Microencapsulation of Sacha inchi oil (*Plukenetia volubilis*) obtained by Supercritical Fluid Extraction

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1. Introduction

Sacha inchi *(Plukenetia volubilis),* also known as Maní Inca, is a wild oleaginous plant of the *Euphorbiaceae* family that is distributed in Central America and the Amazon[1]. Different studies have shown the interest of this oil since its composition accounts for around 93% fatty acids, from which approximately 45.2% correspond to linolenic acid (omega-3) and 36.8% to linoleic acid (omega-6)[1, 2, 3].

The present work studied the production of Sacha inchi`s oil *(Plukenetia volubilis)* applying a green extraction technology such as supercritical fluid extraction with carbon dioxide; additionally its physicochemical and compositional characteristics were evaluated, together with its antioxidant activity using the β-carotene *in-vitro* assay. Later on, a microencapsulation procedure by Spray Drying was studied for oil conservation, estimating process factors such as efficiency and yield.

2. Results and discussion

Figure 1. Supercritical Fluid Equipment

In the extraction process, conditions were optimized using an experimental design and considering extraction pressure and temperature as main factors. The highest yield (22.2% (dry weight) Sacha inchi oil) was obtained at 381 bar and 50°C. The lipid profile showed high content of polyunsaturated fatty acids with more than 90% of the oil consisting of oleic acid (ω9), linoleic acid (ω6), and linolenic acid (ω3) in proportions of 8, 37.04 and 46.36%, respectively. An antioxidant activity of 27.63 ± 0.33% was obtained.

In microemulsification tests, Master Dry and Arabic Gum showed the best results so they were chosen to carry out the spray drying assay. The efficiency of the microencapsulation process was calculated with the total microencapsulated oil. Arabic Gum was the material that provided the highest efficiency, with 98.62 % of encapsulated oil.

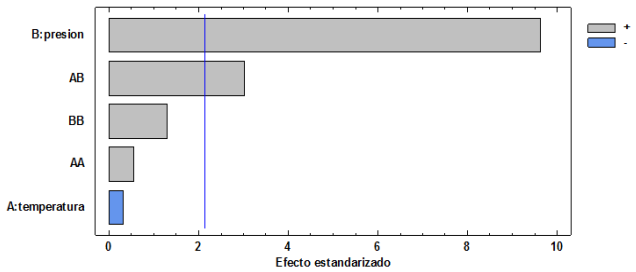

Figure 2. Standardized Pareto Diagram for SFE optimization

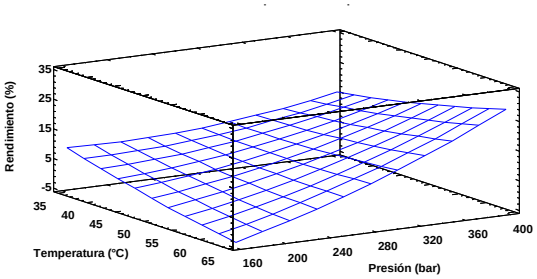

Figure 3. Estimated response surface for SFE optimization

Table 1. Fatty acid composition of Sacha inchi oil by relative percentage of area.

Fatty acids	Present study	Follageti *et al.*, 2009	Hurtado O., 2013	Maurer *et al.*, 2012	Ruiz *et al.*, 2013
Linolenic (ω3)	46.36	50.41	47.7	44	50.6
Linoleic (ω6)	37.04	34.08	35.3	33.5	34.6
Oleic (ω9)	8.00	8.41	8.45	10.7	8.7
Palmitic	6.34	4.24	4.20	4.67	8.3
Estearic	2.23	2.50	2.89	3.5	2.3

3. Conclusions

In the present study, a yield of 22% was obtained in the extraction of Sacha inchi oil by means of supercritical fluids that turns to be a promising alternative because of its greenness and the fact that no chemical residues are found in the final product. Consequently, this methodology has great advantages both at the environmental level and for the harmlessness of the oil, which allows its use for food or cosmetic purposes.

The high content of polyunsaturated fatty acids demonstrated the nutritional quality of Sacha inchi oil, thus being a good alternative in the diet due to its important nutritional and health contribution in the prevention of cardiovascular diseases.

The technique tested for Sacha inchi oil conservation through microencapsulation by spray-drying provided with good results; a high yield (> 80%) in microcapsules formation, and oil encapsulation efficiency greater than 98% was obtained while maintaining its fatty acid profile.

References

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