Application of antioxidant nanoparticles based on starch and the phenolic compounds from propolis extract in jelly candies

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Abstract
Propolis has health-beneficial properties attributed to its phenol composition. However, this natural compound has low water solubility, strong taste, and aroma, limiting its food applications. Recently, starch nanoparticles have been used to stabilize bioactive compounds like propolis. This research aimed to produce starch nanoparticles by anti-solvent precipitation and to apply these nanomaterials as natural additives in jelly candies. Starch nanoparticles based on cassava and potato starches were produced by anti-solvent precipitation. It was observed that the phenolic compounds from propolis extract can be stabilized during the production of starch nanoparticles, in this way, approximately 55% of phenolic compounds from propolis extract were loaded on the starch nanoparticles. The starch nanoparticles containing the phenolic compounds from propolis were characterized by antioxidant capacity, particle size distribution, water activity, and chemical bonds (Fourier-transform infrared spectra, FTIR). All starch nanoparticles had values oscillating between 15 and 18 g of gallic acid equivalent per g of propolis, indicating that these nanostructures have high antioxidant properties. Furthermore, all starch nanoparticles had particle sizes lower than 1000 nm and low water activity (< 0.4), suggesting that these materials can be considered as having high chemical and microbiological stability. FTIR spectra revealed that the phenolic compounds interact with the starch nanoparticles by means of hydrogen bonds. Jelly candies added of starch nanoparticles (1 and 2 %w/w) containing the phenolic compounds of propolis were well dispersed and they imparted a brown color to the food systems. The jelly candies containing the starch nanoparticles displayed antioxidant activity, this property can be preserved when the jelly candies were stored at a low temperature and relative humidity. This research reports for the first-time information regarding the application of starch nanoparticles containing the phenolic compounds of propolis in food systems.

Keywords: Bioactive compounds, nanoparticles, starch, gelatin.