Formulation of solid lipid microparticles as delivery systems of bioactive ingredients for functional foods development

Instituto de Tecnologia Química e Biológica | Av. da República, 2781-901 Oeiras, Portugal
www.itqb.unl.pt

Ana A. Matias [a,c], A. R. Sampaio de Sousa, Catarina M.M. Duarte [a,b,*]

[a] IBET, Apartado 12, 2781-901 Oeiras, Portugal; [b] ITQB - UNL; [c] iMed.UL/CPM, Faculdade de Farmácia, Universidade de Lisboa, Portugal
*cduarte@itqb.unl.pt

AIM

Enhance Sunflower Oil Stability during frying process at elevated temperatures

Encapsulation of hydrophilic bioactive compounds in lipid microparticles

Microparticles

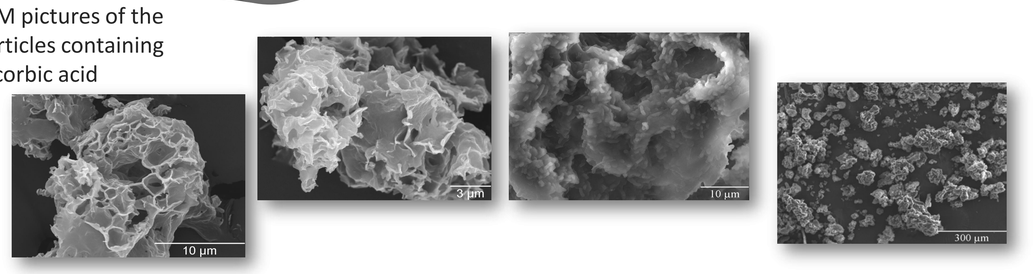
1. Composition

Antifoaming and anticaking agents

Lipid Base Mono-, di and triglycerides of palmitostearic acid*

Antioxidants and Phytosterols: To prevent autoxidation and polimerization of the oil [3]

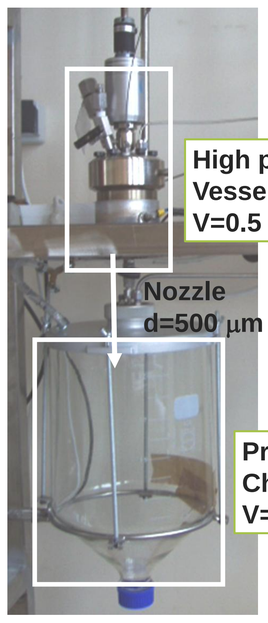
SEM pictures of the particles containing ascorbic acid



SEM pictures of the particles containing olive extract

* Formulation optimization studied in a Previous work

2. Technology



Supercritical fluids Technology Method: PGSS® Particles from Gas Saturated Solutions [1]

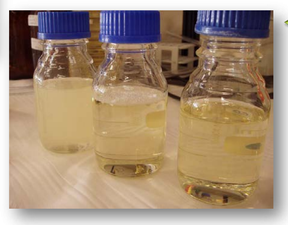
Dense carbon dioxide is solubilised in large quantities in the molten lipids. The gas-saturated solution is obtained, which is then further expanded through a nozzle generating solid particles. [2]

Incorporation Tests

In order to evaluate the viability of the particles to fulfill the goals of this study, tests were performed to incorporate the particles in sunflower oil.

When compared with the incorporation of the bioactive compounds alone, the microparticles showed:

- **Homogeneous incorporation**
- **Less stirring needed**
- **More stability**
- **Less emulsifier needed**
- **No changes in the oil's characteristics**



No stirring
500mg/kg sunflower oil added

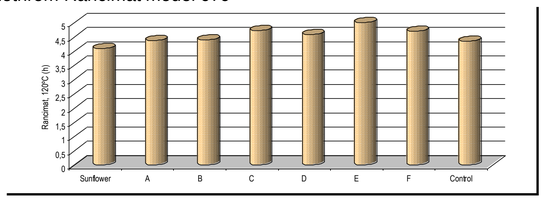
Results & Discussion

1. Oxidative Stability

To evaluate the antioxidative effect of bioactive microparticles at low temperatures (T ≤ 140ºC)

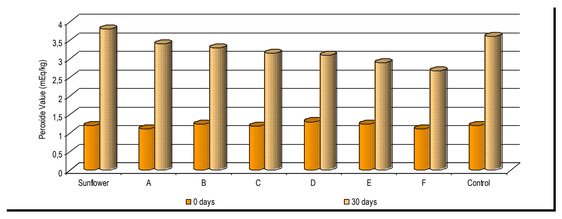
Microparticles	Composition
A	Ascorbic Acid (17%)
B	Ascorbic Acid (17%) + Natural Tocopherols (2%)
C	Ascorbic Acid (17%) + Phytosterols (5%)
D	Ascorbic Acid (33%)
E	Ascorbic Acid (17%) + Phytosterols (5%) + Anticaking Agent (6%)
F	Olivemed, Natural Extract rich in olive polyphenols (15%)
Control	Only mono-, di and triglycerides of palmitostearic acid

The induction time were determined by Rancimat test
Methrom Rancimat model 679



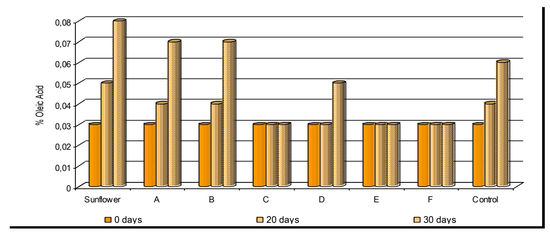
○ **The microparticles with Natural Extract present higher oxidative stability than with other biocompounds**

The peroxide value were carried out by the iodometric assay [4]



○ **Phytosterols and ascorbic acid tend to increase the induction time in rancimat test and reduce the peroxides and FFA**

The Free Fatty Acids were determined by titration IUPAC standard methods (2.201, 1987)



○ **The addition of lipid microparticles with or without bioactive compounds**

○ **Enhance the oxidative resistance at low temperature**

2. Frying Simulation Test

To evaluate the microparticles efficacy at frying temperatures (T ≥170ºC)

Oils	"Frying" Performance	%TPM	%FFA
A	foaming in 1st minute, few splashes	13-16%	0,11
B	foaming in 1st minute, few splashes	13-16%	0,10
C	slight foaming effect in 1st minute, no splashes	6-12%	0,07
D	foaming in 1st minute, no splashes	13-16%	0,10
E	slight foaming effect in 1st minute, no splashes	6-12%	0,06
F	foaming in 1st minute, no splashes	6-12%	0,06
C + E900	slight foaming effect in 1st minute, no splashes	13-16%	0,08
F + E900	no foaming, no splashes	6-12%	0,07
Sunflower	foaming in 2st minute, few splashes	13-16%	0,14

Adapted from the Gertz and Kochhar Method [3]

4 h
180ºC

The TPM *per cent* were determined by colorimetric test - Oleotest®

○ **The Total Polar Materials amount seems to be controlled by the presence of the phytosterols at frying temperature**

○ **The increase of FFA is very slightly but the sunflower oil with phytosterols has a lower value**

○ **The presence of natural olive polyphenols controlled the oxidative stability of the oil and showed better stability at frying conditions**

3. Dimethylpolysiloxane Effect

○ **The addition of 10 ppm of dimethylpolysiloxane (E900) to microparticles C stabilized the foam effect and controlled the performance of the oil**

○ **The anticaking agent is responsible for the splash control**

○ **Microparticles C show a negative synergetic effect with E900**

References

[1] Weidner, E., Knez, Z., Novak, Z., WO Patent 21688, 1995
[2] Fages, J., Lochard, H., Letourneau, J-J., Sauceau, M., Rodier, R., Powder Technology, 141, 3, 219-226, (2004)
[3] Gertz, C. Klostermann, S., Kochhar, S.P, Eur.J.Lipid Sci. Technol, 102, 543-551, (2000)
[4] European Standard EN ISO 3960

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