SHORT COMMUNICATION

Proximate composition, amino acid and fatty acid composition of fish maws

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Fish maws are commonly recommended and consumed in Asia over many centuries because it is believed to have some traditional medical properties. This study highlights and provides new information on the proximate composition, amino acid and fatty acid composition of fish maws of Cynoscion acoupa, Congresox talabonoides and Sciades proops. The results indicated that fish maws were excellent protein sources and low in fat content. The proteins in fish maws were rich in functional amino acids (FAAs) and the ratio of FAAs and total amino acids in fish maws ranged from 0.68 to 0.69. Among species, croaker C. acoupa contained the most polysaturated fatty acids, arachidonic acid, docosahexaenoic acid and eicosapentenacnioc acid, showing the lowest value of index of atherogenicity and index of thrombogenicity, showing the highest value of hypocholesterolemic/hypercholesterolemic ratio, which is the most desirable.

Keywords: fish maw; proximate composition; amino acids; fatty acids

1. Introduction

Fish maw, the dried swim bladders of fish, is one of the four sea treasures (abalone, sea cucumber, shark fin and fish maw) in Chinese cuisine. Fish maws are commonly recommended in Asia over many centuries because they are believed to have some traditional medical properties, as tonics for people recovering, attempting to ward off illness and for women after child delivery (Lin 1939; Sadovy & Cheung 2003; Clarke 2004). Fish maws are mainly produced from croakers, catfish and eels, but maws from croakers are the most highly priced (Clarke 2004). Currently, the chemical composition of fishery products has being been widely

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investigated to analyse their nutritional quality (Jabeen & Chaudhry 2011; Careaga et al. 2013; Murillo et al. 2014). As far as we know, there is no published data on the nutritional quality of fish maws. Therefore, the objectives of this work were to analyse and compare the proximate composition, amino acid and fatty acid composition in dried products of commercial maws from three fish species, and to compare such values with the recommendations provided by authorities to elucidate their nutritional values to consumers.

2. Results and discussion

2.1. Proximate compositions

Proximate compositions are shown in Table S1. Among the three species studied in this work, crude protein content was the highest in Cynoscion acoupa. The fat contents of C. acoupa and Sciades proops were lower than the content of Congresox talabonoides. In previous studies, similar results were found in fish muscles. The fat contents of the Brazilian and Panama marine fish fillets were 1.05–9.03% and 1.81–3.74%, respectively (Fernandes et al. 2014; Murillo et al. 2014). The fat content of the eel C. talabonoides muscle from Bengal was 0.51% (Bhuiyan et al. 2006). According to their fat content, all three species were classified as lean fish (Ackman 1990). Crude ash content was lowest in C. acoupa. The results indicated that fish maws were excellent protein sources and low in fat content.

2.2. Amino acid profiles

The amino acid profile of fish maws is presented in Table S2. The most abundant amino acids in all of them were glycine, proline, glutamic acid, alanine and arginine. These amino acids constituted 64.8–67.1% of the total amino acids (TAAs). Glycine was the most abundant amino acid found in all three species, and these values were significantly higher than those reported for fish muscle (Chalamaiah et al. 2012). Glycine, proline and arginine play an important role in metabolic regulation, anti-oxidative reactions and neurological function. Thus, these nutrients have been used to prevent tissue injury, enhance anti-oxidative capacity, promote protein synthesis and wound healing, and improve immunity to various inflammatory diseases (Wu 2013).

The essential amino acids scores are presented in Table S3. When compared to the reference amino acid pattern of adults, threonine, phenylalanine + tyrosine and tryptophan had the highest scores in fish maws. Isoleucine and leucine were found to be the first limiting amino acids. When compared to the reference amino acid pattern of pre-school children, all of the amino acid scores were <100, except for threonine. However, based on the evidence from animal and human studies, Wu (2010) proposed the new concept of functional amino acids (FAAs), which hold great promise in prevention and treatment of metabolic diseases. The ratio of FAA and TAA in fish maws ranged from 0.68 to 0.69, and no significant difference was found between fish maw species. Therefore, the proteins in fish maws were rich in FAAs. This is a good explanation as fish maws were widely utilised as a traditional tonic and remedy in Asia (Clarke 2004).

2.3. Fatty acid profiles

The profiles of fatty acids are given in Table S4. The profiles of fish maws were dominated by saturated fatty acids. Palmitic acid and stearic acid were the dominant saturated fatty acids, while oleic acid was the main monounsaturated fatty acid. The principal n-6 polyunsaturated fatty acid (PUFA) was arachidonic acid (AA), the values were higher than those reported in fish muscles (Murillo et al. 2014). AA and its metabolic products play important roles in orchestrating immunity and inflammation (Sergeant et al. 2012). Docosahexaenoic acid (DHA) and eicosapentanomiacnolic acid (EPA) are beneficial to human health. In this work, DHA was the
primary \( n \)-3 PUFA, followed by EPA. In fact, the most abundant fatty acid in different species of fish muscle was DHA (Fernandes et al. 2014; Murillo et al. 2014). Among the maws from three fish species in this work, croaker \( C. \) acoupa contained most AA, DHA and EPA.

The indexes of fat quality are described in Table S5. In this study, the \( n/3/6 \) ratios of fish maws were 0.29, 0.91 and 1.09 in \( S. \) proops, \( C. \) talabonoides and \( C. \) acoupa, respectively. These values were lower than that reported for fish muscles (Fernandes et al. 2014; Murillo et al. 2014). Food and Agriculture Organization experts recommended that the ratio should be higher than 0.2 (Food and Agricultural Organization/World Health Organization (FAO/WHO), 2003), and the UK Department of Health experts recommended the ratio should be higher than 0.25 (HMSO 1994). Therefore, these results indicated that both \( C. \) talabonoides and \( C. \) acoupa were rich in \( n \)-3 fatty acids. The index of atherogenicity (IA) ranged from 0.80 to 1.17 with \( C. \) acoupa showing the lowest value, the index of thrombogenicity (IT) ranged from 1.06 to 2.72 with \( C. \) acoupa showing the lowest value. The IA and IT indicate potential for stimulating platelet aggregation. Thus, the smaller the IA and IT values, the greater the protective potential for coronary artery disease. The hypocholesterolemic/hypercholesterolemic (HH) ratios ranged from 0.79 to 1.21 with \( C. \) acoupa showing the highest value. According to the current knowledge on the effects of specific fatty acids on cholesterol metabolism, a high HH value is desirable.

3. Conclusions
The results indicated that fish maws are excellent protein sources and low in fat content. Fish maws are rich in glycine, proline, glutamic acid, alanine and arginine with a well-balanced composition of FAAs. Among species, the amino acid contents were similar but fatty acid profiles were different; croaker \( C. \) acoupa contained the most PUFA, AA, DHA and EPA, showing the lowest value of IA and IT and showing the highest value of HH, which is the most desirable. It appears that no published data on the nutritional quality of fish maws are available. Therefore, the data on chemical, amino acid and fatty acid composition of fish maws shown in this study will form the basis for further research in this field.

Supplementary material
Experimental details relating to this paper are available online at http://dx.doi.org/10.1080/14786419.2015.1040790, alongside Tables S1–S5.

Disclosure statement
No potential conflict of interest was reported by the authors.

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