Protection of bioactive oils using encapsulation solutions

1. Introduction

Bioactive oils are commonly used in food, pharmaceutical and cosmetic applications. Those oils are usually rich in unsaturated and polyunsaturated fatty acids. The majority of fatty acids can be produced by the human body, however omega-3 and omega-6, essential in human nutrition, cannot be synthetized and must be provided by food. Oils rich in unsaturatted fatty acids are therefore widely used in food preparation or for direct consumption. They are though reported to be unstable and to deteriorate through mechanisms such as oxidation or hydrolytic rancidity. Rancidity of edible oils and oil-based products through lipid oxidation is therefore commonly mentionned as a serious problem in the food industry.

The value of such bioactive oils does not only reside in their amount of unsaturatted fatty acids but also in the presence of other active compounds such as sterols, caroteinoids, xanthophylls, flavonols or monoterpenes. These active compounds are reported to exhibit special properties such as anti-inflammatory, antioxidant, antibacterial, antiviral, anticancer or regenerative activity, however they are also quite unstable.

Encapsulation of bioactive oils represents a feasible and efficient approach to modulate oil release, increase physical stability, protect from oxidation reaction, enhance bioactivity, reduce toxicity, mask unpleasant taste and therefore improve patient compliance and convenience

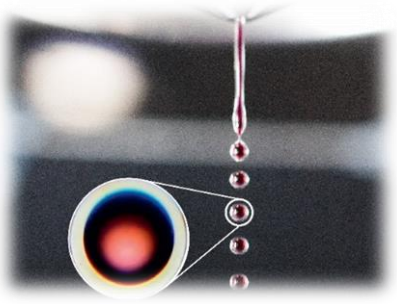

Figure 1: Oil encapsulation with Encapsulator B-395 Pro

In this study, two oils representing high linoleic (hemp) and high linolenic (flax) acid contents were respectively chosen for this study as they represent premium oil grown locally, together with a novel high linoleic acid containing oil extracted from chia seeds. The objective of this work was to use two encapsulation methods to protect oil from deterioration. The oil was extracted from the seeds using a classical Soxhlet extraction method followed by solvent evaporation using a Multivapor™ P-6.

2. Experimental

A dry powder was produced using the Mini Spray Dryer B-290 with an emulsion of oil, maltodextrin and gum arabic (1:2:1). Wet particles were produced by coextrusion technology. A 2% sodium alginate solution was coextruded with the oil and dripped into a 0.1 M calcium chloride solution using an Encapsulator B-395 Pro to produce the capsules.

3. Results

Oil was successfully extracted from linseed, chia and hemp seeds. Yields above 85 % were obtained compared to the fat content (Table 1) quantified by BUCHI fat determination units.

Table 1: Fat content extracted with BUCHI extraction solutions

Seed	Fat content [$g_{oil}/100g_{seeds}$]	
	Extraction Unit E-816 SOX	SpeedExtractor E-916
Linseeds	37.3	39.3
Hemp	31.8	34.8
Chia	32.3	33.5

The extracted oils were successfully encapsulated using either the Encapsulator B-395 Pro (Figure 1) which works on the prilling by vibration principle or the Mini Spray Dryer B-290, which is a classical spray dryer. When the Encapsulator was used, wet alginate core-shell capsules of approximately 800 µm were obtained. The oil content of the capsule was of roughly 50 %. With the Spray Dryer, a dry powder composed of oil, gum arabic and maltodextrin could be obtained. The oil content of the dry particles was of 25%.

4. Conclusion

The combination of BUCHI instruments allowed the successful extraction and encapsulation of bioactive oil. The Multivapor™ P-6 enabled a quick and efficient evaporation of the solvent after the Soxhlet extraction process while both encapsulation methods, spray drying (Mini Spray Dryer B-290) and prilling by vibration (Encapsulator B-395 Pro), allowed a mild encapsulation process of the extracted oil. Conventional, classical polymers have been used for both Encapsulator and Spray Dryer processes, however one could adapt encapsulation process using other carbohydrate or protein based polymers.

For oil determination and quality control BUCHI also offers several analytical extraction solutions; amongst them the Extraction Unit E-816 SOX or the SpeedExtractor E-916. These instruments could be used to extract oil in order to determine fat content (Table 1) and fat composition such as the content of omega fatty acids from seeds, intermediate and final products.

More information about BUCHI solutions for encapsulation and extraction can be found on our website www.buchi.com//en

References

Application note BUCHI 302/2017

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