EFFECT OF FLAXSEED–BASED HYDROGEL COMPOSITION ON MECHANICAL PROPERTIES OF EXTRUDED MICROSPHERS

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ABSTRACT

Encapsulating probiotics within hydrogels is a promising approach to enhancing their protection and stability. Mechanical properties and structural integrity of hydrogels play a crucial role in maintaining carrier functionality during processing and application. In this study, the mechanical properties of hydrogels based on flaxseed cake, alginate, and pectin were investigated, together with the effect of fermentation on their strength. Probiotics were immobilized by the extrusion technique, producing seven types of spherical particles (alginate-pectin, alginate-pectin-flaxseed, alginate-flaxseed, different ratios, and alginate-flaxseed mucilage different ratios) with an average diameter of approximately 2.8 mm. Results showed that the addition of pectin to alginate improved the mechanical properties of hydrogels more than the addition of flaxseed cake or flaxseed mucilage, while the optimal composition was achieved with a flaxseed mucilage to alginate ratio of 35:100. Increasing alginate concentration in flaxseed mucilage reduced hydrogel firmness from 0.525 to 0.120 N. Fermentation affected particle strength differently depending on hydrogel composition, indicating a strong influence of fermentation on hydrogel structure and intermolecular interactions among components. Fermentation caused a pronounced weakening of alginate-pectin hydrogel from 0.622 to 0.229 N (63% reduction in firmness), indicating substantial disruption of its gel network, while alginate-flaxseed showed improved structural integrity after fermentation from 0.279 to 0.470 N, suggesting greater matrix tolerance or even reinforcement under fermentation conditions. These findings highlight the importance of formulation design and fermentation in tailoring hydrogel properties for probiotic immobilization and suggest significant potential for developing stable, functional delivery systems.

Keywords: encapsulation, alginate, pectin, probiotic, flaxseed cake.