Food Chemistry 118 (2010) 224–227

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Amino acid and fatty acid compositions and nutritional quality of muscle in the pomfret, *Pampus punctatissimus*

Feng Zhao [a,b], Ping Zhuang [a,b,*], Chao Song [b], Zhao-hong Shi [a], Long-zhen Zhang [a]

[a] East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, Shanghai 200090, China
[b] College of Fisheries and Life Science, Shanghai Ocean University, Shanghai 201306, China

ARTICLE INFO

Article history:
Received 2 December 2008
Received in revised form 30 March 2009
Accepted 28 April 2009

Keywords:
Pampus punctatissimus
Nutrition
Amino acid
Fatty acid

ABSTRACT

The pomfret, *Pampus punctatissimus*, is an important fisheries resource in China, but little is known about its amino acid and fatty acid compositions. Pomfret muscle contained 18.6% crude protein and 4.95% crude fat. Pomfret protein has a well-balanced amino acid composition, with high amounts of glutamic acid (114 mg/g), lysine (82.8 mg/g), leucine (76.7 mg/g), and aspartic acid (76.0 mg/g). Twenty two fatty acids were found in pomfret oil and saturated fatty acids were the most abundant (48.3%). Palmitic acid (16:0) was the dominant fatty acid, followed by oleic acid (18:1), DHA (22:6n-3), myristic acid (14:0) and stearic acid (18:0), with percentages of 30.5, 26.3, 12.2, 7.37 and 6.86, respectively. The ratio of n-3/n-6 polyunsaturated fatty acids (PUFAs) was 8.04; thus, pomfret muscle is rich in n-3 PUFA.

1. Introduction

Muscle tissue of fish is an important source of protein for humans. The amino acid composition is one of the most important nutritional qualities of protein and the amino acid score (AAS; FAO/WHO, 1990) is used to evaluate protein quality world-wide (Iqbal, Khalil, Atgeeq, & Khan, 2006).

The nutritional quality of fish, is to a great extent, associated with its content of essential fatty acids (EFAs). Lipids of marine fish species are generally characterised by low levels of linoleic acid (18:2n6) and linolenic acid (18:3n3) and high levels of long-chain n3 polyunsaturated fatty acids (LC n-3 PUFA; Steffens, 1997). LC n-3 PUFA cannot be synthesised by humans and must be obtained from the diet (Alasalvar, Taylor, Zubcov, Shahidi, & Alexis, 2002). The n-3 fatty acids are essential for neural development in human infants *in utero* and during the first few years after birth (Montaño, Gavino, & Gavino, 2001). Also, n-3 PUFA have beneficial health effects in conditions of hypertension, inflammation, arrhythmias, psoriasis, aggression, depression, coronary heart disease, inflammatory and auto-immune disorders, and cancer (Candela, Astiasarán, & Bello, 1997; Pike, 1999).

The pomfret, *Pampus punctatissimus* (Temminck & Schlegel, 1845), is distributed in saline water along China's coast from the Yellow Sea to the South China Sea, and in Korean and Japanese coastal waters (Liu, Li, & Li, 2002). In 2006, Chinese fisheries of *Pampus spp.* captured almost 4,00,000 metric tons, and the pomfret was one of the main species in these fisheries.

Several papers have reported the compositions of pomfret fish; however, they are all about the silver pomfret *Pampus argenteus* (Chakraborty, Ghosh, & Bhattacharyya, 2005; Osman, Suriah, & Law, 2001). Determining the amino acid and fatty acid profiles of pomfret muscle will improve the nutritional information available to consumers. The objectives of this study were to analyse the amino acid and fatty acid composition of *P. punctatissimus* muscle and to determine its nutritional quality.

2. Materials and methods

2.1. Sample preparation

Fifteen adult pomfrets were caught from the wild in the waters of Zhoushan (30°39°N, 122°11 E), Zhejiang, China. Body length was 17.80–21.50 cm; wet body weight was 229.37–373.52 g. Sample fish were divided into three groups (five fish, each group). Boneless muscles, used for analysis, were collected from the back of the fish, and then mashed. Mashed muscle sample of each group (five fish) was mixed and stored in a plastic bag, and then kept in refrigerator at −20 °C.

2.2. Proximate composition analyses

Moisture content was determined by drying sample in an oven at 105 °C until a constant weight was obtained (AOAC, 1990).

* Corresponding author. Address: East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences, 300 Jungong Road, Shanghai 200090, China. Fax: +86 021 65683926.
E-mail address: pzhuang@online.sh.cn (P. Zhuang).

0308-8146/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.foodchem.2009.04.110

Crude protein content was determined by the Kjeldahl method (AOAC, 1990), and a conversion factor of 6.25 was used to convert total nitrogen to crude protein. Fat was determined by using the Soxhlet extraction method (AOAC, 1990). Ash was determined by incineration in a muffle furnace at 550 °C for 24 h (AOAC, 1990).

2.3. Amino acid analyses

Amino acid content of samples was measured according to the GB/T14965-1994 in China: the sample was hydrolysed for 22 h at 110 °C with 6 M HCl in sealed glass tubes filled with nitrogen. The hydrolysed samples were taken, and the amino acid concentration was diluted to 50 nM with 0.2 N sodium citrate buffer, pH 2.2. The pH-adjusted samples were analysed by a Biochrom 20 Automatic Amino Acid Analyzer (GE, USA). The content of tryptophan was determined by the colorimetric method of Basha and Roberts (1977) after alkaline hydrolysis of each sample. All determinations were performed in triplicate.

2.4. Amino acid score

Essential amino acid score was calculated with respect to the FAO/WHO reference amino acid pattern of the pre-school child (age, 2–5 year; FAO/WHO/UNU, 1985).

$$\text{Amino acid score} = \text{Sample amino acid}/\text{Reference amino acid} \times 100$$

2.5. Fatty acid analyses

Fatty acids were extracted and fatty acid methyl esters (FAMEs) were prepared according to the ISO5509 method (ISO, 2000): first, Soxhlet extraction, and then, saponification, followed by esterification, and finally, extraction of FAMEs in hexane. FAMEs were subsequently analysed by capillary gas chromatography (column: 30 m × 0.25 mm I.D., 0.5 μm film thickness; Supelco. Flame ionisation detected temperature at 210 °C; carrier gas N_2 at 1.0 ml/min; injector temperature at 210 °C; oven temperature programmed from 180 to 250 °C) using an Agilent 6890 capillary gas chromatograph. Quantitative data were calculated using the peak area ratio (% total fatty acids).

3. Results and discussion

3.1. Proximate composition

The proximate composition of the pomfret is shown in Table 1. Crude protein, crude fat and crude ash contents of the pomfret muscle were 18.59%, 4.95% and 1.36%, respectively.

The crude fat content was higher than the amount found in silver pomfret, *P. argenteus* (Chakraborty et al., 2005; Osman et al., 2001). Based on the moisture and fat contents, the pomfret is a medium-fat fish, with a fat content of 5–10% by weight (Bennion, 1997). According to Feeley, Criner, and Watt (1972), low-fat fish have higher water contents, and as a result, their flesh is white in colour. Fatty fish store the fat in muscle tissue, and their flesh is yellow, grey, pink or another colour (Gurr, 1992). Fat content is influenced by species, season, geographical regions, age and maturity (Piggot & Tucker, 1990).

Table 1
Proximate composition of pomfret muscle.

	Moisture (%)[a]	Crude protein (%)[a]	Crude fat (%)[a]	Crude ash (%)[a]
Mean	75.35	18.6	4.95	1.36
SD	0.32	0.38	0.12	0.02

[a] Percentage of total wet weight.

3.2. Amino acid composition

The amino acid composition of pomfret muscle is shown in Table 2. Pomfret protein contained a high amount of glutamic acid (114 mg/g of crude protein), followed by lysine, leucine aspartic acid, arginine, valine, alanine in decreasing amounts.

Over the past 20 years, increasing evidence suggests the importance of glutamine in the function of many organ systems (Christina, Palmer, & Griffiths, 1999). Glutamine is the most abundant free amino acid in the body, comprising nearly 60% of the free intracellular amino acids in skeletal muscle. The efflux of glutamine from muscle in critical illness serves as an important carrier of ammonia (nitrogen) to the splanchnic area and the immune system (Deutz, Reijven, Athanasas, & Soeters, 1992). As a donor of nitrogen in the synthesis of purines and pyrimidines, glutamine is essential for the proliferation of cells.

Pomfret protein is also rich in lysine, which is the limiting amino acid in cereal-based diets of children in developing countries (Iqtidar & Khalil, 1995; Kim & Lall, 2000). Taurine, a sulfonated β-amino acid derived from methionine and cysteine metabolism, is not utilised in protein synthesis, but is found either as a free amino acid or in simple peptides (Jacobsen & Smith, 1968). Taurine plays a pivotal role in numerous physiological functions of human infants (Redmond, Stapleton, Neary, & Bouchier-Hayes, 1998; Stapleton, O'Flaherty, Redmond, & Bouchier-Hayes, 1998).

Table 2
Amino acid composition of pomfret muscle.

Amino acid	Content (% DW) Mean ± SD	Content (mg/g crude protein)
Taurine	0.11 ± 0.06	1.46
Serine	2.81 ± 0.06	37.2
Tyrosine	2.64 ± 0.29	35.0
Proline	1.92 ± 0.17	25.5
Aspartic acid	5.73 ± 0.07	76.0
Glutamic acid	8.61 ± 0.05	114
Glycine	3.03 ± 0.23	40.1
Alanine	3.72 ± 0.42	49.3
Histidine	1.51 ± 0.08	20.0
Arginine	4.20 ± 0.05	55.6
Methionine	1.76 ± 0.06	23.3
Phenylalanine	3.22 ± 0.04	42.6
Isoleucine	3.33 ± 0.00	44.2
Leucine	5.78 ± 0.19	76.6
Lysine	6.24 ± 0.16	82.7
Threonine	3.03 ± 0.13	40.2
Valine	3.89 ± 0.13	51.5
Tryptophan	1.25 ± 0.17	16.6

Table 3
Amino acid score of pomfret.

Amino acid	Content (mg/g crude protein)	Reference (mg/g protein)[a]	Score
Threonine	40.2	34	118
Tryptophan	16.6	11	151
Cysteine + Methionine	23.3	25	93
Valine	51.5	35	147
Phenylalanine + Tyrosine	77.6	63	123
Isoleucine	44.2	28	158
Leucine	76.6	66	116
Lysine	82.7	58	143

[a] Reference amino acid pattern of preschool children (2–5 years) (FAO/WHO/UNU, 1985).