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Nutritional Profile and Heavy Metal Content of Cultured Milkfish (*Chanos chanos*)

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Abstract

Nutritional profile of fresh cultured milkfish (*Chanos chanos*) revealed that the fish had good quantity of protein, amino acids and poly-unsaturated fatty acids. Essential amino acids formed 49.49% of the total amino acids of milkfish meat. Leucine (8%), lysine (7.3%), phenyl alanine (6.7%) and histidine (6.1%) were the predominant essential amino acids. Glutamic acid (18.2%) was the dominant non-essential amino acid. The fish was rich in unsaturated fatty acids (50.74%) of which mono unsaturated fatty acids (MUFA) and poly unsaturated fatty acids (PUFA) constituted 34.47 and 16.27%, respectively. The predominant MUFA, PUFA and saturated fatty acids were oleic acid C18:1 (26.1%), linoleic acid C18:2 (10.9%) and palmitic acid C16:0 (29.82%). Heavy metals such as zinc, copper, cadmium, cobalt, mercury and lead in different body organs of cultured milkfish were within the acceptable limit. The cultured milkfish can be considered as important fish for human nutrition.

Keywords: *Chanos chanos,* proximate composition, heavy metals, amino acid profile, fatty acid profile

Introduction

Milkfish is an important food fish in Southeast Asia (Sumagaysay, 1998) and is also suitable as an indigenous candidate for aquaculture in India (Murthy et al., 2012) which is currently cultured as freshwater at par with Indian major carps. As fish contributes significantly to human nutrition, information regarding freshness and safety is becoming more and more important for the consumers. However, utilization of cultured fish must accompany the concomitant need for information concerning the chemical composition and nutrient content of this fish. Such information is needed by food processors and technologists to devise optimum processing and storage conditions for this fish.

A proportion of PUFA is reported to be low freshwater fish when compared with marine fish (Rahman et al., 1995). Amino acid composition is one of the most important nutritional qualities of protein. Certain amino acids like aspartic acid, glycine and glutamic acid are also known to play a role in the process of wound healing (Chyun & Griminger, (1984). Apart from nutritional value, it also provides several health benefits, such as reduction of blood cholesterol (Gibbs et al., 2004), antioxidant activity Saito et al. (2003), cytotoxic activity against cancer cells (Kim et al., 1999).

Fish have ability to accumulate toxic metals and it is of absolute importance that the content of undesirable metals is low. Heavy metals and trace elements have certain effect on ecosystem as well as human beings. Several authors reported that elements such as zinc in reduced quantity and copper, cobalt in increased amount elevates oxidative stress which leads to inflammatory diseases and cardiac functional disorders in humans (Salehifar et al., 2008; Topuzoglu et al., 2003). Lead toxicity may lead

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to retardation of growth, anemic conditions in children and further neural and nephral disorders in man (Tabari et al., 2010). Lead absorption may constitute a serious risk to public health (Suppin et al., 2005).

The present work was envisaged to generate information on the heavy metal content and nutritional profile of fresh cultured milkfish from India to understand and design utilization pattern for value addition.

Materials and Methods

Farm reared milkfish having an average weight of 1009±74 g and length ranging between 52.5 cm and 58.5 cm were procured from the Narasapur fish farm of West Godavari, Andhra Pradesh, India during post-monsoon period. The fish were immediately iced (1:1 fish to ice ratio) in High Density Poly Ethylene (HDPE) insulated boxes and brought to the laboratory within 10 h after harvesting. The raw fish was de-iced and thoroughly washed with chilled potable water.

Proximate composition was determined by AOAC (1998) method. Mercury content was estimated using mercury analyzer (MA5840, Electronic Corporation of India, Hyderabad) which works on the principle that mercury vapour (atoms) absorbs resonance radiation at 253.7 nm. Cadmium, copper, zinc and lead were analysed following AOAC (1998) using atomic absorption spectrophotometer (Varian Spectra AA 220, Australia). Total lipid was extracted (Folch et al., 1957) and fatty acids were analysed according to the method of Metcalfe (1966). Amino acid profile of the meat was determined as per Ishida et al. (1981) using high performance liquid chromatography (Shimadzu LC 10AS). Tryptophan was determined spectrophotometrically as per the method of Sastry & Tammuru (1985).

All the analyses were done in triplicate. The data was subjected to ANOVA by statistical software, SPSS version 16.0. Duncan's multiple range tests was carried out to find out significant difference between means of experimental data at 5% level of significance.

Results and Discussion

Proximate composition of fresh milkfish was estimated and is given in Table 1. Moisture and ash content of the fresh milkfish were found to be 72.18±0.39% and 4.02±0.16%, respectively. It showed 20.37±0.50% protein, indicating as a table fish. Fish in general contain 17–22% protein and fat content in a broad range of less than 2% to as high as 20% depending on type of feed given, age, size etc. (Natarajan & Sreenivasan, 1961). Similar protein contents (19.92 to 22.38%) in Godavari Hilsa were reported by Rao et al. (2012). Fat content of milkfish meat was found to be 3.84±0.39%. Minerals namely calcium (355.50±0.24 mg%), phosphorus (2217.0±0.57 mg%), sodium (224.0±0.02 mg%), potassium (845.5±0.05 mg%), iron (8.0±0.01 mg%) and selenium (11.23±0.02 mg%) were present in the cultured milkfish meat. Ca and P are the essential nutrients for growth and major constituent of the structural components of skeletal tissues.

Table 1. Proximate composition of fresh milkfish (*Chanos chanos*)

Parameters	Mean±SD
Moisture (%)	72.18±0.39
Crude Protein (%)	20.37±0.50
Crude Fat (%)	3.84±0.39
Total Ash (%)	4.02±0.08
Calcium (mg%)	355.50±0.24
Phosphorus (mg%)	2217.0±0.57
Sodium (mg%)	224.0±0.02
Potassium (mg%)	845.5±0.05
Iron (mg%)	8.0±0.01
Selenium (mg%)	11.23±0.02

Results are average of triplicate determinations, Mean ± SD

Heavy metal composition of fresh milkfish is given in Table 2. The concentration of minerals and trace element levels are known to vary in fish depending on various factors such as their feeding behaviour, environment, ecosystem and migration (Andres et al., 2000). Zinc, cadmium, copper and lead were detected in the edible part, skin, gills, liver and viscera of milkfish (Table 2). Zinc level was higher in edible part (10.56±0.41 ppm). Cadmium content and lead content was higher in the intestine. Cobalt and mercury content was found below the detectable level. The heavy metal content of different elements in milkfish meat was within acceptable limits (FAO, 1989).

Table 2. Heavy metals in different body organs of milkfish (*Chanos chanos*)

Milkfish body organs	Zinc	Copper	Cadmium	Lead
Meat	10.56±0.41^{c}	0.3±0.05^{a}	0.06±0.004^{a}	0.015±0.005^{a}
Skin	3.95±0.2^{b}	0.23±0.11^{a}	0.067±0.009^{a}	0.025±0.005^{a}
Gills	1.95±0.06^{a}	0.555±0.01^{a}	0.0585±0.000^{a}	0.055±0.005^{a}
Liver	4.025±0.55^{b}	24.59±0.53^{c}	0.0525±0.001^{a}	0.265±0.045^{a}
Gut/Viscera	1.71±0.1^{a}	4.485±0.23^{b}	0.909±0.002^{b}	0.325±0.175^{a}

Results are average of triplicate determinations, Mean ± SD

Value with different superscripts in a column differ significantly ($p<0.5$)

Milkfish meat was found to be a rich source of essential amino acids (Table 3). Essential amino acids formed 49.49% of the total amino acids of milkfish meat. Leucine (8.00%), lysine (7.30%), phenyl alanine (6.70%) and histidine (6.10%) were the predominant essential amino acids. Glutamic acid (18.20%) was the dominant non-essential amino acid. Suseela (2009) reported that the meat of rohu and mrigal constituted higher proportion of glutamic acid and lysine. Mohanty & Kaushik (1991) reported that in the flesh of rohu, catla and mrigal fish - glutamic acid, aspartic acid and glycine were the dominant non-essential amino acids and phenyl alanine, lysine and leucine were the dominant essential amino acids.

Fatty acid content and composition varies with the anatomical location of the sample used for analysis (Cabling et al., 1982). Milkfish meat was rich in unsaturated fatty acids (50.74%) of which mono unsaturated fatty acids (MUFA) and poly unsaturated fatty acids (PUFA) constituted 34.47 and 16.27% respectively (Table 3). The predominant MUFA, PUFA and saturated fatty acids were oleic acid C18:1 (26.10%), linoleic acid C18:2 (10.90%) and palmitic acid C16:0 (29.82%). Similar observations were recorded by Kinsella et al. (1977) for 18 species of freshwater fish. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were relatively low in milkfish meat at 0.12% and 1.26%, respectively (Table 4). Low EPA and DHA contents in Pacu fish were reported by Murthy et al. (2015). The variation in fatty acid composition of milkfish may be attributed to the environment and type of feed (Moreira et al., 2001).

When consumer preference and utilization pattern of cultured milkfish in India is considered, milkfish below the size of 300-500 g are not preferred due to the presence of scattered bones in centric muscles causing inconvenience in consumption of fish. Moreover, cultured milkfish over one kg size are marketed in metro cities in India as it facilitates ease in consumption of fish due to the chunky flesh with bones pushed to peripheral parts in fish.

Table 3. Amino acid profile of milkfish (*Chanos chanos*) (g 100 g^{-1})

Aspartic Acid	12.00
Threonine*	4.40
Serine	4.70
Glutamic Acid	16.20
Proline	0.70
Glycine	2.60
Alanine	5.80
Cystine	0.40
Valine*	5.90
Methionine*	3.00
Isoleucine*	4.90
Leucine*	8.00
Tyrosine	3.20
Phenyl Alanine*	6.70
Histidine*	6.10
Lysine*	7.30
Arginine*	2.10
Tryptophan*	1.09

* Essential amino acids

Table 4. Fatty acid composition of milkfish (*Chanos chanos*) (% of total fatty acids)

Saturated Fatty Acids (SFA)	40.17%
C14:0	1.09%
C15:0	0.27%
C16:0	29.82%
C17:0	0.26%
C18:0	7.28%
C20:0	0.39%
C22:0	0.14%
C23:0	0.19%
C24:0	0.73%
Mono Unsaturated Fatty Acids (MUFA)	34.47%
C16:1	3.15%
C17:1	0.14%
C18:1	**26.1**%
C20:1	4.2%
C22:1	0.48%
C24:1	0.4%
Poly Unsaturated Fatty Acids (PUFA)	16.27%
C18:2	**10.9**%
C18:3	0.89%
C20:3	2.67%
C20:4	0.2%
C20:5	0.12%
C22:2	0.23%
C22:6	1.26%

* Expressed as % of total fatty acids.

Overall, proximate composition of milkfish exhibited 20.37% of protein indicating that fish can be considered as a good table fish. The heavy metal content of different elements in milkfish meat was within acceptable limits. Milkfish meat was found to be a rich source of essential amino acids and unsaturated fatty acids (50.74%).

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