Casein micelles as encapsulating material and delivery system for jaboticaba extract

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INTRODUCTION

The jaboticaba is a dark berry rich in vitamin C, minerals and phytochemicals (phenols and anthocyanins). These last ones have biological properties including strong antioxidant and anti-inflammatory, anti-obesity, anti-diabetic, and anti-oxidative properties. The polyphenols are found only in the fruit peel (~50% of fruit), which is not directly edible. Thus, the extraction of anthocyanins and other bioactive compounds from jaboticaba peel is of industrial interest. However, polyphenols originating from jaboticaba are unstable under environmental conditions and their encapsulation is necessary for industrial applications.

The jaboticaba extract was placed in an extraction solution made of 70% (v/v) acetic acid (pH 2.0). The mixture was shaken under ultrasound (40 kHz) for 30 min. The suspension was concentrated until 10% of the initial volume. A total polyphenol content of 11.64 g L⁻¹ and monomeric anthocyanin content of 0.39 g L⁻¹ were found.

The micellar casein suspension, treated or not with transglutaminase, was added of jaboticaba extract and evaluated by hydrodynamic diameter (D), Zeta potential (ζ) and DLS-RHOD polydispersity. Micellar casein suspensions added of jaboticaba extract were put in contact with glucose-6-phosphate dehydrogenase at pH 4.5. The gels were evaluated by dynamic rheological measurements, water holding capacity and protein sorption assays.

METHODS

The micelles micelles are natural nano-transporters with hydrophilic and hydrophobic binding sites which make favorable the encapsulation of lipophilic and water-soluble compounds. The casein micelles are a renewable resource obtained by the industrial techniques of thermal and drying of bovine milk. Studies have reported that some anthocyanins are able to link to the casein monomers which make the micelles a promising encapsulating agent of polyphenols from jaboticaba fruit. Nonetheless, the caseins are unstable in pH 4.6 and a burst release of polyphenols in the stomach would be expected. Thus, the crosslinking of casein micelles with transglutaminase can make them more resistant to acid pH improving the release of the active at different pH conditions.

RESULTS

The polyphenolic extract and the casein micelles, crosslinked or not, were mixed at the molar ratio of 1:1, and then, spray-dried. Polyphenol extraction from casein micelles was based on the principle that these molecules present more affinity to non-polar solvents than to the proteins. Around 100 mg of the powder samples were diluted into 25 mL of methanol, mixed together and centrifuged at 10000 rpm for 5 min. The supernatant was collected and used for the measure of the antioxidant capacity. The antioxidant capacity of the samples was determined using 2,2-Diphenyl-1-picrylhydrazyl (DPPH). The DPPH solution was prepared with 0.05 M of DPPH dissolved into 50 mL of methanol. Reagents of 0.5 mL of jaboticaba extract or powder extract were added to 4.5 mL of DPPH solution, and the mixture was scanned at 517 nm. The antioxidant capacity was used to verify the evolution of the antioxidant potential of the samples during the storage time (0-90 days) and after heat treatments (40 °C 12 h).

CONCLUSION

This work showed that crosslinked casein hydrogel can be a good candidate to encapsulate Jabuticaba extract. The polyphenols interact spontaneously with caseins and it is entrapped into micelles. The internal encapsulation of extract did not change the properties of caseins in suspension. However, the extract caused modifications in the protein matrix, which can be attested by rheological measurements and pore size evaluation. Crosslinked casein micelle hydrogel can encapsulate polyphenols without large changes in hydrogel properties. For this reason, this hydrogel can be applied to carry and deliver such compounds. After spray drying, the crosslinked micelles presented higher protection of polyphenols against stress agents such as aging and heat treatment, being a good alternative to encapsulation. This brings about the potential use of this encapsulation agent as functional ingredient for foods or drugs.