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Optimization of physico-chemical properties of gelatin extracted from fish skin of rainbow trout (*Onchorhynchus mykiss*)

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ABSTRACT

Physico-chemical properties of gelatin extracted from rainbow trout (*Onchorhynchus mykiss*) skin were optimized using response surface methodology (RSM). Central rotatable composite design was applied to study the combined effects of NaOH concentration (0.01–0.21 N), acetic acid concentration (0.01–0.21 N) and pre-treatment time (1–3 h) on yield, molecular weight distribution, gel strength, viscosity and melting point of gelatin. Regression models were developed to predict the variables. Predict values of multiple response at optimal condition were that yield = 9.36%, α_1/α_2 chain ratio = 1.76, β chain percent = 32.81, gel strength = 459 g, viscosity = 3.2 mPa s and melting point = 20.4 °C. The optimal condition was obtained using 0.19 N NaOH and 0.121 N acetic acid for 3 h. The results showed that the concentration of H^+ during pre-treatment had significant effect on molecular weight distribution, melting point and gel strength. The concentration of OH^- had significant effect on viscosity and for extraction yield, pretreatment time was the critical factor.

1. Introduction

Gelatin is functional gelling protein bio polymer, widely used in many industrial fields, such as food, material, pharmacy and photography, especially in the food and pharmaceutics industries for its unique chemical and physical properties (Yang et al., 2007). About 95% of commercial gelatins are derived from mammalian sources, mainly pig skin and cow hide and the remaining part, about 5% comes from bones of porcine and bovine, but for many socio-cultural reasons alternative sources, like fish skins, are highly demanded especially in halal and kosher food markets. Use of fish skin as an excellent raw material is interesting in the preparation of high-protein foods, beside helping to eliminate harmful environmental aspects and improve quality in fish processing. Since gelatin is derived from denatured collagen, its properties for a particular application is greatly influenced not only by the species or tissue from which it is extracted, but also by the extraction process, which may depend on pH, temperature, and time during both pre-treatment and extraction process (Gómez-Guillén and Montero, 2001). So far fish gelatin has known limited application because the gels formed, tend to be less stable and to show weak rheological properties compared to gelatins extracted from land mammals. This has been largely related to a lower content of the imino acids proline and hydroxyproline in cold-water species, than in warm blooded animals (Norland, 1990). Although collagen from cold-water fish species normally contains less imino acids than collagen from warm water fish species and mammalians, the contents of amino acids as well as other properties such as molecular weight distribution and gelatin viscosity, seem to be species specific (Gómez-Guillén et al., 2002; Gudmundsson, 2002; Johnston-Banks, 1990). However, fish gelatin from cold-water fish species is still preferred due to the greater availability of by-products (i.e. skin and bone) from which it can be manufactured (Haug et al., 2004). Many fish species have been investigated as raw materials for gelatin extraction and the properties of gelatin obtained from these sources have also been examined. There are, however, limited studies using formal optimization procedures for gelatin extraction, which is an important tool for understanding how processing conditions affect the final product and for being able to get products with desired characteristics. Rainbow trout skin was chosen as the raw material for this project for several reasons. First, very few studies have been done on gelatin extraction from trout species. Second, the total world production of trout and it is commercial harvest is increasing in parts of the Caspian Sea. Thus, trout species especially rainbow trout are harvested in sufficient quantity for them to have the commercial potential for gelatin production. Rainbow trouts are usually processed into skinless fillets (mainly for gefilte fish, a European Jewish fish ball-like product), so there is an abundant quantity of raw skins available. Here, optimization of the gelatin extraction procedures and a study on the properties of rainbow trout skin gelatin could be helpful in

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