DEVELOPMENT AND CHARACTERIZATION OF BIOACTIVE *B*-LACTOGLOBULIN NANO-HYDROGELS FOR FOOD APPLICATIONS

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INTRODUCTION

Whey proteins produced during bovine cheese manufacture, or membrane fractionation of bovine milk account for increasingly valuable food ingredient – owing to their nutritionally-balanced composition in amino acid residues coupled with their functional properties (e.g. solubility, and gel-forming, emulsifying and foaming features)[1]. β-Lactoglobulin (β-Lg) is the major fraction of bovine whey proteins (i.e. 50 wt%), and a primary gelling agent; it is stable at low pH and highly resistant to proteolytic degradation in the stomach, besides its ability to act as encapsulating agent[2].

OBJECTIVE

The objective of this work was to understand the kinetics of aggregation during heat treatment, under narrow pH ranges, that leads to the formation of edible β-Lg nano-hydrogels as well as to rationalize the contribution and importance of covalent and noncovalent interactions to maintain the structure thereof. Furthermore, the ability of said nano-hydrogels to encapsulate bioactive compounds (e.g. vitamins) was also assessed.

MATERIALS AND METHODS

In this study, aqueous dispersions of β-Lg were accordingly produced, and formation of stable β-Lg nano-aggregates was ascertained after heating at different temperatures (i.e. 75, 80 and 85 ºC), for different holding periods (i.e. 5, 10 and 20 min) and under different pH values (i.e. 4, 5, 6 and 7); particular emphasis was on pH 6.0. The protein aggregates formed were characterized for stability (turbidity), role of covalent or non-covalent bonds, surface hydrophobicity, morphology, size, surface charge, and content in accessible thiol groups.

RESULTS

Stable dispersions of β-Lg nano-hydrogels were obtained at pH 6, corresponding to an aggregation yield of ca. 65, 77 and 92%, at 75, 80 and 85 ºC, respectively – for a holding period of 20 min. Such structures were characterized by particle size between 100 and 160 nm, low degree of polydispersity (<0.2), and an association efficiency of vitamin B_2 above 50%. Their ζ-potential varied from +20 to -40 mV, depending on pH. Nano-hydrogels obtained at pH 5 displayed a lower content of accessible thiol groups as compared to those obtained at pH values above or below. For pH between 4 and 5, large sedimenting protein particulates were obtained, whereas soluble aggregates were formed at pH values outside that range.

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