MICROENCAPSULATION OF BURITI OIL USING CHICKPEA PROTEIN-PECTIN AND OXIDATIVE STABILITY

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RESUMO – Chickpea protein (CP) and chickpea protein – pectin (CP-HMP) were used to emulsify and microencapsulate buriti oil and the physical properties and oxidative stability of microcapsules were evaluated. Single layer and bilayer emulsions were homogenized at 300 bar and spray-dried at 180/70 ºC and 210/90 ºC. The microcapsules were stored at 20 ºC and 33% relative humidity, and the conjugated dienes were evaluated for 6 months. The microcapsules formulated with CP-HMP presented higher moisture and encapsulation efficiency than CP. The content of conjugated dienes in the oil remained constant after emulsification and spray-drying. The microcapsules presented an increase of conjugated dienes with storage time.

1. INTRODUÇÃO

There is a great interest in the use of protein-polysaccharide complexes to stabilize emulsions. Strong electrostatic complexes between proteins and ionic polysaccharides are formed at pH below the isoelectric point of the protein. According to Serfert et al. (2013), the stabilization of emulsions by protein and polysaccharide complexes can be carried out with a technic called layer-by-layer (bilayer), by sequential adsorption of protein and polysaccharide. Emulsion atomization can be used to encapsulate nutritional oils in an amorphous matrix, increasing the shelf life of the product. Studies demonstrated that bilayer emulsions were more stable to drying processes than single layer ones and their effectiveness to protect encapsulated oil against oxidation was proved (Gharsallaoui et al., 2010; Serfert et al., 2013).

The chickpea protein (CP) has high potential as emulsifying and encapsulating material and pectin is an anionic polysaccharide that is already widely used in the food industry. The buriti oil (Mauritia flexuosa) have high nutritional quality, with blood cholesterol-lowering properties. The nutraceutical fraction of buriti oil consists of tocopherols and carotenes, which have nutritional importance as antioxidants and pro-vitamin A (Aquino et al., 2012). In this context, the use chickpea protein to form a complex with pectin to emulsify and microencapsulate buriti oil by spray-drying can be interesting to obtain carotenoid-rich microparticles with high stability.

The aim of the present study was to use CP and CP-HMP in the emulsification and microencapsulation of buriti oil and to evaluate its oxidative stability during processing and storage of microcapsules, at 20 ºC and 33% relative humidity, for 6 months.
2. MATERIAL AND METHODS

2.1. Materials

Refined buriti oil was purchased from Beraca, Brazil. Chickpea protein (CP) was extracted from Kabuli chickpea. High methoxyl pectin (HMP) was obtained from Herbstreith & Fox, Germany and glucose syrup (GS) DE 38 (C*Dry 01934) from Cargill, Germany.

2.2. Methods

Chickpea protein extraction: The protein was extracted following Papalamprou et al. (2010) method and the CP composition was determined following the official methods of the AOAC (2016).

Preparation and spray-drying of emulsions: The single layer (CP) and bilayer (CP-HMP) emulsions were prepared according to the method described by Serfert et al. (2013). The emulsions at pH 3.5 were homogenized at 300 ± 50 bar using a high-pressure homogenizer (Panda 2K, Germany). In this pH, the surface charge of CP was 22.48 ± 0.99 mV and HMP was -11.90 ± 0.54 mV, which ensured the electrostatic interaction between the biopolymers. The final CP emulsion contained 10.0 wt% buriti oil, 1.59 wt% CP, and 33.41 wt% GS, whereas the bilayer emulsion additionally contained 0.5 wt% HMP. In all emulsions, the load of buriti oil and dry matter were fixed at 10 % and 45 %, respectively.

Spray-drying: The spray-drying of CP and CP-HMP emulsions was carried out on a pilot plant spray dryer (Mobile minor, Niro A/S, Denmark) at 180/70 ºC and 210/90 ºC inlet/outlet temperature operating at 2 bar. The moisture of microcapsules was measured according to AOAC (2016). To evaluate the encapsulation efficiency (EE), the non-encapsulated oil was extracted using petrol ether, then the EE was calculated considering the total oil content in the powder discounting the extracted oil.

Conjugated dienes: The oxidative stability of buriti oil, emulsions and microcapsules was evaluated by analyses of conjugated dienes, by spectrophotometry at 234 nm. The unpacked microcapsules were stored in the dark, at 20 ºC and 33% relative humidity, for 6 months.

3. RESULTS AND DISCUSSION

3.1. Characterization of biopolymers and evaluation of microcapsules

The CP extracted from chickpea grains presented 48.67 ± 0.17 % protein, 5.22 ± 0.01 % fat, 4.82 ± 0.33 % moisture, 6.72 ± 0.01 % ash, 13.58 ± 0.54 % fiber and 20.99 ± 0.23 % carbohydrate. The HMP presented a degree of methoxylation of 71.4% and galacturonan content of 75.6%.

The moisture and EE of microcapsules are presented in Table 1. The microcapsules formulated with CP-HMP presented higher moisture in relation to CP microcapsules. The
encapsulation efficiency of CP-HMP bilayer microcapsules was significantly higher than CP single layer microcapsules, which demonstrates that pectin assists CP in the oil encapsulation during spray-drying. The spray-drying temperature had no significant effect on encapsulation efficiency of microcapsules.

Table 1 – Moisture, encapsulation efficiency (EE), and conjugated dienes of spray-dried microcapsules formulated with CP or CP-HMP

| Sample           | Moisture (%) | EE (%)     | Conjugated dienes (mmol/kg oil) |
|------------------|--------------|------------|---------------------------------|
| CP 180/70°C      | 0.92 ± 0.13a | 86.66 ± 1.58a | 14.61 ± 0.96a                   |
| CP 210/90°C      | 0.81 ± 0.07a | 86.78 ± 1.51a | 13.88 ± 0.89a                   |
| CP-HMP 180/70°C  | 3.81 ± 0.17c | 98.03 ± 0.29b | 14.25 ± 1.00a                   |
| CP-HMP 210/90°C  | 2.86 ± 0.15b | 98.41 ± 0.17b | 13.39 ± 1.55a                   |

3.2. Oxidative stability of buriti oil

The conjugated dienes of buriti oil, emulsions and microcapsules were evaluated to investigate the influence of processing in the oil oxidation. Buriti oil presented 14.64 ± 0.22 mmol/kg oil of conjugated dienes and, according to Drusch et al. (2006), this high concentration is due to the thermal or chemical treatment during refining of the oil. The conjugated dienes of CP emulsion was 14.75 ± 0.45 mmol/kg oil and CP-HMP was 14.08 ± 0.15 mmol/kg oil. The conjugated dienes of microcapsules after spray-drying are presented in Table 1. The concentration of conjugated dienes in the buriti oil was not affected by processing and remained constant after emulsification and spray-drying (p < 0.05).

The oxidative stability of microcapsules is presented in Figure 1. All microcapsules presented a significative increase of conjugated dienes with storage time. There were no significant differences between the microcapsules evaluated.

Although the CP-HMP microcapsules presented higher EE, they also had higher moisture, which can result in the instability of microcapsule. This may be a reason why there were no differences between the four treatments.

4. CONCLUSIONS

The microcapsules formulated with CP-HMP presented higher moisture and EE than CP microcapsules. The buriti oil did not undergo oxidation during the processes of
emulsification and spray-drying. The microcapsules presented an increase in the content of conjugated dienes with storage time, but there were no differences among the four treatments evaluated. The oxidative degradation of buriti oil was very low, which demonstrates the effectiveness of the capsules.

Figure 1 - Conjugated dienes in microcapsules stabilized with CP or CP-HMP stored at room temperature and 33 % relative humidity.

5. REFERENCES

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