Characterization of Soybean Protein Concentrate—stearic Acid/Palmitic Acid Blend Edible Films

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Received 16 July 2009; accepted 7 July 2011
DOI 10.1002/app.35188
Published online in Wiley Online Library (wileyonlinelibrary.com).

ABSTRACT: The effect of incorporating commercial stearic acid/palmitic acid blend (SA/PA, 63/37 wt %) into hydrophilic soybean protein concentrate (SPC) film-forming solutions at neutral and alkaline pH on some selected properties of edible cast films was investigated. SA/PA-added SPC film exhibited a significant increase in translucency, being more relevant for films obtained at pH 7. This was associated with the more heterogeneous morphology of such films as observed by scanning electron microscopy. Calorimetric measurements and X-ray diffraction studies confirmed the presence of crystalline fatty acids in films at pH 7 and new crystalline structures at pH 10 due to interactions or reactions between SPC and SA/PA blend. Fourier Transform infrared spectroscopy results confirmed the incorporation of fatty acids into SPC and revealed the occurrence of interactions between both components, depending on the film-forming emulsion pH. Moisture absorption isotherms at high relative humidity (RH) were determined and experimental data were adequately fitted by Peleg’s empirical equation. Control SPC films produced at pH 7 were distinctly more moisture resistant than those at pH 10 owing to the more charged protein molecules at alkaline pH. The increased moisture resistance of SA/PA-added-SPC film at pH 10 was related to the more homogeneous dispersion of fatty acid particles within the protein matrix. © 2011 Wiley Periodicals, Inc. J Appl Polym Sci 000: 000–000, 2011

Key words: biodegradable; soybean protein concentrate; edible films; differential scanning calorimetry; X-ray diffraction

INTRODUCTION

Polymers from biomass, such as proteins, carbohydrates and lipids have received considerable research attention as potential substitutes for certain conventional polymers in domains where derivatization from natural resources and environmentally sound disposability provide added value. Proteins represent one of the cheapest and most abundant biological feedstocks available in large quantities, and their use as starting materials offers numerous advantages, such as low toxicity and inherent biodegradability.1

Soybean proteins have been used to fabricate edible and environmentally sound films and coatings due to their film-forming ability, excellent gas barrier properties at low relative humidity, low cost, biogenic origin, and worldwide availability.2–8 Soy beans are grown predominantly in North and South America where 33 and 49%, respectively, of the 2007/2008 world bean supply was harvested. Argentina is the third soybean producer (54 million tones 2009/2010) behind USA and Brazil9 and most of the current production is intended for oil production for export (about 7.5 million tones in 2009/2010). The recycle of the soybean oil industry residue may result in the development of economically feasible new industrial products with more added-value. This in turn will give much return to agriculture, thereby reducing the burden of petroleum-based products.

Many different soy protein grades are commercially available such as defatted soy flour containing about 50% protein, soy protein isolates (SPI)2 containing about 90% protein and soy protein concentrate (SPC) which is commercially obtained by removing the soluble sugars from defatted flour, being the remaining protein (about 65–70%) and insoluble carbohydrates.10

Based on ultracentrifugal sedimentation rates, protein fraction in SPC can be classified into four categories: 2S, 7S, 11S, and 15S, being 7S and 11S the largest and most important fractions corresponding to two globular storage protein fractions β-conglycinin (7S) and glycinin (11S). The globulin 7S is a trimer formed by four subunits with similar aminoacidic