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Development of microparticles from biopolymer obtained from potato, carrot and chayote peel waste to be use in cosmetic formulations

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Introduction:

Micro and nanoparticulated systems have been widely used for a range of applications in pharmaceutical and cosmetic areas for their efficacy and ability to protect active ingredient against degradation [1]. Different types of materials are used in microparticles production such as vegetal compounds [2] due to of its availability in nature, biocompatibility, biodegradability and low toxicity [3,4]. An example of these materials is the starch. This compound is a biopolymer classified as polysaccharide constituted by amylose and amylopectin [5,6]. Then, starch can to product a viscous dispersion when exposed in heat water and to be used as carrier to actives compounds. In addiction starch is widely present in nature and in discarded vegetal peels such as potato, carrot and chayote in which can be used as material to production of microparticles loading actives used in cosmetics [6].

Materials & Methods:

1 Starch extraction (adapted from Vericimo, 2010 [7])

The vegetable peels were selected, washed, dried, and weighed in order to calculate the yield obtained from the process.

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The peels were immersed in an aqueous solution of Sodium Metabisulfite (0.2%) for 24 hours

⇩

After the period, the material obtained was strained and crushed.

⇩

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The obtained mass was vacuum filtered and the starch was separated from the water by decanting and dried in an air circulation oven at 60ºC for 20 hours

2 Process yield

⇩

$$\text{Yield (\%)} = 100 \text{ X } \frac{\text{IPM}}{\text{FSM}}$$

3 Characterization of starch ⇨ Determination of amylose content by spectrophotometry; Analysis by Fourier transfer infrared spectroscopy (FTIR); Scanning electron microscopy (SEM); pH analysis; and viscosity analysis.

4 Preparation of microparticles containing starch extracted from vegetable peels [8,9]

A dispersion of 0.1 g of starch in 10 ml of pure water.

⇩

The sample was stirred in a magnetic stirrer until the starch gelatinization was complete.

⇩

The dispersion was then co-precipitated in ethanol in a 1:2 ratio under magnetic stirring.

⇩

Thereafter, the sample was kept for 4h at room temperature under continuous mechanical stirring.

⇩

The precipitate obtained was centrifuged at 3000 rpm for 15 minutes.

5 Characterization of microparticle

Determination of particle size, zeta potential and polydispersity index; Scanning electron microscopy (SEM); Analysis by Fourier transform infrared region spectroscopic (FTIR).

6 Development O/W emulsion containing starch from vegetable peels

An oil-in-water (O/W) emulsion was developed using the universal method for preparing emulsions

Results & Discussion:

Power starch obtained from potato, carrot and chayote waste peels presented white, orange and green colors, respectively, and yield of 3.23%, 0.62% and 1.17%.

Figure 1: A- Starch potato; B- Starch chayote; C- Starch carrots.

The amylose concentration expressed in sample, constituted by the starch from three vegetable, was of 20.02 ± 0.094 µg.mL-1, and the percent amylose of 4.99%.In scanning electron microscopy analysis, samples were analyzed individually, to identify the presence, shape and size of starch extracted from different peels (Fig.2). The pH analysis showed a value of 5.48. For viscosity analysis, five starch dispersions were analyzed (Table 1). A gradual increase in viscosity was observed when the starch concentration was increased.

Microparticles were produced and presented lightly orange color due to beta-carotene presence from carrot.

Microparticles were produced and presented peak recorded in the 3660–3300 cm-1 range attributed to hydrogen-bonded O-H (-OH group of glycoside unit) stretching vibration. This data was found in spectrum of all vegetal species. Peaks for C-O stretching vibration were found at around 1000 cm-1 in all peels samples and in microparticles sample, however, in more concentration in potato sample. Peak for C=O bending vibration at 1622 cm-1 were also found in microparticles and specially in carrot and chayote peels samples (Fig.3).

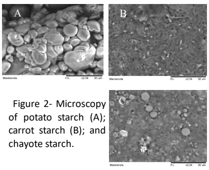

Figure 2- Microscopy of potato starch (A); carrot starch (B); and chayote starch.

Concentration (g)	Viscosity (Pa.s)
0,25	0,005
0,5	0,008
1	0,021
1,5	0,06
2	0,097

Table 1:Table of starch concentration in the sample and the viscosity of the samples.

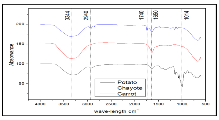

Figure 3 - Infrared spectrum of starch extracted from the peels.

The microparticles presented a zeta potential value of - 27.96 ± 1.0 mV, average particle size of 4494.37nm, PDI index of 0.2 and in the analysis of scanning electron microscopy they presented spherical shape. Fourier transfer infrared spectroscopy analysis showed peaks similar to those in the literature.

One O/W emulsion presented creamy aspect, lightly orange color and characteristic odor (Fig.4). The pH value found was of 5.76 and density of 0.97 g.ml-1 value.

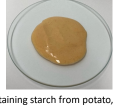

Figure 4: An O/W emulsion containing starch from potato, chayote and carrot peels

Conclusions:

Starch was obtained from vegetable peels waste, presented ability to production of micro and/or nanoparticles and to increase the viscosity in cosmetic formulations, being used as a thickener. In addition, beta-carotene presents in carrot peel offered antioxidant property to microcapsules and topical formulation. Therefore, the peel waste, besides presenting promising results, are also one important alternative to be used in cosmetic products, due to their low cost, contribution to waste elimination and reduced environmental impact.

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