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Properties of a new protein film from bitter vetch (*Vicia ervilia*) and effect of $CaCl_2$ on its hydrophobicity

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ABSTRACT

This work was aimed to investigate the potential preparation of an edible film from bitter vetch seed proteins. The film was cast from bitter vetch protein concentrate (BPC) and glycerol. $CaCl_2$ at the ratio of 0.1–1% (w/w) of the BPC was tested to improve film properties, specially its hydrophobicity. Some physicochemical properties of the films obtained in the absence and presence of $CaCl_2$ were evaluated. The results indicated that moisture content, total soluble matter, water vapour permeability and contact angle of the films prepared in the presence of $CaCl_2$ were significantly modified in comparison with the control values, while their mechanical properties did not significantly change. The surface morphology of the films was also considerably affected by the presence of $CaCl_2$. Therefore, $CaCl_2$ could improve BPC-films barrier properties especially their hydrophobicity, even though calcium concentration seems to be a crucial factor.

1. Introduction

Packaging is an useful methodology for protecting food from environmental conditions and mechanical stress. The wide range of materials usually used for packaging can be divided into synthetic and biodegradable [1–3]. Synthetic materials have certain good properties for food packaging, being flexible, light and effective as water vapour barrier. However, they are quite permeable to gases, and a number of low molecular weight compounds used in their preparation can migrate to food stuffs [4]. Since most synthetic materials are non-biodegradable and cause environmental pollution, in recent years biopolymers including polysaccharides, proteins and lipids have been intensively considered as potential sources of edible/biodegradable film [4–8]. Generally, protein-based films are good gas barrier and exhibit mechanical properties comparable with the ones of the films made by polysaccharides and lipids. Therefore, proteins from different origin have been widely used to form several edible/biodegradable films [9–13].

The *Vicia* genus is a legume with about 160 species distributed throughout temperate regions of Europe, western and central Asia, north Africa and the America [14–16]. Bitter vetch (*Vicia ervilia*) is an important annual *Vicia* genus cultivated for forage and seed yield. *Vicia* seed protein content range from 20.1 to 32% [15]. In particular, bitter vetch (*V. ervilia*) seeds, with up to 25% of protein, are a good and inexpensive source of both protein and energy [17]. Thus, proteins from bitter vetch seeds might represent an affordable alternative protein source to produce synthetic films for food application.

The majority of protein-based films, due to inherent hydrophilic properties, are highly permeable to water vapour. The presence of some additives, such as the hydrophilic plasticizers, in the film forming solution may increase this property [18]. In addition, a number of physical, chemical and enzymatic treatments have also been suggested to improve the water vapour permeability and the mechanical properties of various protein-based films [6,13,18,19].

Glutamic and aspartic acids, lysine, arginine and leucine are the major amino acids occurring in bitter vetch seeds which, conversely, are deficient in the sulfur amino acids methionine and cysteine [15,17]. Since acidic amino acids are dominant, the moisture barrier properties of bitter vetch protein-based films might be improved by cross-linking agents such as calcium salts.

Calcium chloride addition was demonstrated to improve biopolymer cohesion, since Ca^{2+} can act as a firming agent favoring electrostatic interactions between two adjacent carboxylic groups [20]. Thus, we hypothesized that they may improve molecular cohesion and, at the same time, influence both barrier and hydrophobic properties of the bitter vetch protein-based films.

Despite many researches carried out on protein-based films, no information is available about bitter vetch seeds as protein source to produce films for packaging applications. The objective of

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