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Optimal dietary protein requirements of triploid *Clarias gariepinus* fingerlings

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Abstract

Optimal dietary protein requirements of triploid Clarias gariepinus fingerlings (15.0g mean weight) were investigated. Seven experimental diets coded AF (Artificial feed) for AF-1 to AF-7containing 20-50% crude protein was fed to the fingerlings. A total of one hundred fingerlings were stocked in triplicates in 15 flow-through tanks each and fed for 8 weeks. Protein efficiency ratio decreased with increasing dietary protein level up to 40%. Carcass fat and protein content were negatively correlated while ash content increased initially, and later fell. Weight gain, food conversion ratio and protein efficiency ratio showed that 40% protein diet produced maximum growth in triploid C. gariepinus fingerlings with minimum cost of feed ingredients.

Keywords: *Dietary Protein, Triploid, C. gariepinus fingerlings.*

Introduction

Dietary protein is the most expensive component in fish feeds. The formulation of fish fingerlings diet represents the translation of energy and nutrient requirement into a balanced mixture of feed ingredients. This diet should therefore meet the daily need for energy and nutrients to support the maintenance and growth of fingerlings. The determination of dietary protein requirement of catfish *(C. gariepinus*) is one of the major constraints in aquaculture in Nigeria [1].

Huisman *et al.*, [2] considered lack of fish diet with adequate protein require-ment as a major cause of mortality of fingerlings of most fish species and out that fish diet must be adequate not pointed only in quantity but also in quality. Lovell [3] established that protein is required by all fish species for body maintenance and growth, and that the protein level needed for these functions varies with the species and culture environment.

For *C. gariepinus*, the optimum amount of protein in formulated feeds is important because either low or high levels of protein may lead to poor growth while excess protein in the diets may be wasteful and could cause the diet to be unnecessarily expensive.

The growing demand for fish protein in Nigeria has motivated active development of aquaculture [4]. One of the constraints to the development of aquaculture is the formulation of nutritionally balanced diets to meet the requirement of fish species. Dietary protein requirements of different species of Clariids fry and fingerlings have been reported [1, 5, 6, 7,].

However, the dietary protein requirement of triploid *C. gariepinus* fingerlings has not been documented. The aim of this study is to investigate the triploid *C. gariepinus* fingerlings optimum dietary requirement in which minimum cost of feed ingredients will be required.

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Materials and Methods

Feed Ingredients

Seven treatments of feed coded with reference number AF (Artificial Feed) for AF-1 to AF-7 containing 20-50% protein levels at 5% protein intervals were formulated from local feed ingredients. The ingredients which include fish meal, blood meal, guinea corn and groundnut cake were air dried in the laboratory at between 28-34°C, ground and sieved to obtain a particle size fraction between 90 and 150μm. The composition of the experimental diet is presented in Table 1. The proximate analysis of some of the ingredients is given in Table 2.

Experimental Procedure

The experiment was conducted at the National Institute for Freshwater Fisheries Research (NIFFR) Zonal hatchery Complex, Maiduguri, Borno State, Nigeria. Three replicates of each treatment were provided using 21 tanks of 3x3x1m. Each tank was stocked with 100 fingerlings. At the onset of the experiment, random samples of 15 fingerlings (5 from each replicate set) were obtained from each feeding group and weighed to the nearest 0.01mg with analytical metler balance.

Table 1: Ingredients and Proximate composition of experimental diets

Ingredients (g/100dry matter	AF-1 (20%)	AF-2 (25%)	AF-3 (30%)	AF-4 (35%)	AF-5 (40%)	AF-6 (45%)	AF-7 (50%)
Guinea corn	63.1	54.4	43.4	33.9	25.7	13.5	11.8
Ground nut cake	17.6	20.0	27.5	32.5	36.6	42.4	43.5
Blood meal	8.3	11.8	14.5	16.1	18.7	23.5	23.0
Fish meal	5.5	8.3	9.1	12.0	13.5	15.1	16.2
Bone meal	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin premix	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Starch	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Vegetable oil	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Table salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100	100	100
Calculated crude Protein level (%)	20.0	25.0	30.0	35.0	40.0	45.0	50.0
Analyzed nutrient content (% dry matter)							
Protein level (%)	20.1±0.3	24.9±0.4	31±0.2	35.2±0.1	39.8±0.3	45.2±0.1	49.7±0.5
Moisture	7.4±0.3	6.8±0.7	6.5±0.3	6.9±0.4	7.1±0.1	6.7±0.5	7.0±0.2
Ash	8.6±01	8.3±0.5	7.9±0.2	8.1±0.3	8.3±0.5	8.0±0.1	7.7±0.6
Crude fibre	5.1±0.5	4.9±0.3	5.1±0.6	4.7±0.1	4.5±0.4	4.8±0.2	4.7±.05
Crude lipid	4.8±0.2	4.5±0.5	4.9±0.2	5.1±0.1	5.3±0.3	5.0±0.4	4.9±.02
Energy content (KJ g^{-1})	18.8	19.0	18.9	19.2	19.6	19.6	19.5

** AF – Artificial Feed.* *** Vitamin premix – Hoffman la Roche Barle, Switzerland [3]*

Table 2: Proximate composition of dietary ingredients (% dry matter)

	Dry matter	Crude Protein	Ether Extract	Crude Fibre	Total Ash	Nitrogen-free Extract
Guinea corn	89.4±1.0	11.3±0.5	2.5±0.7	2.3±0.2	1.6±0.4	75.0±0.4
Fish meal	87.8±0.3	58.7±2.0	1.9±0.4	5.2±1.4	34.3±2.0	-
Blood meal	90.3±0.7	71.4±3.0	8.0±1.0	1.1±0.3	20.1±3.0	-
Groundnut meal cake	91.5±2.0	47.4±0.5	13.3±3.0	8.2±1.0	6.5±1.0	18.9±3.0

The fingerlings used for the experiment were produced by cold shock at 3°C for 45 minutes and they were fed to satiations four times daily at 06.00, 12.00, 18.00 and 22.00 hours (local time) at 4% body weight. Water inlet into the tanks was usually stopped during feeding to prevent the flushing out of food. Uneaten food was siphoned out every morning before the next day's feeding commenced. Subsequent weight and length measurements were taken weekly and the feed quantity fed adjusted according to the body weights.

At the end of the experiment, samples of 50 fingerlings from each group (AF-1 to AF-7) were obtained and the individual wet weights were measured to obtain their final weights. The experiment lasted for 8 weeks. Statistical difference between treatments were tested by Duncan's new multiple range test [8].

The mean daily weight gain, specific growth rate (SGR) food conversion ratio (FGR), protein efficiency ratio (PER) and apparent net protein utilization [NPU] determined using standard methods [8].

Results

The weight gain, feed utilization and growth of fingerlings are presented in Table 3. There was a relationship between the percentage of protein in the diet and the increase in weight gain up to protein level of 40%. Beyond this level the weight gain dropped. Fish fingerlings fed the diet containing 20,25,30,35,45, and 50% protein had significantly lower weight gains ($P<0.05$) than those fed the 40% protein diet. There is no significant difference ($P>0.05$) in the food conversion ratio of fingerlings fed between 20 and 35% dietary protein and fingerlings fed between 40 and 50% dietary protein. The 50% protein diet was less efficiently converted into weight gain than any of the other diets.

Generally, protein efficiency ratio of *triploid C. gariepinus* fingerlings decreased with increasing dietary protein levels from 20-35% while the apparent protein utilization decreased when dietary protein level exceed 40%. The survival rate of fingerlings fed 40% protein diet was not significantly ($P>0.05$) higher than that of the 20-35% protein diets, but was significantly higher ($P<0.05$) than those fed with diet containing 45 and 50% protein. However, the 50% protein diet has the poorest survival rate of 76.9%. The proximate carcass composition (%) of *triploid C. gariepinus* fingerlings are presented in Table 4. Body composition was affected by increasing dietary protein level. Generally, low protein diets produced lower protein in the carcass than higher protein diets.

Table 3: Effect of dietary protein level of feed utilization and growth of *triploid C. gariepinus* fingerlings

Growth Parameters	AF-1 (20%)	AF-2 (25%)	AF-3 (30%)	AF-4 (35%)	AF-5 (40%)	AF-6 (45%)	AF-7 (50%)
Mean initial body weight (g)	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Mean Final body weight (g)	26.0	29.3	34.9	46.2	53.6	49.3	47.5
Mean daily weight gain (g)	0.10^{a}	0.23^{a}	0.34^{a}	0.49^{b}	0.67^{c}	0.62^{bc}	0.60
Specific growth rate (%)	0.51^{d}	0.70^{d}	1.46^{ab}	1.08^{b}	0.93^{d}	0.90^{abc}	0.82^{abc}
Food conversion ratio	2.01^{c}	2.15^{c}	1.93^{ab}	1.85^{ab}	1.50^{a}	1.45^{a}	1.22^{a}
Protein efficiency ratio	1.80^{d}	1.73^{d}	1.62^{ab}	1.46^{b}	1.86^{d}	1.57^{b}	1.41^{a}
Apparent net protein	-	-	-	-	-	-	-
Utilization (%)	28.52^{a}	29.70^{a}	31.72^{ab}	32.19^{ab}	38.23^{c}	34.5^{b}	33.00^{b}
Survival (%)	80.00	80.15	79.80	78.5	81.70	78.4	76.90

Means within each column not sharing a common superscript are significantly different (P<0.05)

Table 4. Proximate carcass composition (%) of *triploid C. gariepinus* fed formulated diets

	Dietary protein levels (%)						
	AF-1 (20%)	AF-2 (25%)	AF-3 (30%)	AF-4 (35%)	AF-5 (40%)	AF-6 (45%)	AF- 7 (50%)
Protein (%)	13.16[a]	15.00[a]	15.90[b]	16.0	17.60[d]	16.70[c]	16.60[c]
Lipid (%)	6.20[c]	5.90[c]	5.80[bc]	5.60[b]	5.10[a]	5.35[a]	6.10[c]
Moisture (%)	77.60[a]	75.60[a]	75.80[a]	75.80[a]	7410[b]	73.60[c]	73.90[c]
Ash (%)	3.30[a]	3.85[b]	3.96[bc]	4.10[c]	3.50[a]	4.00[c]	3.62[a]

Means within each row not sharing a common superscript are significantly different (P<0.05).

Discussion

The results show that 40% dietary protein is the optimal level for maximum growth of *triploid C. gariepinus* fingerlings. This level is comparable to the protein requirement of channel catfish [10]. It also agrees with similar values reported for fingerlings of *Heterobranchus bidorsalis*, but differs from the dietary protein requirements of other Clariid catfishes such as *C. isheriensis, C. buthopogon* and *C. batrachus* for which 37% and 30% were reported [6].

Zeitoun *et al* [11] reported that the growth depression observed when fish was fed diets exceeding the optimal level of protein requirement was probably due to protein toxicity. [12] observed that caloric diets of high protein levels contain insufficient non-protein energy which results in part of the dietary protein being metabolized for energy. Among the dietary treatment, the maximum protein efficiency ratio was recorded for fish fed 40% protein diet. This ratio increased as the dietary protein level decreased and this indicated that protein conversion efficiency in *triploid C. gariepinus* was higher for low protein diets than for high protein diets (45% protein diets).

The carcass composition at the end of the experiment shows that whole body protein increased with increasing protein levels while fat decreased correspondingly. However, fish fed the 45% and 50% protein diets had higher carcass fat content which may be stored in the body. Moisture content increased with increase in protein level and showed an inverse relationship with carcass fat. Body ash was unaffected by dietary regime as has been reported for other fish species [13,14,15]

To reduce the cost of feed ingredients, 40% dietary protein levels is optimal to attain maximum growth of triploid *C. gariepinus* fingerlings whose culture is gaining popularity in Nigeria because of their relative fast growth.

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