Title Diffusivity of propolis compounds in Polylactic acid polymer for the development of anti-microbial packaging films

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Citation Journal of Food Engineering, Volume 98, Issue 3, June 2010, Pages 294-301

Keywords Propolis; Polylactic acid; Diffusion kinetics; Mathematical models

Abstract

A major research gap is the lack of packaging materials that can provide the release of active compounds at rates suitable for a wide range of food packaging applications. For this reason an anti-microbial/antioxidant release system for food packaging applications was realized by incorporation of propolis into Polylactic acid (PLA) film. The composition of the films was modified by adding polyethylene glycol (PEG) and calcium bentonite (CB) to the initial PLA casting solution; dispersed structures in fact open the molecular network and increase migration rates. The presence of the anti-microbial compound is required essentially at the food surface where the microorganisms are numerous and where they are intended to grow. The diffusivity of four polyphenols was measured in water and ethanol as food simulating liquids (FSL) and the concentration of additives at the interface PLA/Food Simulant was calculated using Fickian models. The external mass transfer coefficient at the interface polymer/FSL could be neglected (with *Bi* number higher than 200). This is due to the low diffusivity values of propolis polyphenols in the PLA matrix ($0.03–0.83 \times 10–13$ m^2/s) which lead to a predominant internal mass transfer phenomenon compared to the external one in the system PLA/water. The concentration at interface at equilibrium was different for each substance and depended of the thermodynamical parameter *K*. Such a delivery system for direct contact with liquid aqueous medium would be a very efficient delivery system because some active agents (polyphenols acids) would be released in relevant quantity in the food whereas others (flavonoids) would remain in the polymer to act at the polymer/food interface.