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Growth, survival and nutrient utilization of the brackish water catfish (*Chrysicthys walkeri*) fry as affected by dietary protein and energy levels

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Abstract

The effect of varying dietary protein and calorie levels on the growth, survival and nutrient utilization of 540 brackish water catfish (Chrysicthys walkeri) fry average liveweight of 0.14g was investigated in a 3x3 factorial experiment with 3 calorie levels (2800, 3000 and 3200 Kcal ME/Kg diet) and 3 levels of crude protein (36%, 39% and 42%) giving a total of 9 diets, fed to the fish for a period of 56 days. Mean weight gain, specific growth rate, feed conversion ratio, survival and protein productive value were significantly higher ($P < 0.05$) in fish fed diet 6 (3000 Kcal ME/Kg and 42% crude protein) when compared to other diets. Weight gain was highest in diet 6 with a value of 0.64g and lowest (significantly $P< 0.05$) with a value of 0.46g in diet 7. Percentage survival was highest in diet 6 with a value of 71.67% and lowest in diet 1 (2800Kcal ME/Kg and 36% crude protein) with a value of 53.34%, while protein productive value was highest in diet 6 (78.40) and lowest in diet 2 (2800Kcal ME/Kg, 39% crude protein) with a value of 64.33%. Thus, C. walkeri fry survived and performed best when fed on 42% crude protein and 3000Kcal ME/kg diet.

Key words: Growth, protein, Calorie, *Chrysicthys walkeri.*

Introduction

The level and efficiency of production of any animal depends on the provision of adequate protein, energy, vitamin and mineral salts in the diet in the right proportions. In broad classification of dietary essentials, nutritionally and economically, protein and energy are probably the ones of greatest significant. It is to our advantage therefore, to make the best possible use of both energy and protein by ensuring that the amount required for maximum growth are optimum in the diet (Davidson, 1961). This is because the worth of a diet is its potentiality to provide the fish with nutrients for maintenance and growth.

Moreover, Lovell (1989) noted that a dietary excess or deficiency of useful energy can reduce growth rate. The reason is because energy needs for maintenance and voluntary activity must be satisfied before energy is available for growth. He further stressed that protein will be used for energy when the diet is deficient in energy relation to protein. On the other hand, a diet containing excess energy can restrict food consumption and thus prevent the intake of necessary amount of protein and other nutrients for maximum growth.

Although, information on the requirements for protein in most culturable indigenous fish species are very much available (Faturoti *et al*, 1986, De Silva and Gunasekara, 1989, Faturoti and Obasa, 1992 and Obasa and Faturoti, 2000), little or no work has been done on the energy or calorie requirement. Xianghua(1988) recorded a

daily energy budget running from 3100 to 3400 Kcal ME/Kg feed in mud carp while Smith (1989) reported 3000 Kcal DE/Kg of feed in channel catfish (*Ictalurus punctatus*). On the above background, this work was undertaken, to assess the caloric and protein needs of the brackish water catfish (*C. walkeri*) fry, an indigenous species with high consumer acceptance and commercial importance in Nigeria.

Materials and Methods

The design of this experiment was 3x3 factorial with 3 levels of energy (2800, 3000 and 3200 Kcal ME/Kg), and 3 levels of crude protein (36%, 39% and 42%) giving a total of 9 treatments (Table 1). Five hundred and forty (540) fry of *C. walkeri* fry of 0.14g mean weight, hatched in the hatchery of the Department of Wildlife and Fisheries Management, University of Ibadan, Ibadan, Nigeria were stocked in plastic tanks of 30l capacity at the rate of 30 fish per tank. Every treatment was replicated and a constant water volume of 20*l* was maintained in each tank. Feeding of fish started immediately after egg yolk absorption. Fish were fed to satiation three times at 8.00, 14.00 and 18.00 h daily for a period of 8 weeks. Left over feeds and feaces were siphoned out daily, while stale water drained every other day to maintain relatively uniform physico-chemical parameters.

Dissolved oxygen was determined weekly by the Winkler titrimetric method (Mackareth 1963) while hydrogen ion concentration was measured weekly using pH meter (E.52.0) Metrolin model. Water temperatures in the experimental system was measured daily by using mercury thermometer. Aeration was facilitated by the use of aerators (TECAS 180) model. Batch weighing of fish in each tank was carried out at the beginning of the experiment and afterward on weekly basis, using a mettle PE2110 top-loading balance.

Proximate analyses of experimental diet and fish samples before and after the experiment were carried out using A.O.A.C.(1990) method. The metabolizable energy of each diet was estimated from the metabolizable energy of the ingredients in the gross composition of each diet according to (Aduku 1993).

Diet performance was evaluated on experimental fish according to Olivera *et al* (1990) as follows:

Weight gain = Final body wt – initial body wt

Specific growth rate (SGR %/day) =

$$\frac{(\log_e \text{final body wt} - \log_e \text{initial body wt}) \times 100}{\text{Time (days)}}$$

Feed conversion ratio (FCR) =

$$\frac{\text{Dry wt. of feed fed (g)}}{\text{Fish weight gain.}}$$

Protein efficiency ratio (PER) =

$$\frac{\text{Fish weight gain (g)}}{\text{Protein fed.}}$$

Apparent net protein utilization = $\frac{Nb - Na \times 100}{Ni}$

Where Na = Body nitrogen at beginning of test.

Nb = Body nitrogen at the end of test.

Ni = Amount of nitrogen ingested.

Percentage Survival =

$$\frac{\text{Initial number of fish stocked - Mortality} \times 100}{\text{Initial number of fish stocked}}$$

Statistical comparison of growth performance, nutrient utilization and survival values were made by using analysis of variance (ANOVA) and correlation analysis system (SAS 1988).

Results

The water quality parameters monitored during the experimental period were not significantly different ($P < 0.05$), the mean values obtained are as followed: temperature, 26.30 ± 0.20oC; dissolved oxygen, 6.40 ± 0.12mg/l; and pH, 7.30±0.07. The nutrient and energy composition of the test diets are shown in Table 1. Crude protein ranged from 36.42% to 42.12% while the calculated metabolizable energy ranged from 2773.72 to 3206.50 Kcal ME/Kg. Fat content increased as the energy level increased from 7.32% in diet 1 to 9.92% in diet 7. Moisture ranged from 6.72% in diet 9 to 8.83% in diet 5, while nitrogen free extract (NFE) decreased as energy and protein increased.

The carcass analysis of the tissue of experimental fish is as shown in Table 2. Crude protein increased at each energy level as energy increased, with the peak at diet 6 (3000 Kcal ME/Kg and 42% protein level), which was also significantly higher (P<0.05) than the lowest value of 62.24% in diet 1. Fat also increased significantly (P<0.05) as protein and energy increased with the highest (6.87%) in diet 8 and lowest in diet 1. Table 3 shows the values of the growth, nutrient utilization and percentage survival of the brackish water catfish *C. walkeri* fed experimental diets for 8 weeks. Weight gain was significantly higher (P<0.05) in diet 6 than in other diets while the lowest value of 0.46g was observed in diet 7. Specific growth rate was directly proportional to increase in protein level at each calorie level. The highest value of 2.45% per day was obtained in diet 6 and significantly different (P<0.05) from the value of 2.11% in diet 1. Feed conversion ratio also increased as protein increased at each calorie level. The lowest value being 2.13 in diet 6, which was significantly lower (P<0.05) than 2.77 observed in diet 7.

Productive protein value displayed consistently higher values in diets with 42% protein with the peak at diet 6 being significantly higher (P<0.05). Survival also maintained in interplay between the protein and calorie contents of the diets. Lowest percentage survival of 53.34% was recorded in diet 1 while the highest of 71.67% was obtained in diet 7.

Discussion

The trend observed in this work showed that fish fed diets with 42% crude protein and 3000KcalME/Kg calorie gave the best performance. This is similar to the results of workers like Sidiqui *et al* (1988) who observed best performance in *Oreochromis niloticus* fry on 40% dietary protein and 2913 Kcal ME/Kg while Reis *et. al.*(1989) observed the best feed conversion ratio and specific growth rate in channel catfish *Ictalurus punctatus* on 39% dietary protein and 3050Kcal ME/Kg while Khan *et al.*, (1993) reported higher percentage weight gain in Malaysian fresh water catfish *Mystus nemerus* on 42% crude protein and 5600Kcal gross energy/Kg. The results observed in this work, whereby growth performance and nutrient utilization were closely related to protein and energy levels of feed, could be as a result of interplay between protein and energy. Hence, in formulation of feed for fish, protein should not be considered in isolation of energy. This observation is similar to that of Prather and Lovell (1977), who reported optimum growth in *Ictalurus punctatus* on 29% protein when total energy was 2200 Kcal ME/Kg, and increasing the feed energy to 2800Kcal/Kg permitted the fish to use 42% protein food and attained considerably better growth.

The lower growth performance and nutrient utilization in fish fed diets with higher calorie value (3200Kcal ME/Kg) in this study might have resulted from lower feed consumption. Lovell, (1989), noted that a diet containing excess energy can restrict food consumption and thus prevent the intake of necessary amount of protein and other nutrients for maximum growth. Sheng and He, (1994) observed highest weight gain, feed conversion ratio and specific growth rate in bream (*Megalobrama skrikovii Dybowski*) fingerlings on gross energy of 3790Kcal/Kg feed. These, however decreased as gross energy increased to 3810 Kcal/Kg.

The high survival recorded in diet 6 showed that the diet was well tolerated by *C. walkeri* fry. This is similar to the observation of Sidiqui *et al* (1988) who reported the highest growth and survival of *O. niloticus* fry on 40% crude protein and 2913Kcal ME/Kg diet. Likewise, Alavia and Lin (1988) reported the highest survival in milk fish *(Chanos chanos)* reared on 41% protein. While Carl *et. al.* (1995) reported best growth and survival of sunshine bass *(Morone chrysops X M. saxatilis)* on 40% protein and 4000 Kcal/Kg gross energy in diet.

Conclusively, it is evident from the results of this investigation that brackish water catfish (*C. walkeri*) fry, grow, survive and utilize better 42% dietary crude protein and 3000 Kcal ME/Kg energy.

Table 1: *Percentage composition of experimental diets fed C. walkeri for 56 rearing days*

Ingredients	M.E[1]. (2800kcal)			M.E. (3000kcal)			M.E. (3200kcal)		
	36%CP DIET 1	39%CP DIET 2	42%CP DIET 3	36%CP DIET 4	39%CP DIET 5	42%CP DIET 6	36%CP DIET 7	39%CP DIET 8	42%CP DIET 9
Yellow Maize	35.00	32.00	18.00	29.14	25.40	16.09	25.15	23.15	20.50
Groundnut Cak	24.58	35.09	45.47	24.53	35.09	42.56	28.50	30.50	25.57
Fish Meal	17.18	12.52	15.29	13.82	17.44	17.02	17.50	19.67	20.05
Blood Meal	8.19	10.04	6.39	6.40	6.72	6.51	6.50	7.83	15.03
Brew. Waste	6.20	2.50	6.00	4.00	3.00	6.00	6.50	3.50	2.00
Palm Oil	5.00	4.00	5.00	8.25	9.00	8.00	12.00	11.50	11.00
Bone Meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Vit. Premix	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Oyster Shell	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated: Metabolizable engy/Kg	2796.12	2773.72	2807.57	2991.49	2996.02	2978.99	3195.75	3197.65	206.50
Analysed: Protein(%)	36.52	39.48	42.35	36.19	38.76	41.94	36.21	39.14	42.12
Moisture (%)	7.81	7.89	7.47	7.92	8.83	6.84	8.06	7.41	6.72
Fat (%)	7.32	7.84	8.11	8.54	8.74	9.15	9.92	9.35	9.29
Crude Fibre(%)	5.49	5.57	4.61	4.71	5.02	4.03	4.76	4.98	4.12
Ash (%)	11.84	11.61	10.44	12.43	10.69	10.39	11.61	10.44	11.13
Nitrogen Free Extract (%)	31.02	27.71	27.02	30.21	28.27	27.65	29.64	28.68	26.52

RADAR VIT. PREMIX supplies per 100g diet. Palmitate (A) 1000IU; Cholecalciferol (D3) 1000 IU; α-tocopherol acetate (E) 1.1mg; menadione (K) 0.2mg; Thiamine (B1) 0.63mg; Riboflavin (B2) 0.5mg; Pantothenic (B6) 0.15mg; Cyanocobalamine B12, 0.001mg; Nicotinic acid 3.0mg; Folic , 0.01mg; Choline, 31.3mg; ascorbic acid C, 2.5mg; Fe 0.05mg; Cu, 0.25mg Mn, 6.0mg; Sn, 5.0mg; S,0.02mg.

Table 2: *Proximate composition (%) of experimental fish (brackish water catfish (C. walkeri) fry) before and after feeding trial for 56 days.*

Para-meters (%)	Before Trial	M.E. 2800Kcal/Kg			M.E. 3000Kcal/Kg			M.E. 3200Kcal/Kg			SEM
		PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8	PC 9	
		36% CP	39%CP	42%CP	36%CP	39%CP	42%CP	36%CP	39%CP	42%CP	
CP	59.05d	62.24c	62.43b	62.68b	62.29c	62.70a	62.90a	62.16c	62.68b	62.83a	1.13
Moisture	3.51c	5.62b	6.32a	6.10a	5.73b	5.85ab	6.15a	5.76b	5.63b	6.36a	0.82
Fat	5.32b	6.25b	6.52b	6.78a	6.39b	6.61a	6.61a	6.41b	6.86a	6.79a	0.44

SEM = Standard error of the mean. Values without common alphabet in horizontal rows are significantly different (P<0.05).
CP= Crude protein

Table 3: *Growth performance, nutrient utilization and percentage survival of the brackish water catfish (C. walkeri) fry fed experimental diet for 56 days*

Parameters	M.E. 2800 Kcal/Kg			M.E. 3000 Kcal/Kg			M.E. 3200 Kcal/Kg			S.EM.
	36% CP Diet1	39% CP Diet 2	42% CP Diet 3	36%CP Diet 4	39% CP Diet 5	42%CP Diet 6	36% CP Diet 7	39%CP Diet 8	42% CP Diet 9	
Initial wt. (g)	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0
Final wt. (g)	0.61	0.72	0.74	0.66	0.68	0.78	0.60	0.74	0.72	0.03
Weight gain(g)	0.47^{d}	0.58^{b}	0.60^{b}	0.52^{c}	0.54^{c}	0.64^{a}	0.46^{d}	0.60^{b}	0.58^{b}	0.03
SGR (%/day)	2.11^{e}	2.26^{d}	2.38^{b}	2.22^{d}	2.33^{c}	2.45^{a}	2.08^{e}	2.26^{d}	2.34^{b}	0.04
FCR	2.66^{b}	2.45^{e}	2.23^{gf}	2.46^{e}	2.26^{g}	2.13^{f}	2.77^{a}	2.39^{cd}	2.29^{de}	0.04
PER	1.05^{cd}	1.06^{c}	1.07^{bc}	1.08^{abc}	1.13^{a}	1.12^{a}	1.00^{d}	1.07^{bc}	1.04^{cd}	0.02
PPV	70.91^{c}	64.33^{fg}	71.81^{b}	67.52^{d}	73.32^{ab}	78.40^{a}	67.62^{ed}	72.61^{b}	68.70^{e}	0.22
Survival %	53.34^{d}	65.00^{abc}	63.34^{abc}	60.00^{cd}	63.34^{abc}	71.67^{a}	57.67^{cd}	65.00^{abc}	68.34^{ab}	0.26

CP= Crude Protein, FCR=Feed Conversion Ratio, PER=Protein Efficiency Ratio, PPV= Productive Protein Value, SGR=Specific Growth Rate
Note: Values with common alphabets in horizontal rows are not significantly different (P>0.05).

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