

The effects of varying dietary protein levels on growth performance and some quality parameters of carcass and eggs of *Clarias gariepinus* (Burchell, 1822)

Efecto de diferentes niveles de proteína dietética sobre el comportamiento del crecimiento y algunos caracteres de calidad del canal y huevos de *Clarias gariepinus* (Burchell, 1822)

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ABSTRACT

Growth performance and some quality parameters of broodstocks and eggs of female *Clarias gariepinus* were investigated in this study for 70 days. Fish were fed diets with varying crude protein levels (CP); 30, 35 and 40% in triplicates with imported feed as control. Proximate analysis of feeds, fish and eggs alone were done and data were collected on fish growth and nutrient utilization efficiency fortnightly. Results showed that fish fed diets with 35% CP exhibited significantly ($P<0.05$) higher growth rate, feed conversion ratio and apparent net protein utilization than fish fed diet with 40% CP. Fish fed diets with 35 and 40% CP had higher CP values of carcass and for eggs while both were significantly higher ($P<0.05$) than the CP values of other treatments. Egg development was however higher in fish fed 40% CP diet but with marginal differences as compared to the values obtained in fish fed 35% CP diet. The result showed that diet with 35% crude protein produced good growth rate in catfish broodstock and better nutrient utilization as well as improved egg development and maturity than fish feed diet with 30% crude protein.

Key words: *Clarias gariepinus*, female broodstock, growth performance, carcass quality, egg quality,

RESUMEN

En este estudio se investigó el comportamiento del crecimiento y algunos caracteres de calidad de las reproductoras y huevos de *Clarias gariepinus* durante 70 días. Los peces se alimentaron con dietas con diferentes niveles de proteína cruda (PC): 30, 35 y 40% en triplicados con alimento importado como control. El análisis proximal de los alimentos, peces y huevos se realizaron y se recogieron los datos sobre el crecimiento de los peces y la eficiencia de la utilización de los nutrimentos en dos semanas. Los resultados mostraron que los peces alimentados con dietas con 35% de PC significativamente exhibieron ($P<0,05$) mayor tasa de crecimiento, mayor relación de conversión alimentaria y mayor utilización neta aparente de proteína que aquellos peces alimentados con la dieta con 40% de PC. Los peces alimentados con dietas con 35 y 40% de PC presentaron mayores valores de PC de la canal y de los huevos, mientras ambos fueron significativamente mayores ($p<0,05$) que los valores de PC de los otros tratamientos. Sin embargo, el desarrollo de los huevos fue mayor en los peces alimentados con la dieta con 40% de PC, pero con diferencias marginales en comparación con los valores obtenidos en los peces alimentados con la dieta con 35% de PC. El resultado mostró que la dieta con 35% de proteína cruda produjo una buena tasa de crecimiento en los reproductores del bagre y una mejor utilización de los nutrimentos, así como un mejor desarrollo de los huevos y la madurez que la dieta de alimentos para peces con 30% de proteína cruda.

Palabras clave: *Clarias gariepinus*, reproductoras, comportamiento del crecimiento, calidad de canal, calidad de huevos.

INTRODUCTION

Clarias gariepinus is one of the culturable fin fish species in Nigeria that is of high commercial interest (Faturoti, 2000). It is known to be capable of withstanding adverse environmental condition more than other culturable species such as tilapia (Pillay, 1990). This, coupled with its fast growth rate has made it attractive to catfish farming in Nigeria for the

past two decades. African catfish hardly reproduces in captivity (Howerton, 2001) but with the popular induced breeding (artificial method of spawning, incubation and hatching of eggs under controlled environmental conditions) technique, it has been possible to produce fish seed all year round (Ayinla, 1988). Although the technique for induced breeding has been developed, the problem of low egg hatchability and larva survival rate remains a major

hindrance to the success of its mass production. Nutritional deficiency has been identified as a great factor affecting artificial spawning of fish (Hogendoorn and Vismans, 1980). The works of Chong *et al.*, 2004; El-Sayed *et al.*, 2003; Coward and Bromage, 2000 have further emphasized the importance of broodstock nutrition for the enhancement of reproductive performance of cultured fish species especially, dietary protein level (Muchlisin *et al.*, 2006). NRC (1983) and Kent (2002) reported that there are differences in the nutritional requirements of the growth-out fish and the brood fish. This study therefore is an attempt to investigate the effects of different dietary protein levels on female catfish brooders reproductive fitness.

MATERIALS AND METHODS

This study involved the use of three levels of dietary protein (30, 35 and 40%) feeds as test diets under a completely randomized experiment. The protein sources used in formulating the feeds include

fish meal, blood meal and soyabean meal (Table 1), also, gross ingredients used in the formulation of the experimental diets are shown in Table 1. In addition to the three formulated diets an imported brood fish diet was used as the control making a total of four test diets (Table 2), also, the proximate composition of all the test diets are presented in Table 2. All formulated diets were made into pellets of 6mm size after homogenous mixing in a Hobart mixer. One hundred and twenty catfish female broodstocks of 1.29 ± 0.04 kg average weight were evenly distributed in twelve concrete tanks of 2 x 2 x 1.5 m and are allowed to acclimatize for seven days before the commencement of the experiment. For all test diets, fish carcass and eggs were chemically analyzed for their crude protein, crude fibre, crude lipid, nitrogen free extract, ash and moisture according to AOAC (2000). Fish were fed *ad libitum* between 08:30-09:00 hours and 16:30-17:00 hours. Feeding of fish per treatment was done in triplicates for 70 days. Water quality parameters (dissolved oxygen, pH and ammonia) were kept constant during the culture period in tanks

Table 1. Percentage composition of ingredients for experimental diets of *Clarias gariepinus*

Ingredients (g/100 g)	Diets (% crude protein)		
	30	35	40
Fish meal	10.0	12.7	15.0
Blood meal	8.5	11.5	11.4
Soyabean meal	35.3	35.8	37.3
Brewers grain	14.0	14.0	14.0
Yellow maize	26.2	20.0	16.3
Dicalcium phosphate	2.0	2.0	2.0
Common salt	0.5	0.5	0.5
Soya salt	1.5	1.5	1.5
† Vitamin/mineral premix	2.0	2.0	2.0

† Biomix fish vitamin/mineral providing per kg of diet at 5kg per tonne inclusion: 20,000 iu, vitamin A, 200 i.u, Vit. D3, 200 mg Vit E, 8 mg Vit k3, 20mg Vit B1, 30 mg Vit B2, 12 mg Vit B6, 50 mg Pantothenic acid, 0.8 mg Biotin, 150 mg Niacin, 0.05mg Vit B12, 160mg Vit. C, 4.0mg Cobalt, 40 mg Iron, 5.0 mg Iodine, 30 mg Manganese, 4 mg Copper, 40 mg Zinc, 0.2 mg Selenium, 100 mg Lysine, 100 mg Methionine, 100 mg Anti-oxidant.

Table 2. Proximate composition of experimental diet on wet basis of *Clarias gariepinus*

Nutrient (%)	Diets (% crude protein)			
	31 †	30	35	40
Crude protein	30.91	30.21	35.03	40.12
Crude fibre	3.44	3.81	3.61	3.58
Ash	11.97	10.40	10.32	11.65
Crude lipid	26.23	24.55	22.83	20.17
Moisture	14.82	14.47	13.75	13.33
Nitrogen free extract	13.23	15.56	14.46	12.15
Energy (Kcal/kg)	3028.71	2970.16	3014.06	3014.45

† Imported brood fish diet

by regular changing of the water on weekly basis. At the end of the experiment all fish were sacrificed for carcass analysis while eggs were equally analyzed separately. Data collected on fish growth at fortnights were computed for nutrient utilization assessment (protein efficiency ratio (PER) feed conversion ratio (FCR), apparent net protein utilization (ANPU), specific growth rate (SGR) and total feed intake (TFI)) and they were all subjected to analysis of variance test of the one way ANOVA using SPSS and significant mean differences were separated at 0.05 probability level according to (Steel *et al.*, 1997).

RESULTS

Fish were able to utilize the test diets at varying degrees but weight gain and specific growth rate of fish were only marginally different ($P > 0.05$). Total feed was highest in treatment 3 and lowest in treatment 2 but PER was significantly higher ($P < 0.05$) in treatment 2 than in treatment 3 (Table 3).

Feed conversion ratio was least in the control (treatment 1) which was marginally different from treatment 2 while values of FCR for treatment 2 (1.42) and 4 (1.41) were significantly lower than those treatment 1 and 2. ANPU was highest in the control and least in treatment 4 and their statistical relationship with other treatments followed the same path with PER and FCR. No mortality was recorded in all treatments as survival rate was 100% throughout (Table 3).

Fish carcass protein increased from the initial value of 63.07 in all treatments while the reverse is the case for crude lipid (Table 4). Weight of egg increased throughout in all the treatments from 71.20g to 98.04g in treatment 4 and similarly for the crude protein values which increased from but, crude lipid however decreased from the initial value of 14.33 to 10.08% in treatment 4 (Table 5). Crude fibre was not detected in all treatments for carcass and eggs (Tables 4 and 5).

Table 3. Growth and nutrient utilization assessment of *Clarias gariepinus* broodstocks fed varying dietary protein levels during 70-day feeding trial.

Parameters	Diets (% crude protein)				SEM ‡
	31 †	30	35	40	
Initial weight (g) ($\times 10^3$)	1.27 a ¥	1.25a	1.33b	1.30 b	0.73
Final weight (g) ($\times 10^3$)	1.49 b	1.46 b	1.54 a	1.52 a	0.89
Weight gain (g) ($\times 10^2$)	2.15 a	2.08 b	2.13 a	2.11 b	1.10
Specific growth rate (%/day)	0.22 a	0.22 a	0.21 a	0.21 a	0.37
Feed intake (g/day)	41.40 b	40.65 b	43.10 a	42.39 a	0.64
Total feed intake (g) ($\times 10^3$)	2.90 b	2.85 b	3.02 a	2.97 a	0.24
Protein efficiency ratio	2.40 a	2.41 a	1.41 b	1.77 c	0.33
Feed conversion ratio	1.35 b	1.37 b	1.42 a	1.41 a	0.30
Apparent net protein utilization	0.36 a	0.31 a	0.28 b	0.22 c	0.02
Survival rate (%) §	100	100	100	100	-

† Imported brood fish diet

¥ Values with different letter along the same row are significantly different ($P < 0.05$)

‡ SEM = Standard error of the means. § Survival rate was not statically analyzed

Table 4. Carcass proximate composition of *Clarias gariepinus* broodstocks fed varying dietary protein levels during 70-day feeding trial.

Treatments	Crude protein (CP)	Crude lipid	Moisture	Ash	Crude fibre
Initial	63.07 \pm 1.14a ‡	7.92 \pm 0.62a	4.34 \pm 1.46b	4.83 \pm 1.53a	ND
31% CP †	66.26 \pm 0.07b	5.84 \pm 0.18b	6.35 \pm 0.22a	4.46 \pm 0.42a	ND
30% CP	65.94 \pm 0.22b	6.02 \pm 0.13b	6.97 \pm 0.13a	4.72 \pm 1.13a	ND
35% CP	66.10 \pm 1.11b	6.16 \pm 0.46b	6.76 \pm 0.07a	4.43 \pm 1.09a	ND
40% CP	65.86 \pm 0.04b	5.98 \pm 0.12b	6.99 \pm 0.14a	5.12 \pm 0.33a	ND

† Imported brood fish diet; ND = Not Detectable

‡ Values with different letter along the same row are significantly different ($P < 0.05$)

DISCUSSION

In this study, fish weight gain increased precisely between treatment 2 and 3 but there was a slight decrease in diet 4 which has higher dietary protein value indicating low utilization level. An important contribution of dietary protein level toward broodstock performance relates to the effect on body size. Earlier reports of El-Sayed *et al.*, (2003) and Chong *et al.*, (2004) relate body size to maturation of gonads and that egg occur earlier in larger broodstocks. Fish fed 30% protein diet had the lowest carcass protein composition, suggesting that this level is insufficient to fulfill the nutritional requirement of the female broodstock and hence, the need to utilize body nutrient reserves for gonadal development. This observation is similar to the reports of (Gunasekera *et al.*, 1996; Lim *et al.*, 2002; Muchlisin, 2006) where high values of fish egg weight increasing high dietary protein contents directly inclined with high values of crude protein contents of the eggs indicating better gonadal development and maturation. From the nutrient utilization assessment in this study, higher feed intake were recorded for fish fed higher dietary protein diets which gave lower SGR and PER values indicating inefficient utilization of the diets. This is in agreement with the reports of (Aiyelari *et al.*, 2007; Ramezani, 2009) and may suggest that female catfish broodstock would apparently utilize diets with 30 – 35% crude protein better for growth diets than with 40% crude protein.

CONCLUSION

Increase dietary protein level of catfish diet up to 40% would produce best gonadal development but the same quality of gonadal development can be achieved at 35% crude protein dietary level especially with better weight gain and protein utilization efficiency.

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Table 5. Wet weight and proximate composition of eggs of *Clarias gariepinus* broodstocks fed varying dietary protein levels during 70-day feeding trial.

Parameters	Initial values	31% CP †	30% CP	35% CP	40% CP
Weight of egg (g)	71.20 ± 0.04c ‡	92.80 ± 1.10b	94.40 ± 0.19b	95.03 ± 0.17b	98.04 ± 0.23a
Crude protein (CP) (%)	68.45 ± 0.16b	72.71 ± 0.43a	72.68 ± 0.27a	73.60 ± 0.36a	73.77 ± 0.02a
Crude lipid (%)	14.33 ± 0.20a	10.47 ± 0.18b	10.54 ± 0.47b	11.05 ± 0.11b	10.08 ± 0.14b
Ash (%)	1.72 ± 1.10a	1.01 ± 1.03a	1.22 ± 0.72a	0.44 ± 0.30b	0.58 ± 0.25 b
Moisture (%)	10.84 ± 0.12a	9.75 ± 0.31a	8.79 ± 0.66a	6.54 ± 1.12b	6.74 ± 0.02b
Crude fibre (%)	ND	ND	ND	ND	ND

† Imported brood fish diet; ND = Not Detectable

‡ Values with different letter along the same row are significantly different (P < 0.05)

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