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Nile perch collagen and gelatin extraction and physico-chemical characterisation

By

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DEDICATION

To Alinda, Atiila, Faith and Birah Muyonga, the four ladies who give me reason to keep going.

DECLARATION

I declare that the thesis which I hereby submit for the degree PhD (Food Science) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at another University or institution of higher education.

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ABSTRACT

Nile perch collagen and gelatin extraction and physico-chemical characterisation

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Nile perch (*Lates niloticus*) is the most dominant fish species in Uganda, accounting for approximately 46% of all the fish landed. Industrial processing of Nile perch is estimated at 60,000 metric tonnes per annum, but processing waste, which represent approximately 50% of the raw material are under-utilised. This investigation was aimed at extracting and characterising collagen and gelatin from Nile perch waste in order to establish the potential of using these materials as sources for collagen and gelatin.

Acid soluble collagen (ASC) was extracted from young and adult Nile perch skins using 0.5 M acetic acid and precipitated using 0.9 M NaCl. The ASC yield, on dry basis, was 63.1 and 58.7%, respectively for young and adult fish skins while no collagen could be solubilised from bones of young and adult Nile perch by 0.5 M acetic acid. The skin collagens were found to consist of two alpha components (α1 and α2). Their imino acid content (19.3 and 20.0%, respectively for young and adult fish) and denaturation temperature (36°C) were higher than for most fish species. This confirmed that the imino acid content of collagen is a key determinant of the denaturation temperature of collagen. Fourier transform infrared (FTIR) spectroscopy showed a higher degree of molecular order in ASC from adult than from young Nile perch. This suggested a higher incidence of intermolecular crosslinks in adult Nile perch ASC.

Type A gelatins were extracted from skins and bones of young and adult Nile perch perch. Skins gave higher gelatin yield, higher 50°C extractability and skin gelatins generally exhibited superior functional properties to bone gelatins. Bone and skin gelatins had similar amino acid composition, with a total imino acid content of about 21.5%. Sodium dodecyl sulphate polyacrylamide gel electrophoresis revealed that skin gelatins had a higher content of polypeptides larger than β-chains (~200 kD) compared to bone gelatins. The functional properties of the gelatins were found to be correlated to the molecular weight distribution, with the >β fraction contributing positively to functional properties while the <α fraction contributed negatively. Passing gelatin extract through a column of activated carbon eliminated the fishy odour.

Forier transform infrared spectroscopy indicated that denaturation of collagen to gelatin leads to loss of molecular order and that the later gelatin extracts, derived from the more crosslinked collagen, possess higher molecular order than earlier gelatin extracts.

In general, the results showed that Nile perch skins and bones have potential for supplementing mammals as sources of gelatin. There is also potential of exploiting Nile perch skin as source of acid soluble collagen. It was also shown that there are no marked age-related changes in Nile perch collagen solubility as well as gelatin extractability and properties, probably because there is minimal development of mature crosslinks with animal age, in Nile perch collagen.

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