INFLUENCE OF DIETARY PROTEIN CONTENT ON GROSS EFFICIENCY OF FOOD CONVERSION AND NET PROTEIN UTILIZATION OF AFRICAN CATFISH (*Clarias gariepinus* BURCHELL, 1822) FRY

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ABSTRACT

The influence of dietary protein content on some nutritional parameters of Clarias gariepinus fry was studied. Seven diets were formulated to yield 28, 31, 34, 37, 40, 43, and 46% crude protein (CP) while the 8th 48.8% CP diet was prepared from microencapsulated whole egg and preserved in a refrigerator at 7° C. The diets were fed to advanced fry of C. gariepinus (mean initial weight, 1.6 ± 0.24 g) in triplicate 25 L plastic baths per treatment at 5% body weight per day in three portions for 56 days. The mean weight gain (MWG), daily rate of growth (DRG) increased as the dietary protein level increased up to 40% but gradually declined as CP level increased while increase in CP did not significantly affect daily rate of feeding (P > 0.05). The best response of fish to gross efficiency of food conversion was within 37 - 40% dietary CP and thus reflected the best mean weight gain (0.86 - 1.93g), DRG (0.17 – 20 g), and nitrogen metabolism (12.62 - 13.43 mg/100g) respectively. There was a relatively high metabolizable energy:protein ratio for the 48.80% CP diet (9.88 KJ/mg) compared to 40% CP diet (7.60 mg/kg). Similarly, the low net protein utilization (NPU) value recorded with diets of between 31% to 40% CP compared to the NPU value of higher CP level (43% to 48.8%) suggests that despite the apparently better utility of protein by fish fed the higher CP diets, much of the ingested protein might have been affected by endogenous nitrogen losses resulting in its unavailability for productive use by the fish.

Keywords: *Clarias gariepinus,* Dietary protein, Growth, Feeding rates, Net protein utilization.

INTRODUCTION

The effect of feeding is one significant factor among the setbacks to the rapid growth of the African catfish (*Clarias gariepinus* Burchell, 1822) under culture in Nigeria. Nutritionists have tried to study as many growth and nutritional parameters as possible in order to enhance better understanding of production process both in nature (Gerking, 1972) and in fish culture (Brett, 1976). The importance of protein in fish diet is mainly associated to its role as the source of building material for growth and the production of enzymes (Steffens, 1989). Protein is the basic component of animal tissue and is an essential nutrient for maintenance and growth. Kaushik *et al.* (1995) reported that protein in the diet has an obligatory role of replacing lost body proteins (skin, digestive track) as well as the losses due to amino acid oxidation and utilization for purposes other than synthesis and protein turn-over.

Various researchers have carried out several nutrition studies on the protein requirement of warm water fishes. Faturoti *et al.* (1986) reported that 40 % crude protein diet was optimum for growth and utilization of *C. lazera* fry while no significant difference (P > 0.05) was observed between the protein values of the carcasses of the fish fed 37 % and 40 % protein diets. Although no significant correlation (P > 0.05) was established between nitrogen metabolism and specific growth rates of *C. gariepinus* fry (Ugwu *et al.,* 2001), the workers reported that 28 - 56 day-old fry of the African catfish, metabolized less nitrogen than 56 - 84 days old fry. The responses of fish to dietary protein levels could vary among warm water fish species. For instance, while Ogunji and Wirth (2001) reported increased growth rates and body protein of tilapia (*Oreochromis niloticus*) fingerlings as the dietary protein increased, the specific growth rates of *C. gariepinus* fry were not significantly different (P > 0.05) when fed diets ranging between 31 % and 40 % protein (Ugwu *et al.,* 2001). Dabrowski (1977) earlier indicated that the determination of optimal protein diet for fish was complicated because protein level is considerably affected by the components of the

diet such as the type o dietary protein and the experimental condition. This makes it di icult to compare studies. The need to relate all reports about the dietary requirements and the nutritional response studies o ish has been suggested by Ogunji and Wirth (2001).

Other studies (Jauncey, 1982; Wang et al., 1985; and Ogunji and Wirth, 2000) have also identi ied the protein requirements o di erent ish species with varied results on the e ect o protein on growth rate, ood conversion and body composition. Variability in protein requirements could possibly be due to the di erent e ects o the ree amino acids supplied by the dietary proteins and the consequent catabolism o tissue proteins. It has been reported that α-keto acids resulting rom the catabolism o ree amino acids are used as a source o energy or carbon or at synthesis or or glycogenesis (Kim *et al.*, 1992). The workers also maintained that amino acid oxidation is principally in luenced by the level o protein (or amino acid) or other energy sources in the diets. In addition, in the circulatory luid o animals including ish, most lipids orm complexes with protein (Gotto *et al.*, 1986) in the orm o lipoproteins, which are the major carriers o lipids and other hydrophobic compounds (Ando and Mori, 1993). It is there ore possible that a lack o adequate protein may result in loss o serum lipoprotein thereby a ecting the transport and storage o lipids in *C. gariepinus*. There ore, a de iciency o protein may impede physiological unctions and urther reiterates the need or optimal dietary protein or e ective ish rearing. This study investigated the in luence o dietary protein content on gross e iciency o ood conversion and protein utilization o A rican cat ish (*C. gariepinus*) ry and also studied other growth and nutritional parameters o the species that are a ected by dietary protein intake.

MATERIAL AND METHODS

Experimental Procedure: Four hundred and eighty (480) advanced ry (mean initial weight, 1.60 ± 0.24 g) o *C. gariepinus* were randomly allotted to 8 triplicate 25 L plastic baths at 20 ry per bath, replicated three times and allowed to acclimatize or 14 days in the Research Laboratory o Ebonyi State University, Abakaliki, Nigeria. The ish were ed or 56 days with eight diets, seven o which were ormulated to yield 28, 31, 34, 37, 40, 43 and 46% crude protein content while the 8th diet comprised a 48.8% crude protein microencapsulated whole egg diet (M). Gross components o diets calculated with Pearson's square method (De Silva and Anderson, 1995) is shown in Table 1. Temperature readings o water were taken thrice daily with a maximum and minimum thermometer while the pH was recorded with a pH meter (model PH J – 201 L). The water conductivity was measured with a conductivity meter and dissolved oxygen was measured with Hach test kit FF3.

The ish were ed at our-hourly interval starting rom 0800 h, at the rate o 5% (live weight basis) o their total biomass per day in three portions. Weekly weighing o the ish was carried out with the aid o a Mettler balance (model P 1210) and the eed administered was adjusted in accordance with the body weight o ish. Owing to the ouling o water by aeces and other eed debris, the plastic baths were cleaned on weekly (7 days) basis and replenished with clean tap water.

Analytical Procedure: The proximate compositions o both the experimental diets and ish were analysed by methods described by Windham (1996). Crude protein was determined by micro kjeldahl method, at by soxhlet extraction method, ibre by the ceramic ibre ilter method and ash by combusting in mu le urnace at 600° C or 2 h. The digestible carbohydrate content was computed by obtaining the di erence between the % crude protein + % at + % ibre + % ash contents and 100%. The amino acid concentrations o samples were determined by acid hydrolysis and high per ormance liquid chromatography (HPLC) method as described by Ogungi and Writh (2001).

Determination of Growth and Nutrient Parameters: The mean weight gain (MWG) o ish was computed ollowing Ishwata (1969) method. The daily rate o growth (DRG) was calculated rom the relationship between the mean increase in weight per day and the body weight o ish, thus: DRG = (mean increase in weight)/(body weight o ish). The daily rate o eeding (DRF) was obtained rom the expression: DRF = (mean ration per day)/(body weight o ish). While the gross e iciency o ood conversion (GEFC) was calculated rom the relationship between the daily rate o growth (DRG) and daily rate o eeding (DRF): GEF = DRG/DRF.

The nitrogen metabolism (Nm) was derived using the method o Dabrowski (1977), thus:

$$Nm = \frac{(0.549)(a+b)h}{2},$$

where: a = initial weight o ish, b = inal weight o ish, h = experimental duration in days.

The net protein utilization (NPU) was estimated according to Miller and Bender (1955) method, thus:

$$NPU = \frac{b - No + Nm}{1b},$$

Table 1: Gross composition (% dry matter) of experimental diets fed to *Clarias gariepinus* fry or 56 days

Diet (% crude protein in diet)	Feed ingredient											
	Yellow maize	Groundnut Cake	Fishmeal	Blood meal	Brewers waste	Oyster shell	Ad-vit[1]	Salt	Palm oil	Bone meal	Egg (M)[2]	Total
1 (28.00%)	43.10	28.71	8.61	5.73	5.00	0.50	0.60	0.25	5.00	2.50	-	100
2 (31.00%)	36.70	32.97	9.89	6.59	5.00	0.50	0.60	0.25	5.00	2.50	-	100
3 (34.00%)	30.30	37.23	11.17	7.47	5.00	0.50	0.60	0.25	5.00	2.50	-	100
4 (37.00%)	29.92	41.49	12.45	8.30	5.00	0.50	0.60	0.25	5.00	2.50	-	100
5 (40.00%)	17.54	45.74	13.72	9.12	5.00	0.50	0.60	0.25	5.00	2.50	-	100
6 (43.00%)	11.14	50.03	15.03	9.95	5.00	0.50	0.60	0.25	5.00	2.50	-	100
7 (46.00%)	4.80	54.26	16.31	10.78	5.00	0.50	0.60	0.25	5.00	2.50	-	100
8 (48.80%)	-	-	-	-	-	-	-	-	-	-	100	100

[1]Advit: Pfizer livestock feeds production supplying the following vitamins and minerals per grain of diet: A, 19823 IU; D_3, 1965 I.U; B_{12}, 10 g ton^{-1}; Riboflavin, 41 mg; Niacin, 246 mg; Pantothenic acid, 98 mg; Folic acid, 19 mg; Manganese, 241 mg; Zinc, 100 mg; Iodine, 20 mg; and Oxytetracycline hydrochloride, 20 g ton^{-1}. [2]M = Micro encapsulated whole egg diet.

Table 2: Proximate composition of experimental diet for *Clarias gariepinus* fry

% crude protein diets	Proximate composition (% dry matter)									
	Dry matter	Crude protein	Ether extract	Ash	NFE[1]	Crude fibre	ME[2] (KJ/kg)	TDN[3]	[4]SE	ME:Protein ratio (KJ/mg)
28	86.57	27.86	10.24	12.96	40.93	8.01	12.98	80.44	75.36	10.25
31	88.64	30.46	10.36	13.68	38.23	7.27	13.00	80.56	75.52	10.05
34	90.71	33.68	10.72	14.72	33.78	7.10	13.03	80.84	75.61	9.18
37	89.25	36.56	10.86	10.42	33.96	8.20	12.72	80.72	75.74	8.30
40	88.92	38.68	11.24	10.68	32.33	7.07	12.59	80.96	75.60	7.60
43	87.83	41.72	12.43	9.74	28.9	7.20	12.58	81.36	74.45	7.56
46	91.45	43.46	13.85	9.63	26.64	7.02	12.57	81.45	72.92	7.52
48.80 (M)	-	48.80	43.36	-	-	-	89.47	-	-	9.88

[1]Nitrogen Free Extract = 100 – (% Ash + % crude fibre + % Fat +% Protein). [2]Metabolizable energy; [3]Total digestible nutrient. [4]Starch equivalent.

where: No = nitrogen content of fish before the experiment, Nb = nitrogen content of fish after the experiment, Nm = nitrogen metabolism, 1b = nitrogen content of experimental diet.

Statistical Analysis: The analysis of variance to test for statistical difference among treatment means (Steel and Torrie, 1980), and factorial and regression analyses of measured parameters were done with the computer Statistical Package for Social Sciences (Nie *et al.*, 1972). Prediction equations for the growth and nutrient parameters were derived to reflect the degree of linear relationships (Y = a + bx) of the sets of parameters.

RESULTS

The results are shown in Tables 2 – 7. Tables 2 and 3 showed the proximate compositions of the experimental diets and the fish respectively. Table 4 shows the selected amino acids composition of the experimental diets. The mean weight gain (MWG) of *C. gariepinus* fry fed the different diets is shown in Table 5. Table 6 shows the correlation matrix of nutrient parameters of the *C. gariepinus* fry. The mean water temperature was 28.0 ± 1.0° C, the mean pH was 6.8 ± 0.1, the mean water conductivity was 1.03 ± 0.10g S/cm and mean dissolved oxygen was 5.55 ± 1.00 mg/L. There were relatively lower qualities of dietary proteins at the lower CP levels (28% and 31%) (Table 2). These produced lower protein deposition in the body of the fish fed the diets (Table 3) compared to the higher protein deposition in fish fed the higher dietary CP levels (37 % and 40 %). However, the fish also deposited relatively lower protein when fed higher CP diets of 43 % and 46% than the 37% and 40% CP diets. Table 4 also shows that there are satisfactory levels of amino acids in the 37% and 40% CP levels compared to lower CP levels. The amino acid levels in 43% and 46% CP diets were however in most cases higher than the lower CP levels.

Table 3: Proximate body composition of *Clarias gariepinus* fry fed different dietary protein levels for 56 days

% crude protein in the diet	Proximate body composition (% dry matter)					
	Moisture	Crude protein	Ether extract	Crude Fibre	Ash	Gross Energy (KJ g^{-1})
Initial	75.82	59.68	26.68	0.70	12.94	23.15
28	73.64	63.25	25.66	0.68	10.41	22.31
31	72.53	64.36	24.56	0.64	10.44	21.96
34	70.35	65.46	25.26	0.60	8.68	22.68
37	75.46	66.38	24.78	0.64	8.20	23.67
40	75.35	66.66	24.12	0.61	8.61	22.82
43	74.80	65.23	26.02	0.60	8.15	23.32
46	76.30	64.5	26.68	0.62	8.20	23.46
48.8	98.66	-	-	-	-	-

Table 4: Selected amino acids composition (% dry matter) of experimental diets fed to *Clarias gariepinus* frys[1]

Name of amino acid	Experimental diet[2]							
	28%	31%	34%	37%	40%	43%	46%	48.8%
Aspartic acid[3]	1.72	1.99	2.08	3.02	3.20	4.21	2.58	4.36
Glutamic acid[3]	3.26	3.56	3.72	3.95	3.48	4.68	3.73	4.78
Serine[3]	1.00	1.15	1.25	1.32	1.60	0.62	0.72	1.58
Histidine[3]	0.38	0.40	0.60	0.50	1.77	0.80	1.67	1.02
Glycine[4]	0.88	0.92	0.98	0.98	1.06	0.97	0.86	1.35
Threonine[3]	0.98	1.00	1.01	1.05	0.68	0.82	0.72	1.00
Arginine[3]	0.97	1.10	1.23	1.31	1.57	1.66	0.98	1.10
Carnosine[4]	0.04	0.06	0.08	0.08	0.11	0.17	0.45	0.13
Taurine[4]	0.01	0.02	0.05	0.04	0.07	0.02	0.16	0.002
Alanine[3]	0.98	1.00	1.17	1.66	1.80	1.75	1.96	2.96
Tyrosine[3]	0.97	1.00	1.15	1.25	1.43	1.52	1.58	1.66
Valine[1]	0.05	0.06	0.07	0.08	0.11	0.12	0.14	0.13
Phenyl alanine	1.00	1.11	1.21	1.25	1.33	1.68	1.73	1.80
Isoleucine	0.60	0.80	1.00	1.06	1.22	1.37	1.31	2.45
Leucine[3]	1.00	1.04	1.07	1.11	0.80	0.79	0.79	0.94
Ornitine[4]	1.36	1.56	1.66	1.80	2.04	2.28	2.13	2.30
Lysine[3]	0.02	0.02	0.03	0.03	0.04	0.05	0.06	0.06

[1]Analysis was carried out using HPLC; 5 mg samples were hydrolyzed at 110° C for 24 h. [2]All values of each amino acid at different levels in a row are significantly different ($p < 0.05$). [3]Essential amino acids; [4]Non-essential amino acids.

Table 5: Growth and nutrient utilization of *Clarias gariepinus* fry fed different dietary protein levels[1]

% Crude protein in the diets	Growth and nutrient parameters							
	Initial weight (g)	Final weight (g)	Weight gain (g)	DRG[2] (g)	DRF[3] (g)	GEFC[4]	Nm[5]	NPU[6] mg IU
28	1.60	2.38	0.28^{c}	0.013^{b}	0.10^{b}	0.70^{b}	4.58^{b}	1.15^{c}
31	1.84	2.22	0.38^{d}	0.016^{b}	0.11^{b}	0.09^{b}	5.99^{b}	1.23^{c}
34	1.46	2.10	0.64^{c}	0.014^{b}	0.10^{b}	-0.02^{c}	5.18^{b}	1.08^{c}
37	1.62	2.48	0.86^{c}	0.017^{b}	0.14^{b}	0.11^{b}	6.46^{b}	0.85^{b}
40	1.63	3.56	1.93^{a}	0.020^{b}	0.11^{b}	0.11^{b}	12.62^{c}	2.29^{d}
43	1.80	2.36	0.56^{b}	0.008^{c}	0.06^{b}	0.04^{a}	13.43^{c}	2.64^{d}
46	1.60	2.16	0.51^{b}	0.007^{c}	0.07^{b}	0.02^{a}	13.68^{c}	2.86^{d}
48.8	1.56	2.07	0.51^{b}	0.009^{c}	0.03^{b}	0.01^{a}	3.00a	0.39^{a}

[1]Values in the same column having the same subscript are not significantly different ($P > 0.05$); [2]Daily rate of growth. [3]Daily rate of feeding. [4]Gross efficiency of food conversion. [5]Nitrogen metabolism; [6]Net protein utilization

In all cases, for each amino acid there was significant difference in amino acid values among the diets ($P < 0.05$). In Table 5, the weight gain tended to increase with the increase in dietary crude protein (CP) up to 40% and declined as the dietary CP increased up to 48.80%. There was a significant effect ($P < 0.05$) of increase in the dietary CP on MWG (Table 5). While MWG was significantly positively correlated ($P < 0.05$) with the daily rate of growth ($r = 0.87$) no significant correlation ($P > 0.05$) was established between MWG and the daily rate of feeding ($r = -0.42$), the

Table 6: Correlation matrix of nutrient parameters of *Clarias gariepinus* fry fed different dietary protein levels[1]

	DRG[2]	DRF[3]	GEFC[4]	NM[5]	MWG[6]
DRG[2]	1.00	-	-	-	-
DRF[3]	-0.43	1.00	-	-	-
GEFC[4]	0.12	0.18	1.00	-	-
NM[5]	-0.13	-0.03	-0.07	1.00	-
MWG[5]	0.87* *	-0.42	0.26	-0.17	1.00

*[1]For statistical significance, ** = significant at 1% (P < 0.01); those figures without * or ** are not significantly correlated at 1% (P < 0.05) or 1% (P < 0.01). [2]Daily growth rate (g), [3]Daily rate of feeding (g), [4]Gross efficiency of food conversion (g)., [5]Nitrogen metabolism, [6]Mean weight gain per week (g).*

Table 7: Prediction equations of nutrient parameters of *Clarias gariepinus* fry fed different dietary protein levels[1]

Dependent Variable y	Independent variable x	Predication equation y = a+ bx	± S.EM	r	r^2	Significant level.
Daily rate of feeding	Daily rate of growth	Y = 0.13 – 0.80x	0.03	0.43	0.27	n.s.
Nitrogen metabolism	Protein intake per week	Y = 0.47 + 13.49x	1.19	0.94	0.89	* *
Gross efficiency of food conversion	Daily rate of growth	Y = 0.02+ 2.26x	0.32	0.12	0.02	n.s.
Mean weight gain per week	Feed per fish per week	Y = 0.12+ 0.08x	0.11	0.19	0.04	n.s.

*[1]For the statistics, n.s. = not significant at 5% probability; ** = significant at 1% probability; r = correlation coefficient; r^2 = coefficient of determination; SEM = standard error of mean.*

gross efficiency of food conversion (r = 0.26), and the nitrogen metabolism (r = 0.17) (Table 6).

Whereas there was significant difference (P < 0.05) in the mean values of DRG of fish (Table 5), the mean values of DRF were not significantly different (P > 0.05) as the dietary CP increased from 28 to 48.80%. For the DRG, the values were significantly the same from 28% to 40% but significantly declined thereafter as the CP level approached 48.80% (P < 0.05). Both the DRF and the DRG were each not significantly correlated with GEFC and Nm (P > 0.05) (Table 6). While DRG was significantly correlated with MWG (P < 0.05), DRF was not significantly correlated (P > 0.05).

Fish responses to the gross efficiency of food conversion (GEFC) showed no definite pattern at the lower dietary CP levels (28 % to 38%) when compared to the responses at the higher CP levels (43% to 48.8 %) where the GEFC decreased with the increase in dietary CP. The best responses of fish to GEFC was recorded between 37 to 40 % CP diet (Table 5) and this was corroborated by the higher estimates of protein contents in the body of fish that were fed the respective diets (Table 3). The effect of the increase in the dietary CP on GEFC was significantly correlated (P > 0.05) with Nm, DRF, and MWG respectively.

Estimates of the nitrogen metabolism (Nm) and the net protein utilization (NPU) of fish showed that both parameters increased as the dietary CP level increased except for the micro encapsulated diet M (48.80 %), where Nm and NPU estimates were relatively low (Table 5). The effect of the dietary increase in CP on Nm and NPU was significant (P < 0.05). The Nm of fish showed non-significant negative correlations with DRG, DRF, GEFC and MWG. The prediction equations for the growth and nutrient parameters are shown in Table 7.

As expected the relatively lower qualities of dietary proteins at the lower CP levels (28 % and 31 %) (Table 2) produced lower protein deposition in the body of the fish fed the diets (Table 3) compared to the higher protein deposition in fish fed the higher dietary CP levels (37% and 40%). However, the fish deposited relatively lower protein when fed diets of between 37 % and 40 % CP levels even when the dietary CP levels of the former were higher than those of the later. The fish responded more positively to weight increase (MWG) and daily growth (DRG) at the 37 % and 40 % dietary CP levels than at the 28 % and 31 % or 43 % and 48.80 % dietary CP levels (Table 5). Nevertheless, the fish did not exhibit any definite pattern of response to the essential amino acids (EAA) profiles of the experimental diets (Table 4) as the dietary CP levels increased.

DISCUSSION

The increasing levels of dietary crude protein (CP) in this study seemed to affect the increase in weight and daily rate of growth of the young *C. gariepinus* up to 40 % CP (Table 5) but declined at higher CP level (48.80%) This result compares favorably with that of Faturoti *et al.* (1986) on juvenile *C. lazera*, in which the optimum dietary

protein content that enhanced growth was 40%, while the micro encapsulated egg diet depressed growth. The 48.80 % CP in the diet used in this study must have been in excess of the CP required by the fish to support efficient utilization of available nutrients as was the case in Faturoti *et al.* (1986). From the present study, the relatively higher metabolizable energy:protein (ME:P) ratio recorded for the 48.80% CP diet (9.88 kJ/mg) as against that of the 40% CP diet (7.6 kJ/mg) also agrees with the report of Cho (1981). The worker stipulated that a higher energy-protein ratio may result in inadequate protein intake and that the loss of most of the ingested nitrogen as ammonia might retard the deposition of protein for tissue formation.

Previous workers on other warm water fishes have provided ME:P ratio that gave optimum growth with specified dietary protein levels. Jauncey (1982) reported an ME:P ratio of 27.81 mg/kg for tilapia (*Sarotherodon mossambius*) fed with 40% CP diet, while Mazid *et al.* (1979) estimated an ME:P ratio of 19.43 mg/kg for *Tilapia zillii* fed with 35% CP diet. Generally, it is obvious from various reports that ME:P ratio varies significantly between fish species and within species depending on the digestibility and amino acid composition of the protein source, water temperature (Hildalgo and Alliot, 1988) and the environmental parameters which affect the portioning of energy (De Silva and Anderson, 1995). The lower values of DRG recorded at the higher CP levels (43% to 48.80%) were in contrast with the high DRG recorded at the lower CP levels (Table 5).

This indicates that despite the non-significant effect ($P > 0.05$) of the daily feeding rate (DRF) of fish among the test diets, the content of the diet, caused by the higher fibre contents of some of the ingredients pronounced at the higher CP levels. This must have also resulted in less protein being consumed for optimum growth. Dilution effect of bulk resulting from fibre has been reported by Lovell (1989). The best response of fish to the gross efficiency of food conversion (GEFC) was within 37% and 40% dietary CP and this reflected the best weight increase (MWG = 0.86 to 1.93 g); daily rate of growth (DRG = 0.17 to 0.20 g) and nitrogen metabolism (Nm = 12.62 to 13.43 g/100 g) obtained within the experimental period. The high Nm and NPU (Table 5) recorded for 37 and 40% CP diets paralleled the relatively high protein contents of the fish that were fed these diets (Table 3). It is hence obvious that the energy content of the diets were optimum within this CP range (37%- 40%) as to spare the protein for tissue formation. The decline in the GEFC of fish fed 43% to 48.80% diets conforms to the earlier The decline in the GEFC of fish fed 43% to 48.80% diets conforms to the earlier deductions made with respect to the diets. However, the net protein utilization values for fish fed the 37 % to 40 % CP diets were less than those fed at higher CP levels. This result varies from the results of previous worker such as Jauncey (1981) for tilapia (*S. mossambicus)*; Ogino and Saito (1970) for common carp (*Cyprinus carpio*), and Mazid *et al.* (1979) for *Tilapia zillii.* These workers reported a decrease in NPU with increasing dietary protein level. It could be that the *C. gariepinus* fry in the present study utilized protein at the higher CP levels for other physiological processes than for protein synthesis and growth. It is therefore inferred that despite the apparently better utility of protein (NPU) by fish fed the higher CP diets, much of the ingested protein have been affected by endogenous nitrogen losses resulting in its unavailability for productive use by the fish.

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