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Extraction and Characterization of Gelatin from Bovine Heart

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Objectives

Gelatin is extracted by partial hydrolysis of the intermolecular and intra-molecular bonds of collagen and is widely used in the cosmetic, food and pharmaceuticals industries. Generally gelatin is extracted from collagen in animal tissues with heat which results in low yields but the enzyme pepsin may increase gelatin yield. Bovine heart (BH) which consists mainly of type I collagen can be a potential source of gelatin. This study was aimed to extract gelatin from BH with heat and subsequently with pepsin to assess potential increases in yield and characterize and compare the quality of the extracted gelatin to evaluate functionality.

Materials and Methods

Connective tissue (CT) from BH was isolated by blending BH in deionized (DI) water and then collecting CT on a metal sieve. This was repeated twice and blotted dry by filter paper. BH gelatin was extracted first at 80°C for either 4 or 6 h from collected CT and the CT residue subsequently digested with pepsin at either 100 or 200 mg pepsin/g CT residue. Resulting gelatins were characterized for functionality by testing gel strength, viscoelastic properties and molecular weight (MW) distribution. The characteristics of heat extracted BH gelatins were examined for the effect of duration of heating at 80°C using the Statistical Analysis System (SAS Inst. Inc., Cary, NC) with a one-way ANOVA using PROC GLM. The sole source of variation was heating duration (4 or 6 h), and mean differences were determined using ANOVA. For pepsin-extracted gelatins, the effect of pepsin concentration and duration of heating were determined using a two-way ANOVA with prior heating time (4 or 6 h) and pepsin concentration (100 or 200 mg) and their interaction as fixed sources of variation. Mean differences were determined using Tukey's Honest Significant Difference.

Results

Heat- followed by pepsin-extraction of BH yielded about 7.5 and 11.5-fold more gelatin than 4 h heat extraction of BH at 100 and 200 mg pepsin/g CT, respectively, and about 7.0 and 7.5-fold more than 6 h heat extraction of BH at 100 and 200 mg pepsin/g CT, respectively. Protein was the major proximate component of BH gelatin and trace amounts of crude fat and ash indicating high quality. The gel strength of heat-extracted BH gelatin did not differ between 4 and 6 h of extraction period but poor in pepsin-extracted gelatin and highest for gelatin extracted with 100 mg pepsin/g CT regardless of whether it had been previously heated for 4 or 6 h. Gelling and melting temperatures of heat-extracted BH gelatin were about 25 and 33°C, respectively, with pepsin-extracted gelatin showing the lowest gelling and melting temperatures. Frequency sweep tests showed that both heat- and pepsin-extracted BH gelatins were frequency independent. Heat-extracted BH gelatin gels showed numerically higher storage moduli than pepsin-extracted BH gels which indicated heat-extracted gelatin gels were more stable and stronger than pepsin-extracted gels. Heat-extracted BH gelatin contained predominantly γ, β, and α chains with some low MW peptides not lower than 37 kDa, while the pepsin-extracted gelatin were characterized by a comparative decrease in β and α chains and increased low MW peptides.

Conclusion

Results indicated that BH is a potential source of gelatin for application in diverse applications and use of pepsin is a viable method of extracting additional gelatin after heat extraction, but that increasing gelatin yield with pepsin was at the expense of gelatin quality.