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Preparation and characterization of chitosan biomembranes loaded with natural polyphenols from fruit peels and waste steams

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Abstract – Chitosan biomembranes loaded with natural polyphenols isolated from cramberry (*Vaccinium oxycoccos*) presscake and pomegranate (*Punica granatum*) peels have been developed as a novel device for the controlled release of these well known phytonutrients. Characterization of biomembranes loaded with polyphenols was performed by physical (swelling behavior), thermal (DSC), morphological (SEM) and crystallographic (XRD) analysis, as well as the release properties of polyphenols from the biomembrane matrix. Results suggest that chitosan biomembranes are a suitable system for controlled release of natural polyphenols.

Polyphenols are found in large quantities in strawberries, blueberries, grapes, cranberries, green tea and certain types of non-traditional agricultural products such as mangosteen, rambutan or pomegranate. There are two groups of polyphenols: hydrolyzable tannins (HT) and proanthocyanidins (PAC). Consumption of foods, beverages and nutritional supplements that contain natural polyphenols is associated with decreased risk of diseases which have an inflammatory, oxidative and microbial adherence etiology, such as urinary tract infections, cardiovascular disease or cancer [1, 2]. The established safety of these phytopharmaceuticals which are showing good clinical activity has infused a great interest in industry and academia alike. The challenge now is to incorporate these promising molecules into dosage forms that will standardize their usage for prevention and therapy of diseases [3].

Natural polyphenolic fractions were isolated from cranberry presscake (PAC) and pomegranate peels (HT) obtained form fruit processing waste streams, according to previously described protocols [1, 2, 4]. Chitosan-polyphenol composite biomembranes were obtained by dissolving chitosan in acetic acid 0.5% v/v and mixing under stirring with each of the polyphenolic extracts, at a final concentration of 10% v/v, for 30 min. Composite mixtures were poured into a glass mold, dried at room temperature overnight and storage in a desiccator for further characterization. Polyphenols release from the biomembrane matrix were conducted with and with out the addition of a cross-linking agent (glutaraldehyde 0.10% v/v).

Results suggest that addition of polyphenols into chitosan matrix modifies thermal behavior (Fig. 1), surface morphology (Fig. 2) and swelling properties of the biomembranes. Release studies indicate that cross-linked chitosan biomembranes are a suitable controlled release system for natural polyphenols (Fig. 3).

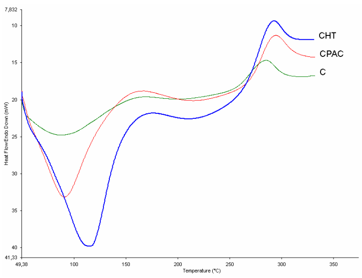

Figure 1. Differential scanning calorimetry (DSC) thermograms for chitosan (C), chitosan-proanthocyanidins (CPAC) and chitosan-hydrolizable tannins (CHT) biomembranes.

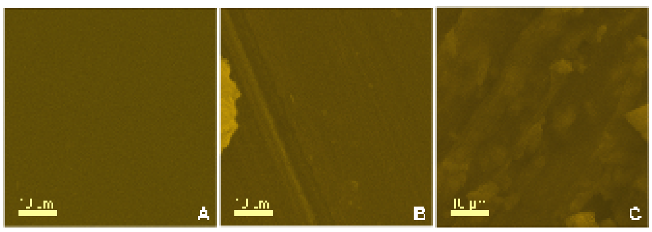

Figure 2. Scanning electron (SEM) micrographs for chitosan (A), chitosan-HT (B) and chitosan-PAC (C) biomembranes. Scale bar represents 10 µm.

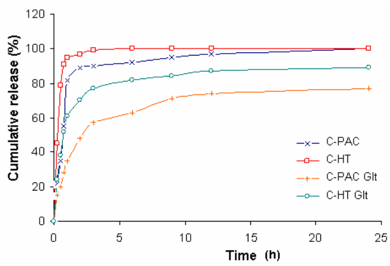

Figure 3. Polyphenols cumulative release from chitosan biomembranes (C-PAC and C-HT) with and without coss-linking with glutaraldehyde (Glt).

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