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Mini Review

Blending of pressed vegetable oils from pomegranate seeds and soybean to increase functional lipids consume

Abstract

The main objective of this study was to develop an affordable bioactive food ingredient from a blend of pressed pomegranate seed oil (PSO) and soybean oil (SO) microencapsulated by spray drying. Compared to liquid oil blends, the microencapsulated powder presented higher oxidative stability (42%) due to the effective protection of the carrier agents and higher antioxidant capacity (two-fold) due to the antioxidant characteristic of the applied carrier material, proving to be an adequate alternative to associate the pressed pomegranate and soybean oils.

Keywords: functional lipids, pomegranate seeds oil, soybean oil, microencapsulation

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Abbreviations: PSO, pomegranate seed oil; SO, soybean oil; PA, punicic acid; CLnA, conjugated linolenic acid; PUFA, polyunsaturated fatty acid

Introduction

Nowadays, the byproduct of fruit industrialization has been recommended as a raw material to obtain new functional ingredients that contribute to sustainability in agribusiness. Pomegranate fruit processing discards up to 50% of the raw-fruit, of which 14% are seeds.[1] Pomegranate seed oil (PSO) contains over 70% of a rare punicic acid (PA) in its fatty acid composition. PA, a conjugated linolenic acid (CLnA), presents anti-inflammatory properties, and has been commercialized despite its very high sensibility to oxidation and its high price. Due to its availability, and competitive price, soybean oil (SO) is the most consumed vegetable oil in Brazil, and the Brazilian soybean production is the second largest in the world.[2] Thus, the PSO blend with a more stable and accessible oil, such as so, will contribute to the manufacture of a more stable product, extending its useful life. The blending of vegetable oils with different fatty acid profiles is a common practice to improve physical-chemical characteristics and achieve new industrial applications.[3]

Objective

The aim of the present study was to develop a microencapsulated food ingredient that increases CLnA intake by humans. For this purpose, the raw oils were characterized with regard to their fatty acid composition, total phenolic compounds, antioxidant capacity and oxidative stability. Maltodextrin and gum Arabic (1:1) was used to assess the influence of different drying temperatures (110°C to 150°C) on oxidative stability, antioxidant capacity and structure of powder.

Materials

Fresh pomegranate (*Punica granatum*) fruits, growing in the semiarid Brazilian region, were purchased directly from a farm. Cold-pressed soybean organic® oil was acquired from a local product store. This oil had no added antioxidants, as declared by the supplier. Maltodextrin DE 5 (MD, Globe® 1805) and Gum Arabic (GA, Vetec) were purchased in Brazil.

Processing

The oil blends were prepared by adding PSO to SO at a 1:4 ratio (w/w) followed by mixing in an Ultra-Turrax IKA, for 2 minutes. An oil:carrier material ratio of 1:4 was applied. The emulsion was prepared by continuously adding the carrier materials dispersed in water to the blend, reaching 30% of total solid contents for all emulsions, as recommended by Li et al.[4] The microencapsulation was performed using a mini-spray dryer (LabPlant SD-06). The emulsion was fed at 0.36 $L.h^{-1}$, with a co-current air flow rate of 25$kg.h^{-1}$ and air inlet temperature between 110°C and 150°C, using a 0.7mm diameter nozzle. The room temperature was maintained at 25±0.5°C and relative air humidity in about 40%. The powder was stored into sealed metallic packaging at -18°C.

Analytical methods

Fatty acid was evaluated *a*ccording AOCS official method (Ce 1j-07);[5] total phenolic compounds was carried out according to Nascimento et al.[6] oxidative stability was measured on a Rancimat® 743 equipment according to the EN 14112 accelerated test, at 80°C, as recommended by Lutterodt et al.[7] antioxidant capacity was determined according DPPH (2,2-diphenyl-1-picryl-hidrazil) radical method, adapted for vegetable oils; the moisture content of the powder was determined according to the AOAC method 934.01;[8] surface free oil content was determined by successive washings in hexane according to Carneiro et al.[9] the encapsulation efficiency was calculated as the ratio between the encapsulated oil and total oil content in the powder; the microphotographs were taken on a TM3030 plus Hitachi scanning electron microscopy (SEM), using an accelerating voltage of 15kV at 7000x magnification. All analytical determinations were carried out in triplicate and variance analysis (ANOVA) followed by *Fisher's LSD* test was performed using Statistica v.13.0.

Discussion and conclusion

A new technology for pomegranate seed application was developed based on the microencapsulation of PSO:SO blend. The physicochemical characteristics of the microencapsulated product are mainly controlled by inlet air temperature, inlet air flow rate and encapsulating material composition. The selection of the carrier agent for wall material is critical, since it protects the core during heating and increases yield by reducing stickiness. The chosen combination of carrier materials was MD:GA, and it reached 95% of encapsulation efficiency at drying temperature of 130°C and air flow rate of 25kg.h^{-1}. In these conditions, the antioxidant capacity (0.85mg/µg DPPH) and induction time (16 hours) of microencapsulated powder was, respectively, 2.5-fold and 42% higher as compared to the non-encapsulated oils blend. The PSO:SO blend contains phenolic compounds, ellagic and p-hidroxibenzoic acid and morin, which have antioxidant capacity against free radicals. The antioxidant property of these extracts may protect lipids against oxidative rancidity and may be able to replace synthetic additives. In human metabolism, they may act in the prevention of oxidative-caused diseases, such as atherosclerosis and cancer. At a 500x and 7000x magnification, it was possible to observe rounded capsules, as shown in Figure 1, with smooth surfaces, indicating that the encapsulation process effectively created a physical protection to the core. Additionally, the microcapsules presented high content of MUFAs and PUFAs (about 80%), including 15% of punicic acid (ω-5), and it may be an adequate source of ingredients for food or pharmaceutical industries.

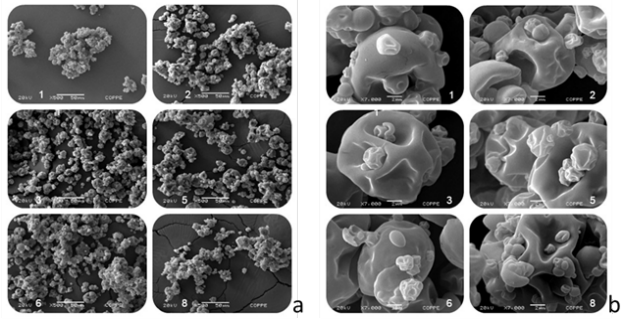

Figure 1 SEM micrographs of microcapsules: Magnification (A) 500x and (B) 7000x.

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None.

Conflict of interest

The author declares no conflict of interest.

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