as F2 wall material changes its charge.

- Better protection and less oil release was obteined by F2.

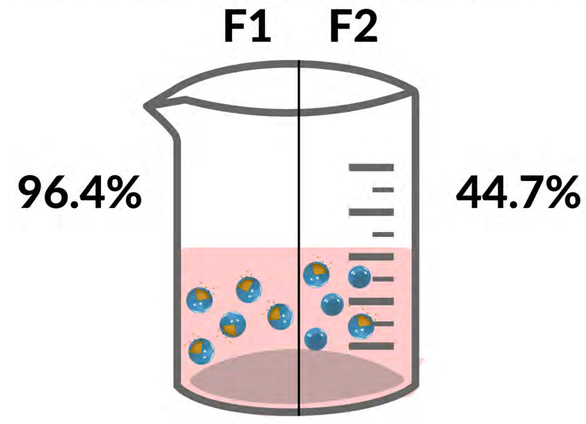


**Figure 4.** SGF oil released percentage representation.

- **Simulated Intestinal Fluid (SIF) [pH = 7.0]**

- Repulsive forces between chia seed oil and caseinate allowed a higher release by F2 compared to F1.

- F2 wall material improved a target release of the active compound in the small intestine.

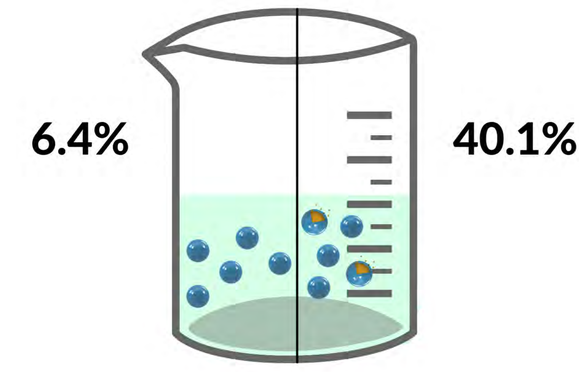


**Figure 5.** SIF oil released percentage representation.

## CONCLUSIONS

- The formulation with 5% sodium caseinate as wall material (F2) was established as the best formulation, as it showed the highest release in simulated intestinal fluid (SIF). Meanwhile, oil release resistance during salivary (SSF) and gastric (SGF) *in vitro* simulation improved due to their constituent β-bonds and their isoelectric point, respectively.
- Use sodium caseinate as a wall material enabled more stable capsules with less agglomeration tendency, compare to the capsules with only matodextrin as wall material.

## REFERENCES

[1] M. R. Segura-Campos, N. Ciau-Solís, G. Rosado-Rubio, L. Chel-Guerrero, and D. Betancur-Ancona, "Physicochemical characterization of chia (Salvia hispanica) seed oil from Yucatán, México," Agric. Sci., vol. 05, no. 03, pp. 220–226, 2014, doi: 10.4236/as.2014.53025.

[2]M. Minekus et al., "A standardised static in vitro digestion method suitable for food-an international consensus," Food Funct., vol. 5, no. 6, pp. 1113–1124, 2014, doi: 10.1039/c3fo60702j.

[3]S. F. Hamed et al., "Edible alginate/chitosan-based nanocomposite microspheres as delivery vehicles of omega-3 rich oils," Carbohydr. Polym., vol. 239, no. March, 2020, doi: 10.1016/j.carbpol.2020.116201.

[4]E. García-Márquez, I. Higuera-Ciapara, and H. Espinosa-Andrews, "Design of fish oil-in-water nanoemulsion by microfluidization," Innov. Food Sci. Emerg. Technol., vol. 40, pp. 87–91, 2017, doi: 10.1016/j.ifset.2016.11.007.

[5]G. de Figueiredo Furtado, R. A. Mantovani, L. Consoli, M. D. Hubinger, and R. L. da Cunha, "Structural and emulsifying properties of sodium caseinate and lactoferrin influenced by ultrasound process," Food Hydrocoll., vol. 63, pp. 178–188, 2017, doi: 10.1016/j.foodhyd.2016.08.038.