

Evaluation of Crude Protein and Amino Acid Contents in the Scales of Blue Tilapia, *Oreochromis aureus* from Pakistan

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Abstract: A study was conducted to analyze the amount of crude protein (CP) and amino acids in the scales of a cichlid species, *Oreochromis aureus*, which is commonly known as “blue tilapia”. The results of the present study revealed that like other materials obtained from fish, scales of *Oreochromis aureus* could also be considered as a rich source of protein that is 88.65% on dry weight basis. Furthermore, the concentration of about eighteen amino acids was also determined in the present study, which revealed that both glycine and proline contents were found in highest concentration in the scales of tilapia fish than the remaining amino acids, while cysteine, methionine and tryptophan were not detected. Thus, it had been proved that tilapia scales could also be considered as a not only a rich source of protein but also contain various essential and non-essential amino acids, therefore, could be used in various pharmaceutical and cosmetics industries.

Key words: Blue Tilapia (*Oreochromis aureus*) • Cycloid Scales • Crude Protein • Amino Acids

INTRODUCTION

Oreochromis aureus belongs to family Cichlidae is also commonly known as ‘blue tilapia’, which is a combination of Latin and Greek words, ‘*Oreo*’ is from ‘*aurum*’ a Latin word that means “gold” and ‘*chromis*’ is use for “coloration” [1]. This is because, they are mostly dull golden or brownish grey in color on belly area whereas bluish on chest. Moreover, their body also has numerous dark colored spots [2]. They are found in freshwater but have high tolerance of brackish water as well [3]. *Oreochromis aureus* is potamodromous in nature [4], as they hatch in upstream of fresh water, but migrate to down streams and stay there until they grow to adult stage and then once again migrate back to upstream of freshwater for the sake of spawning [5-6]. It can breed in both fresh and brackish water at temperature 20°C. They have a laterally compressed body and their body shape resembles to that of a perch or a sun fish [7].

Their jaws are fused together, that allow them to feed upon a various types of food. In adult stages, it feeds mostly upon aquatic plants and sea weeds, but during small age, they depend upon detritus, eggs and larval fishes and occasionally feed on zooplanktons [8]. Maximum length is about 47.5 cm in total length. It is a well-known commercial fish because they are fastidious in growth and reach the weight of kilograms very quickly [9]. This species has also been introduced in many parts of the world as a most popular food fish. Furthermore, it can also be used to control aquatic vegetation. Sometimes, *Oreochromis aureus* can be a problematic invasive species in new warm-water habitats. Historically, it has major importance in artisan fishing in Africa and increasing importance in aquaculture and aquaponics.

Scales are hard proteineous structures that protect the fish body from being injured by sharp objects present in their living habitat. As teleost fishes mostly possess two types of scales i.e., cycloid and ctenoid scales, but in *Oreochromis aureus* of our present study contain only

cycloid scales that are round or circular in shape and have smooth posterior margin without ctenii. Previously, scales were mostly used to determine age and life history pattern of fish as well as in taxonomy [10-11], but now scales have also been used industrially on a wide range for the production of certain important materials in pharmaceutical industries as well as for the production of certain cosmetics, fertilizers etc., because fish scales have been considered as protein rich in nature [12]. According to Nagai *et al.* [13], Courtemanche *et al.* [14] and Mitsuhiro *et al.* [15], fish scales possess almost about 40-80% of proteins and 16 to 59% of minerals, on dry weight basis. Moreover, about 70% of organic portion of scale is consists of only collagen protein [16]. Another type of protein i.e., ichthylepidin had also been reported in the scales of cartilaginous fishes for about 24%, on dry weight basis [17].

Therefore, the basic objective of our present study was to estimate the amount of protein and amino acids in the scales of blue tilapia, *Oreochromis aureus*, in order to observe that whether blue tilapia scales are rich source of protein, and can holds a good quantity of certain essential and non-essential amino acids. Furthermore, our present study will provide useful information's that later could be valuable for the productions of various useful products in industries.

MATERIALS AND METHODS

Samples Collection: A total of 20 specimens of *Oreochromis aureus* were purchase from the fish market at Korangi creek of Karachi coast, Pakistan on dated 15 January 2013. Specimens were immediately transferred to the department of Zoology, University of Karachi. In laboratory, scale samples were taken through direct scrapping from the fresh and healthy specimens. Then scales were air dried for two days until a constant weight was obtained. Then these dried samples of scales were converted into powder form, which was then later utilized to calculate concentrations of crude protein and amino acids.

Analysis of Crude Proteins: Crude protein (CP) content in the scales of blue tilapia was determined by using micro-Kjeldhal method followed by Zubia *et al.* [12].

Amino Acid Analysis: Amino acid composition of scale protein was determined by liquid chromatography with slight modifications. Amino acid analysis was conducted on the Amino Acid Analyzer by using the method followed by Zubia *et al.* [12].

Table 1: Shows Amino acid composition in the scales protein of *Oreochromis aureus* (Values are given in gram/ 100 g of crude protein (CP), on dry weight basis)

Amino acids	Code	Amount of Amino acid (AA) in g/100 gram of CP
Aspartic acid	ASP	7.32
Threonine	THR ^a	2.36
Serine	SER	2.59
Glutamic acid	GLU	7.82
Proline	PRO	14.23**
Glycine	GLY	25.39***
Alanine	ALA	9.39
Cysteine	CYS	ND
Valine	VAL ^a	1.76
Methionine	MET ^a	ND
Isoleucine	ILE ^a	1.03♣
Leucine	LEU ^a	1.82
Tyrosine	TYR	1.10
Phenylalanine	PHE ^a	1.50
Histidine	HIS ^a	1.64
Tryptophan	TRP ^a	ND
Lysine	LYS ^a	7.11
Arginine	ARG	6.01
Total		91.07

Note: ^a Essential amino acid; *** shows highest value;

** Shows high value; ♣ shows lowest value; ND= not detected.

RESULTS

In the present investigation, the amount of crude protein and eighteen amino acids were analyzed in the scales of blue tilapia. The result of the present study revealed the organic portion scales of *Oreochromis aureus* contain highest percentage of protein that is 88.65% on dry weight basis. The method used for determining the amino acid contents in the scale protein of *Oreochromis aureus* has only allowed the analysis of eighteen amino acids. Among them, nine were included as an essential amino acids (EAA) i.e., threonine, valine, methionine, isoleucine, leucine, phenylalanine, histidine, methionine, tryptophan and lysine, respectively. The amount of each amino acid was calculated as gram per 100 grams of crude protein (CP), as shown in the Table 1 and Figure 1, respectively.

The results of the present study revealed that both glycine and proline were present in highest concentration, while aspartic acid, glutamic acid, alanine, lysine and arginine were seen in a mediocre amount. However, threonine, serine, valine, isoleucine, leucine, tyrosine, phenylalanine and histidine were found in least amount. But, methionine, tryptophan and cystine were completely absent. The amount of total amino acid (TAA) content in scales was 91.07 g/100 g crude protein (CP), on dry weight basis. The amount of total essential amino acids (EAA) in crude protein content of scales was 17.22 g/100g CP, while

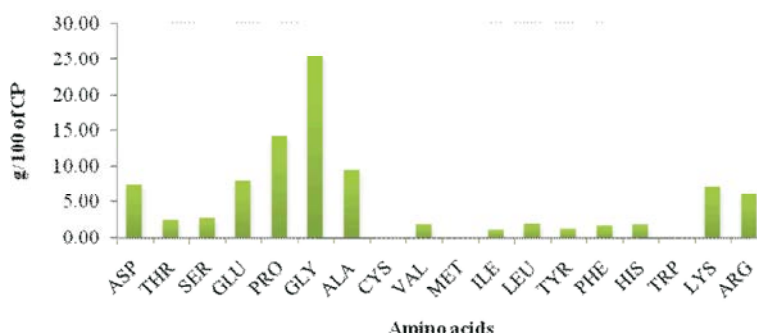


Fig. 1: Shows the amount of amino acids in g/100 grams of Crude protein (CP)

Table 2: Essential (EAA) and non-essential amino acid (NEAA) contents in the scale protein of blue tilapia, *Oreochromis aureus* (g/100g crude protein) on dry weight basis

Amino acid	g/100g crude protein (CP) on dry weight basis
Total amino acid (TAA)	91.07
Total non-essential aminoacids (TNEAA)	73.85
Total essential amino acid (TEAA)	
-With HIS	17.22
-No HIS	15.58

the amount of total non-essential amino acids (NEAA) was 73.85 g/100g CP, dry weight basis respectively. Hence, our present study revealed that non-essential amino acids (NEAA) holds highest amount as compare to the essential amino acids (EAA), as shown in Table 2 respectively.

DISCUSSION

Present study revealed that scales of *Oreochromis aureus* are rich source of protein that is 88.65% on dry matter basis. Previous studies related to the analysis of crude protein and amino acid content in the scales of tilapia fish was still inadequate in the literature, thence, the comparison of present data with previous published data was almost impossible, however, according to the recent investigation of Zubia *et al.* [12], scales of four mugilid species of the family Mugilidae on Karachi coast of Pakistan also contain the highest amount of crude protein ranged from 62.28 to 78.07%, respectively. Moreover, the results of this study demonstrated that the value of crude protein content (88.65%) of the scales of *Oreochromis aureus* was highest than mullets (>62%) and silver carp (43.43%) as reported by Zubia *et al.* [12] and Zhang *et al.* [18], respectively. Such variations might be owing to their different feeding habits, seasons, age, size, stages of growth as well as the habitat of fish as

reported by Ushaand Prakasam [19]. According to present investigation, both glycine and proline contents in the scale protein of *Oreochromis aureus* are found in highest, which was in consistency to Zubia *et al.* [12]. According to Zhang *et al.* [20], such highest amount of glycine and proline are responsible for collagen formation. Therefore, *Oreochromis aureus* was found to be having high collagen content. Furthermore, amino acids like threonine, serine, valine, isoleucine, leucine, tyrosine, phenylalanine, histidine are found to be least in 100 grams of crude proteins. According to Ikoma *et al.* [21] and Muyonga *et al.* [22], least presence of tyrosine, histidine and tryptophan shows the presence of type I collagen. According to Nagai *et al.* [13], Matmaroh *et al.* [23] and Nurul-Asyraf [24], glycine, proline, alanine and glutamine are also found to be in highest amount in scale proteins obtained from different fish species. Furthermore, cystine content of *Oreochromis aureus* was found to be 0 (Zero), which was in contrast to Zhang *et al.* [20] who reported that scales of fresh water fishes mostly contain high content of cysteine. Lysine and arginine contents were also found to be high in the present study (Table 1). Lysine is responsible for cross linking during the formation of collagen [25].

CONCLUSION

From the results of the present study and studies of previous literature, it was concluded that fish scales contain almost all essential and non-essential amino acids along with some variation among them. It was also seen that some important essential amino acids are also seen in a moderate amount. The overall results revealed that tilapia scales are rich in glycine and proline contents that lead them to produce more collagen. These scales can therefore be used in the production of protein rich goods. Our present study will provide widespread knowledge on crude protein and amino acid contents of tilapia scales

that later could be useful in pharmaceutical and cosmetics industries to produce various protein rich products and biomedical materials.

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