

Validation of Essential Amino Acid Requirements of Red Tilapia (*O. mossambicus* x *O. hornorum*) Assessed by the Ideal Protein Concept

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Abstract: Red" tilapias have become increasingly popular in Egypt because of their hardiness, fast growth rate and large size adults and their similar appearance to the marine red snapper which has a high market value. Protein requirement and optimum dietary protein to energy ratios for red tilapia have already been studied. However its essential amino acid requirements have not been determined. The objective of this study was to determine the amino acid requirements of the red tilapia (*O. mossambicus* × *O. hornorum*) taking into account the empirically determined lysine requirements which had been estimated by the ideal protein concept. The determined values are compared with values in the literature. The essential amino acid requirements in g kg⁻¹ protein were estimated as follows: arginine 40g, histidine 16g, isoleucine 26g, leucine 45g, methionine + cystine 35g, phenylalanine + tyrosine 49g, threonine 33g, tryptophan 8g and valine 30g. Except for higher leucine and lower phenylalanine + tyrosine, estimated requirements for the other essential amino acids were similar to the empirically determined which were recorded in the literature. It could be concluded that the estimated essential amino acid (EAA) requirements by using ideal protein concept will help in formulating a well balanced, mixed diet for economic feeding and optimal growth of red tilapia.

Keywords: Amino acid requirements, ideal protein concepts, red tilapia

INTRODUCTION

Protein is the most expensive dietary macronutrient and directly affects fish weight gain (Abdelghany, 2000 and Ng *et al.*, 2001). However, the balance of the protein essential amino acids (EAA) is also fundamental since fish have quantitative requirements for each EAA. Determination of fish amino acid requirements is usually done through dose-response studies, which are costly and time consuming, especially when determining the requirement for all essential amino acids (Akiyama *et al.*, 1997). Wilson & Poe (1985) have determined channel catfish (*Ictalurus punctatus*) body amino acid composition and identified a strong correlation ($r = 0.96$) between body amino acid profile and EAA requirements for this species. Wilson (1991) applied the ideal protein concept to estimate the dietary essential amino acid requirements of *I. punctatus* and reported close agreement with essential amino acid requirement values determined by empirical methods. Woods & Soares (1996) also used the ideal protein concept to estimate the dietary essential amino acid requirements of striped bass (*Morone saxatilis*) broodstock. Based on this concept, estimates of EAA requirements have been calculated for several fish species (Kaushik, 1998; Ngamsnae *et al.*, 1999; Fagbenro 2000; Portz, 2001 and Meyer & Fracalossi, 2005). These workers also reported that amino acid composition of the whole body of the fish did not change with the size of the fish and dietary history.

Tilapias are the third most important cultured fish group in the world, after carps and salmonids (FAO, 2004). Essential amino acid requirements of several cultivated tilapias have not been established but that of *O. niloticus* is available

(Santiago & Lovell, 1988). Essential amino acid requirement values empirically determined for the Nile tilapia should suffice, but NRC (1993) cautioned that essential amino acid requirements are not interchangeable among species.

The "red" tilapia has become increasingly popular because its similar appearance to the marine red snapper gives it higher market value because of their hardness, fast growth and attainment of large size as adults under both freshwater and brackish water. Protein requirement and optimum dietary protein to energy ratios for red tilapia have already been studied (Watanabe *et al.*, 1990). However, amino acid requirement studies have not yet been carried out for this species. Therefore, the objectives of the present investigation was to determine the whole body essential amino acid profile of red tilapia (*O. mossambicus* × *O. hornorum*) based on the empirically determined dietary lysine requirements (Santiago & Lovell 1988), its dietary essential amino acid requirement were estimated by the ideal protein concept, and compared with the respective determined values in literature.

MATERIALS & METHODS

Red tilapia (*O. mossambicus* × *O. hornorum*) fingerlings reared in a fresh water experimental concrete ponds, were used for the determination of whole-body amino acid composition. The fish were fed on diet containing 32%CP with energy level of 15.6 ME MJ/kg through samples collection. Three replicates, twenty fish of fingerling size (5-10 g) per replicate, were sampled from each experimental group for determination of whole body amino acids composition. Fish samples were oven dried at 105°C for 24 hours, finely powder and sieved. The crude protein of fish samples were analyzed according to (A.O.A.C., 1995) procedures. The amino acid composition was determined in acid hydrolysates (6 mol/litre HCl under reflux for 24 h at 110°C) using an automatic amino acid analyser (LC 3000, Biotronik, Munchen). Sulfur amino acid group (methionine & Cystine) destroyed by the acid hydrolysis described above, therefore a pretreatment with performic acid was essential for protection. Tryptophan was determined colorimetrically after hydrolysing triplicate samples in 4.2 mol/litre NaOH (Fischl 1960). From the whole-body amino acid composition, essential amino acid ratios were computed. The dietary essential amino acid requirement pattern was estimated relative to the empirically determined lysine requirement of 51 g lysine/kg protein (Santiago & Lovell 1988) as reference using the ideal protein concept (Wilson 1991). Both sets of values were tested for statistical analysis significance ($P < 0.05$). Data was analyzed by correlation test (r) using SPSS 10 (Statistical Package Computer Software, USA).

RESULTS & DISCUSSION

The whole body essential amino acids pattern of Red tilapia (*O. mossambicus* × *O. hornorum*), Using the ideal protein concept (essential amino acid ratio) and it translates to the estimated essential amino acid requirement are presented in Table 1. Comparatively, the phenylalanine + tyrosine requirements were higher while leucine was lower ($P < 0.05$) in the determination. The estimated essential amino acid requirement of red tilapia showed a strong correlation ($r = 0.918151$) to the determined essential amino acid values reported by Santiago & Lovell (1988) and to the whole body essential amino acid pattern ($r = 0.917302$). From the numerous techniques used to determine amino acid requirement of fish species, the one relating the body amino acid composition to dietary lysine requirement by using dose response experiments, seems to be the fastest and cost efficient. Moreover, there is a great similarity in the

lysine requirement among several freshwater fish species, bearing feeding habits similar to that of red tilapia. For this reason, lysine requirement of Nile tilapia was used to estimate the EAA for red tilapia. Thus, if the dietary lysine requirement for a fish is known, the dietary requirement for the remaining essential amino acids of the fish relative to the lysine requirement could be estimated. These results are in agreement with those findings by Wilson (1991) with catfish, Kaushik (1998) with seabream, Fagbenro (2000) with tilapia, and Meyer & Fracalossi (2005) with native catfish.

Table (1): Essential amino acid profile of Red tilapia tissues and the estimated essential amino acid requirements (g/kg protein) using ideal protein concept

	Tissue essential amino acid	Essential amino acid ratio	Essential amino acid requirement	
			Determined ¹	Estimated ²
Lysine	89	100	51	-
Arginine	70	78.6	42	40
Histidine	28	31.4	17	16
Threonine	58.1	65.3	37.5	33
Valine	52.5	58.9	28	30
Leucine	78.8	88.5	34*	45
Isoleucine	46	51.6	31	26
Methionine	24.7	69.6	32	14
Cystine	37.3			21
Phenylalanine	56.3	95.9	55.4*	32
Tyrosine	29.1			17
Tryptophan	13.8	15.5	10	8

¹ Santiago & Lovell (1988)

² Ideal protein concept

* Values are significantly different ($P < 0.05$) from estimated values.

CONCLUSION

This procedure for determined essential amino acid requirements using the ideal protein concept (based on the whole body essential amino acids pattern) is much less time consuming and less costly than determining amino acid requirements of the fish by conventional means and can serve as a valuable index for formulating the diets of other cultivated tilapias. The need to optimize red tilapia diet is increasingly required for commercial culture as well as for other tilapias. It could be concluded that this data of essential amino acids is useful in developing nutrient-balanced, cost-effective research diets and practical feeds especially for red tilapia in Egypt.

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