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Preliminary Studies on the Essential Amino Acid Requirements of the Pearlspot, *Etroplus suratensis*

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Abstract

Three groups of juvenile pearlspot, *Etroplus suratensis,* were fed a formulated feed (CP:31.5%) containing fish meal, groundnut cake, wheat bran, tapioca powder, vitamins and minerals over 20 d. An attempt was made to determine the essential amino acid (EAA) requirement of pearlspot by calculating the daily EAA increment of the fish fed with the diet. The EAA requirement profile expressed as percentage of dietary protein is 3.4% arginine, 2.1% histidine, 1.4% isoleucine, 3.5% leucine, 9.7% lysine, 2.0% methionine, 2.2% phenyl alanine, 3.0% threonine, 2.2% tryptophan and 2.1% valine.

Introduction

Among the two cichlid species indigenous to Asia, the euryhaline pearlspot (*Etroplus suratensis*, Cichlidae) is a potential species for aquaculture because of its high market demand and large size. This species is cultured in the southern state of Kerala in India and in Sri Lanka. Commercial culture of pearlspot in the different agroclimatic regions of India has been described by Jhingran and Natarajan (1972), Thampy (1980), Sumitra et al. (1981) and Anon. (1983).

It has been shown by a few authors that the essential amino acid (EAA) composition and more so the $A \cdot E^{-1}$ ratios (ratio between individual EAA·sum^{-1} of EAA x 1,000) reflect closely the EAA requirements of a given species (Arai 1981; Ketola 1982; Ogata et al. 1983; Wilson and Poe 1985; Gatlin 1987; Ravi and Devaraj 1991). Ogino (1980) attempted to estimate the overall EAA requirements of rainbow trout and carp based on daily EAA gain by fish under positive growth conditions. Based on this principle, studies were made to estimate

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the EAA needs of *E. suratensis* so that optimum balancing levels of the nutrients could be determined for best growth and feed conversion efficiency.

Materials and Methods

The experimental feed (ES-5) evolved in earlier experiments (Anon. 1988) was selected for the present experiment. The diet contained fish meal, groundnut cake, wheat bran, tapioca powder, vitamins and minerals in different proportions (Table 1). Juveniles of *E. suratensis* were collected from brackishwater canals adjacent to the Narakkal Fish Farm of the Central Institute of Brackishwater Aquaculture (CIBA). Fish were acclimatized to laboratory conditions for 2 d and then fasted for 1 d before commencement of the feeding experiment. Twenty fish of average weight of 17.75 g (335 g total biomass) were stocked in a 3 x 2 feet plastic pool containing 300 l brackishwater. The set-up had three replicates. The diet was prepared as dry 1-cm^{-3} cubes and the fish were fed to satiety for 20 d. Daily in the morning, leftover feed was siphoned out, dried and weighed. In the pools, 50% of the water was exchanged daily. Temperature, salinity and pH of the water were measured daily and the range was 26.2-30.6°C, 2.88-3.30 ppt and 7.00-7.64, respectively. Samples of 10 fish before and after the experiment were oven dried at 60°C and powdered for analyses.

Analysis of dry matter (60°C : 24 h), crude protein (Kjeldahl nitrogen x 6.25), gross energy (Gallenkamp adiabatic bomb calorimeter), crude fat

Table 1. Composition of the experimental diet ES-5 for *Etroplus suratensis*.

Ingredients	% composition
Fish meal	59
Groundnut cake	10
Wheat bran	8
Tapioca powder	19
Vitamin mix[1]	1
Mineral mix[2]	3
Crude protein (% DM)	31.5
Crude fat (% DM)	6.4
Gross energy ($kJ \cdot g^{-1}$ DM)	16.3
Ash (% DM)	23.1
Dry matter (%)	93.8

[1]Vitamin mix : 100 g of diet contained 2,500 IU vitamin A, 200 IU vitamin D3 , 2 mg vitamin B1, 2 mg vitamin B2, 25 mg nicotinamide, 30 mg vitamin C .

[2]Mineral mix : 100 g of diet contained 0.46 g calcium carbonate, 0.93 g potassium dihydrogen orthophosphate, 0.11 g dicalcium phosphate, 0.03 g zinc sulphate, 0.04 g ferrous sulphate, 1.40 g magnesium sulphate, 0.03 g copper sulphate.

(methanol : chloroform extraction) of diet and fish samples were carried out following standard laboratory procedures. For EAA, the diet and fish samples were hydrolyzed with 6N HCl at 110°C for 24 h and the chromatographic separation and analysis of the amino acids was performed after orthophthaldehyde (OPA : Sigma P 1378) derivatization of amino acids using High Performance Liquid Chromatograph (HPLC-Varian Model 5000, Aminotag reversed phase column) following modified procedure of Gardner and Miller (1980).

Daily EAA increment per 100-g fish was calculated as

$$EAAI = \frac{(FBW \times FBC - IBW \times IBC)}{(MBW \times n° d)} \times 100$$

where MBW = (IBM + FBW)/2, IBW and FBW the initial and final whole body weight of fish and IBC and FBC the initial and final EAA composition of the whole body tissues.

The EAA requirements (as % of dietary protein) were computed as

$$Need = \frac{EAAI}{DPI} \times 100$$

where EAAI is daily EAA gain and DPI is mean digestible protein intake per 100 g fish, respectively, as per Ogino (1980).

Results and Discussion

The whole body composition of *E. suratensis* before and after the feeding trial is shown in Table 2, and the amino acid composition of the experimental diet and the fish before and after the feeding experiment is furnished in Table 3. The amino acid composition of the body proteins of the pearlspot after feeding diet ES-5 is comparable to the amino acid composition of rainbow trout and Atlantic salmon as reported by Wilson and Cowey (1985). However the arginine content of pearlspot is slightly higher than that of carp, rainbow trout, salmon and channel catfish.

It is generally recognized that the whole body amino acid composition of fish reflects the EAA requirement profile of the same fish. This is so because

Table 2. Body composition of *Etroplus suratensis* fed with experimental diet ES-5 for 20 d.

Parameters	Initial[1]	Final[1]
Moisture (%)	76.7	75.7
Dry matter (%)	91.4	92.9
Crude protein (% DM)	66.4	67.2
Crude fat (% DM)	12.2	11.7
Gross energy ($kJ \cdot g^{-1}$ DM)	17.5	18.9
Ash (% DM)	29.5	30.1

[1]Samples of 10 fishes were oven dried at 60°C and the whole body was analyzed.

Table 3. Amino acid composition of the experimental diet and whole body tissue of *Etroplus suratensis*.

Amino acids	AA content ($g \cdot 16^{-1}$ g N)		
	Diet	Initial	Final
Aspartic acid	09.4	10.4	07.4
Glutamic acid	07.8	13.2	11.8
Histidine	00.9	01.1	01.2
Serine	03.4	03.7	03.2
Arginine	08.3	14.9	13.4
Glycine	08.3	05.1	05.7
Threonine	02.9	03.7	03.5
Alanine	05.3	06.5	06.3
Tyrosine	01.6	01.8	02.5
Methionine	01.8	02.2	02.2
Valine	03.3	03.2	03.1
Phenylalanine	03.5	03.7	03.5
Isoleucine	02.7	02.7	02.5
Leucine	05.8	06.0	05.6
Lysine	08.6	11.7	08.2

the EAA needs for growth represent the EAA needs for protein accretion in almost all animals. An ideal EAA profile would be one that corresponds to the whole body protein composition of the given fish. Ogino (1980) demonstrated that the daily EAA gain will be a near estimate of the daily EAA needs, provided provision is made for digestive losses.

The EAA requirement profile of pearlspot in comparison to that of tilapia, catla, carp and trout is shown in Table 4.

On the whole, the general EAA requirement pattern of pearlspot obtained in the present study is broadly comparable to the EAA need of other tropical finfishes like tilapia (Santiago and Lovell 1988) and catla (Ravi and Devaraj 1991) with the notable exception of lysine. However, the requirement pattern of leucine, methionine, threonine and valine is close to the need of related cichlids and catla. On the other hand, the requirement pattern of arginine, histidine, isoleucine and tryptophan is close to the requirement pattern of other teleosts like carp and channel catfish.

Estimates of the EAA needs of *E. suratensis* shown in this study are lower than the established and recommended (NRC 1981) values for some teleosts. However, data presented here cannot be considered as truly reflecting the EAA needs since the EAA requirement was calculated based on EAA increment of pearlspot fed with diet ES-5. Further studies using graded levels of individual EAA are required to understand the precise need of the fish for each EAA. Indeed data obtained by Santiago and Lovell (1988) in tilapia using dose-response studies differ from those calculated earlier by Jauncey et al. (1983). But the data presented here may be useful as a basis for the formulation of practical diets of *E. suratensis*.

Table 4. Daily essential amino acid increment and estimated dietary amino acid requirement (% dietary protein) of *E. suratensis* in comparison to tilapia, carp and trout.

Essential amino acids (EAA)	EAA ($mg \cdot 100\ g^{-1} \cdot d^{-1}$)	EAA requirement (% dietary protein)				
		Pearlspot	Tilapia[1]	Catla[2]	Carp[3]	Trout[4]
Arginine	01.3	03.4	04.20	04.80	03.3-04.0	03.1-04.0
Histidine	00.3	02.1	01.72	02.45	01.2-01.5	01.4-01.8
Isoleucine	00.5	01.4	03.11	02.35	02.0-02.6	02.1-02.8
Leucine	01.4	03.5	03.39	03.70	03.7-04.8	03.9-05.0
Lysine	03.8	09.7	05.12	06.23	04.7-06.0	04.7-06.0
Methionine	00.8	02.0	02.68	03.55	—	—
Phenylalanine	00.8	02.2	03.75	03.70	02.9-03.8	03.0-04.1
Threonine	01.2	03.0	03.75	04.95	01.8-02.3	01.9-02.4
Tryptophan	03.2	02.2	01.00	00.95	—	—
Valine	00.8	02.1	02.80	03.55	—	—

[1]Santiago and Lovell (1988)
[2]Ravi and Devaraj (1991)
[3,4]Ogino (1980)

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