P-030

Encapsulation of green coffee oil by spray dryer: morphological and thermal characterization

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INTRODUCTION AND OBJECTIVES

Microencapsulation is an effective method to slow down the oxidation of lipids, in addition to being an effective method to protect the stability of bioactives against environmental factors (Pu 2011; Jimenez 2006).

Among the many techniques that can be used for the production of microparticles there are the spray drying, spray cooling and fluidized bed (Pu 2011), but among these the spray drying is the most common.

The encapsulation of bioactives in powders is a very attractive process both for the food industry and for the pharmaceutical industry (Turchiuli 2005). The dried product is generally more stable than its liquid form (Elversson 2005) and the formation of a barrier can ensure protection against oxygen, water and light (Turchiuli 2005).

Microencapsulation of vegetable oils can be an alternative to protect these materials against lipid oxidation by increasing their stability. There are many materials that can be used as encapsulating agents such as gums and polymers. Arabic gum is noted for presenting excellent emulsifying properties and is widely used for the retention and protection of oil (Jimenez 2006).

Because it is widely used, arabic gum (AG) was chosen in this work as a matrix for the encapsulation of green coffee oil (GCO). This vegetable oil presents a unique composition and previous studies showed an expressive antioxidant activity against lipid peroxidation (Kroyer 1989).

Some factors such as morphology and particle size can influence the manufacturing process such as the flow of powder (Walton 1999) and they can also interfere in the release and distribution of these systems (Elversson 2005).

Thus, the objective of this study was to produce microparticles containing GCO using arabic gum as a matrix, by the technique of spray drying and to study important characteristics of microparticles such as the morphology and thermal behavior. Possible interactions between the GCO and AG were evaluated by differential scanning calorimetry, DSC.

MATERIAL AND METHODS

Wall material AG was dissolved in water (1:2) under magnetic agitation on the day prior to drying.

Emulsions The emulsions were prepared with a mixture of matrix and GCO in concentrations of 10, 20 and 30%. An Ultra-Turrax stirrer (Turratec Te-102, Tecnal, Brazil) was used at 14.000 rpm for 5 min.

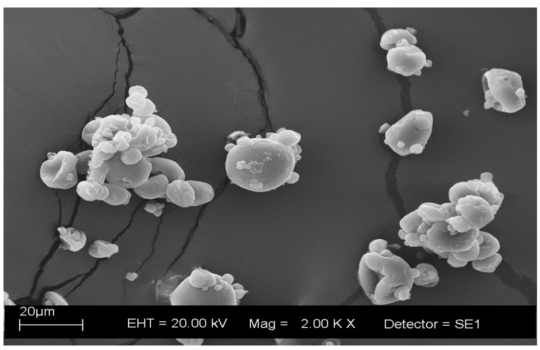
Encapsulation The drying process of the mixture was made using a laboratory scale spray dryer a model MSD 0.5 (Labmaq Ltda, Brazil). The emulsion was atomized by a pneumatic spray nozzle in the drying chamber and the microparticles were separated by a cyclone and collected in a flask. The following drying conditions were kept constant during the experiments: emulsion feed rate 6mL/min; drying air flow rate 1.25m^3/min; atomization pressure 6 bar, atomizing air flow rate 50mL/min; drying temperature 100^{o}C.

Morfology Microparticles morphology was observed by Scanning Electron Microscopy, SEM,using a microscope XL30-TMP NO (Phillips Co., Netherland).

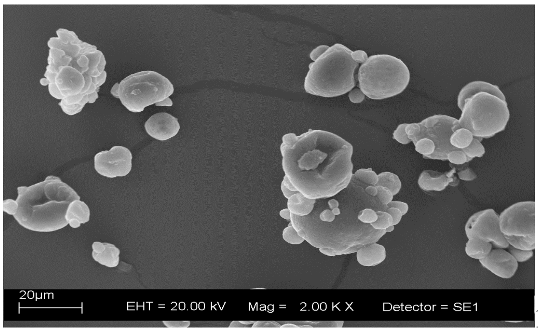
Thermal analysis The samples were placed in aluminum pans under a nitrogen atmosphere and heated to 420^{o}C at a rate of 10^{o}C/min. DSC measurements were performed using a DSC-50 (Shimadzu Corp., Japan).

RESULTS AND DISCUSSION

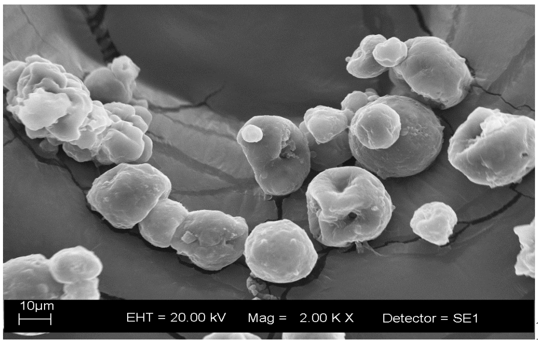
The preparation of microparticles by spray dryer was successful. Figure 1 shows SEM photomicrographs. They indicate that GCO was encapsulated by the AG within a typical morphology for microparticles, with a rounded outer surface, without cracks, fissures or pores allowing for greater protection of oil (Santos 2005; Trinidade 2000; Bertolini 2001). Some flat or concave surfaces observed are probably caused by shrinkage of the liquid drop due to rapidly moisture loss during the early stages of spray drying (Santos 2005). The morphology of the microparticles were similar for different concentrations of GCO (10% Figure 1a; 20% Figure 1b; 30% Figure 1c).



1a



1b



1c

Figure 1. SEM photomicrographs

The photomicrographs showed a possible increase in size of the microparticles as GCO concentrations increase, this event was also observed in previous studies (Elversson 2005).

Thermal analysis (Figure 2) showed endo and exothermic effects, where the first endothermic peak is likely associated with the water loss from functional groups of the polymer (Zohuriaan 2004). The second peak is characterized by an exothermic event featuring the degradation of arabic gum, which showed a shift in peak temperature when comparing AG to the microparticles. The peak degradation of AG occurs at 308°C while the thermogram of the microparticles showed degradation peaks at 303, 299 and 297°C for GCO contents of 10, 20 and 30%, respectively. These shifts in degradation temperatures are possible due to changes in molecular weight and polarity of the polysaccharide groups (Loss 2006).

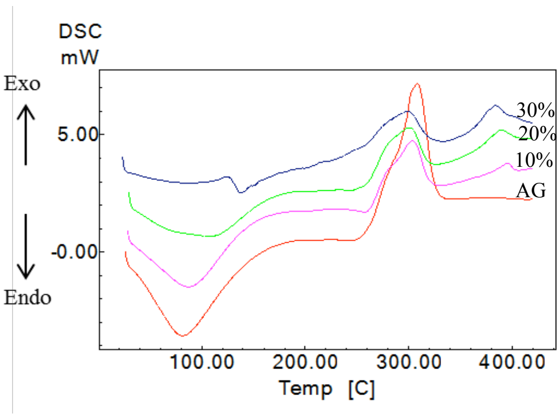


Figure 2. Differential scanning calorimetry

CONCLUSION

The spray dryer technique proved to be effective for the production of microparticles containing 10, 20 and 30% of green coffee oil. Arabic gum demonstrated excellent encapsulating properties, producing smooth surfaces, free of cracks or fissures, ensuring stability of the GCO.

Thermograms suggest interaction of arabic gum and green coffee oil, which led to a decrease in degradation temperarures and enthalpy variations.

The results estimulates further studies to evaluate other important parameters of spray drying, such as drying temperature and flow rate of dispersion atomization, as well as detailed analysis to verify the encapsulation efficiency and GCO stability.

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