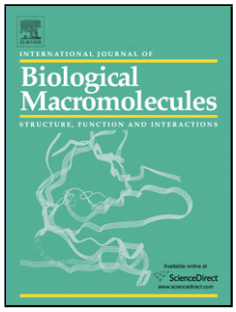

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A comparative study of the properties and self-aggregation behavior of collagens from the scales and skin of grass carp (*Ctenopharyngodon idella*)

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Abstract

Collagens were extracted from the scales and skin of *Ctenopharyngodon idella* (*C. idella*) as raw materials using an acid-enzyme hybrid method. The structural properties of the extracted collagens were compared using ultraviolet-visible spectrophotometry, Fourier transform infrared spectroscopy, sodium dodecyl sulfate-polyacrylamide gel electrophoresis, and differential scanning calorimetry. Additionally, the *in vitro* self-aggregation behaviors of the two types of collagens (fish skin- and scale-derived collagens) were compared using turbidimetric assays, aggregation assays, and scanning electron microscopy (SEM). The results showed that both types of extracted collagen were typical type I collagen with two α chains and intact triple-helical structures. The denaturation temperatures of the collagens from fish scales and skin were 34.99 °C and 39.75 °C, respectively. Both types of collagens were capable of self-aggregation in neutral salt solution at 30 °C, with aggregation degrees of 28 % and 27.33 % for the scale and skin collagens, respectively. SEM analysis revealed that both types of collagens could self-aggregate into interwoven fibers, and the fish scale-derived collagen had a more pronounced reticular fiber structure with a striped periodic D-band pattern of collagen fibrils, whereas the collagen fibers from the self-aggregation of fish skin-derived collagen had a certain degree of disruption without any D-band pattern.

Keywords: Collagen; Skin of *C. idella;* Scales of *C. idella;* Self-aggregation

1. Introduction

Collagens are abundant proteins in animals and present in all multicellular animals. Due to contain a helical fibrous domain consisting of three α peptide chains (α chains), collagens have unique and genetically conserved structures [1]. So it has been widely applied in various fields, including as biomedical materials and drug delivery vectors and in tissue engineering applications, cosmetics, and foods [2].

Currently, there are two main methods for extracting collagens from fishes. The first is the acid hydrolysis method. Collagens are structural proteins in the extracellular matrix (ECM) and have a fibrous structure and relatively poor solubility in aqueous solution, but they can be easily dissolved in an acidic medium. Hence, acid solutions are often used for extraction during collagen preparation. In this method, the pre-processed fish skin is swollen by adding an appropriate amount of acetic acid, citric acid, or lactic acid, and the skin is then homogenized to obtain a crude extract of fish skin-derived collagen. Then, the crude extract is mixed and filtered to obtain the collagen [3]. Chuaychan [4] and Hu [5] prepared fish-derived acid-soluble collagen (ASC) using organic acids as solvents. In

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