

ECONOMIC EVALUATION, GROWTH PERFORMANCE AND NUTRIENT UTILIZATION OF RUMEN CONTENT IN THE NUTRITION OF AFRICAN CATFISH (*CLARIAS GARIOPIUS*) BURCHELL, 1822.

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ABSTRACT

A total of 225 *Clarias gariepinus* fingerlings with average weight of 8.30 g±0.01 were fed rations in which rumen content (RC) were included in a completely randomized design. They were grouped into 5 treatments of 3 replicates, each containing 15 fish, fed RC in a practical diet at 0, 6, 12, 18 and 24% dietary inclusion levels for 72 days. The total feed fed (TFF), average daily weight gain (ADWG) and protein productive value (PPV) were significantly affected ($P < 0.05$) by the treatment while the specific growth rate (SGR), feed conversion ratio (FCR) and protein efficiency ratio (PER) were not significantly influenced ($P > 0.05$) by the treatments. Fish fed 6% RC had the best mean weight gain (9.21g), SGR (0.42%/day) and feed efficiency (TFF) (0.49g), FCR (0.05) and PER(0.37g). A part from diet 2, MWG, SGR and PER were inversely related to the level of RC in the diet. The study showed that RC gave the best growth performance at 6% inclusion in *Clarias gariepinus* fingerlings diet. The control diet had the highest feed cost per kg of #9.44 and the lowest was recorded for fish fed 24%RC. Fish fed 24% RC (diet 5) had the best feed cost per kg (#4.88), least cost of weight gain per fish (N1.96) and cost of feed consumed per fish(N0.038).

Keywords: Rumen content, *Clarias gariepinus* diet, economic evaluation and dietary inclusion level.

Introduction

Clarias gariepinus is one of the most important species for culture in fish farming in Nigeria (Falaye and Oloruntuyi,1998). One of the major problems associated with its culture is the increasing cost of fish feed which is as a result of the high cost of conventional feed ingredients.

Several efforts have been made in recent times, to increase, the use of under utilized plant and animal materials to replace conventional feed ingredients like maize and fishmeal in livestock and fish production (Falaye *et al* 1999). The possibilities of designing practical fish and shrimp diets with the use of plant feed stuffs have been reported by Lim *et al.* (1992) and Moyano *et al.* (1992). With the development of the fish feed processing industry, it could be possible to put into profitable use some plant and animal by-products which are presently discarded as wastes .Gouveia (1991), critically reviewed the use of animal by products in diets for Samonids and described the use of various proteins concentrates that originated from the rendering industries Dairo *et al.*, (2005) also evaluate the performance of growing rabbits fed varying levels of rumen content and blood rumen content mixture. Rumen content is one of the abattoirs waste products that could be environmentally unfriendly if not properly handled. It is partially digested feed material obtainable as wet mixture of plant materials, digestive juice and millions of bacteria after the rumen has been cut opened. It is yellowish brown, with unpleasant odour. It contains micro-organism such as the phycomycetous fungi, protozoa, bacteria and others (Preston, 1991). Its acceptability can be increased by adding masking agents like molasses oil to make it palatable. Therefore rumen content could be a good source of protein if well

processed (Adeniji, 1996). Experiments had revealed that rumen content can serve as a good source of protein in *Clarias gariepinus* feeds (Adeniji and Balogun, 2001, 2002; Dairo and Aina, 2000). The crude protein range of 9-20% had been reported for rumen content (Whyte and Wadak, 2002). Adeniji (1996) estimated the rumen content of bovine origin output in Nigeria abattoir to be 9,634 tonnes while 18.067 tonnes per annum could be obtained from carprine sources.

This study therefore, investigated the Economic, growth performance and nutrient utilization of rumen content in the nutrition of African cat fish *Clarias gariepinus*.

Materials and methods

Collection and Processing of Rumen content

Rumen content were collected from the main abattoir in Ogbomoso town while slaughtering of the animals was in progress. The rumen was split opened with the aid of a sharp butcher's knife and the content emptied into a 50L plastic vat. It was later emptied into a plastic bucket to drain. After draining, the rumen content was sundried to a total dryness and then stored in air tight sack.

Experimental diets

Five experimental diets were formulated. Diet 1 did not contain BRCM while diets 2, 3, 4 and 5 contained 6, 12, 18 and 24% BRCM respectively. Other ingredients as contained in the gross composition are shown in table 1. All diets were formulated to be isonitrogenous and isocaloric. Feed ingredients were purchased from a reputable feed Mill in Ogbomoso, Nigeria.

TABLE 1: Gross Composition of Experimental Diets

Ingredient %	1	2	3	4	5
Fish meal	28.70	22.41	17.00	11.51	5.74
Groundnut cake	19.13	20.33	20.63	19.11	17.08
Yellow maize	24.08	24.04	24.08	24.08	24.08
Rice brane	12.04	12.34	12.14	12.84	14.14
Rumen Content	-	6.00	12.00	18.00	24.00
Blood meal	9.56	8.36	7.65	7.96	8.46
Bone meal	2.00	2.00	2.00	2.00	2.00
Premix	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.50	1.50	1.50	1.50	1.50
Lysine	0.50	0.50	0.50	0.50	0.50
Vegetable oil	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total (kg)	100.00	100.00	100.00	100.00	100.00
Determined Analysis (%)					
Moisture	7.40	9.01	8.17	8.74	8.84
Crude Protein	40.06	40.04	40.08	40.04	40.07
Exther Extract	2.85	2.85	2.75	2.76	2.74
Fibre	7.64	5.75	6.17	6.14	6.15
Ash	2.50	2.43	2.57	2.60	2.60
Nitrogen	39.55	39.92	39.65	39.72	39.71
Free Extract					
M.E (kcal/kg)	3039.26	3051.29	3035.33	3037.23	3036.29

ME = Metabolizable energy . The M.E of diets were estimated and adapted for fish using Pauzenga (1985) formula: $M.E = 35CP + 81.8EE + 35.5NFE$. Nitrogen free extracts = $100 - (\text{moisture} + \text{crude protein} + \text{crude lipid} + \text{crude fibre} + \text{ash})$.

Feeding Regime and Experimental Protocol

A total of 225 *Clarias gariepinus* fingerlings of an average weight of $\pm 8.30\text{g}$ were acclimatized for 2 weeks prior to the commencement of the experiment in order to free their gastro-intestinal tract from the pre-experimental diet. The feeding trials were conducted in an automatically controlled circulation system. The plastic tanks were approximately 50L with suspended overhead tank of 1000-L bio filter compartment. A 12-h light cycle was provided by fluorescent lighting. The water temperature, pH, ammonia (NH_3), nitrite (NO_2) nitrate (NO_3) and dissolved oxygen were monitored and remained at acceptable levels throughout the experimental period.

At the end of the acclimatization period, the fingerlings were divided into five treatment groups. Each treatment group was sub divided into 3 replicates of 15 each on weight equalization basis per tank. Each treatment group was then randomly fingerlings assigned to one of the five treatment diets in a completely randomized design (CRD). The fingerlings were fed twice daily in the morning (0.900hours) and in the evening (17.00hours), at a rate of 3% body weight per day in two equal feedings. The fish were weighed bi-weekly, and prophylactic treatment of acriflavin I (3mg/L) sigma chemical) administered after each weighing to reduce bacteriological infestation caused by handling (Garling and Wilson 1976). The feeding trial lasted 12 weeks. Initially 15 fish were killed in order to determine initial carcass composition. Five fish were collected from each experimental unit at the end of the feeding trial to analyze the carcass composition.

Analytical Procedure : Samples of test ingredient, experimental diets, initial and final carcasses and faeces were proximately analysed using standard methods of (AOAC, 1990). The Metabolizable (M.E) of the diets were calculated and adapted for fish using Pauzenga (1985) formula; $\text{M.E} = 35\text{CP}\% + 81.8\text{EE}\% + 35.5\text{NFE}$.

Analysis of growth response and feed utilization

Data obtained were used to calculated weight gain, Total feed intake, specific grow rate (SGR), Food Conversion Ratio, (FCR), Protein Intake (PI) and Protein Efficiency Ratio (PER).

Weight gain = Final body weight – initial body weight

Specific Growth Rate (SGR) was determined using Brown (1957) method.

$$\text{SGR} = \frac{\log_e W_2 - \log_e W_1}{T_2 - T_1}$$

Where W_1 = Initial Weight (g)

W_2 = Final Weight (g)

e = The base of natural logarithm

T_2 = Final (day)

T_1 = Initial (day)

Feed Conversion Ratio (FCR) was determined as described by Hephher (1988)

$$\text{FCR} = \frac{\text{Weight gained by fish}}{\text{Weight of feed consumed}}$$

$$\text{Protein Intake} = \frac{\% \text{protein in diet} \times \text{total diet consumed}}{100}$$

Protein Efficiency Ratio (PER) was determined as described by Mazid *et al.*, (1972)

$$\text{PER} = \frac{\text{Weight gained}}{\text{Protein fed}}$$

Economic Analysis: This was done using current market price. Cost per kg of feed was calculated from the cost of various ingredients use during ration formulation. Cost per kg weight gain was determined by multiplying cost per feed by feed gain ratio.

Statistical Analysis

Following the experimental design, data generated were subjected to one –way analysis of variance (ANOVA) using SAS procedure (SAS 1988). Duncan’s multiple range test of the same software was to separate means with difference. Treatment effects were considered significant at ($P \leq 0.01$).

Results

Test ingredient

Rumen contents (RC) was analysed to contain 7.55%, moisture; 9.21%CP, 2.56% E.E; 10.26%CF, 24.53%ash; and 45.89%NFE. The estimated M.E for RC was 2160.85kcal/kg.

Growth

The growth performance and feed utilization of *Clarias gariepinus* are indicated in Table 2. The mean weight gain and average daily weight gain by the fish were significantly ($P < 0.05$) influenced by the dietary levels of RC. Fish fed 6% RC had highest mean weight gain (9.21g) and average daily growth (0.13g/day), specific growth rate (0.42) while lowest values 4.89g and 0.07g/day respectively were shown by fish fed 24% RC. Highest was shown by fish fed control and 6% RC while lowest value was shown by fish fed 24% RC. Even though, the specific growth rate shown by the fish along the treatments were not significantly different ($P > 0.05$), feed conversion ratio and Protein efficiency ratio were however significantly different ($P < 0.05$) highest Although, lowest value of FCR (0.05) and highest PER (48.39) were recorded by fish fed control diet and 6% RC

The carcass protein of the fish after the feeding trial are significantly different ($P < 0.05$). Fish fed 18% RC had the highest crude protein of 52.75%

Table 2: Growth performance and feed utilization of *Clarias gariepinus* fingerlings fed diets containing varying levels of rumen content.

Components	Diet number					SEM
	1	2	3	4	5	
Initial weight (g)	8.79	8.14	8.89	8.22	8.89	
final weight (g)	17.50 ^a	17.35 ^a	16.00 ^b	14.47 ^c	13.78 ^d	
Mean weight gain (g)	8.71 ^{ab}	9.21 ^a	7.01 ^b	6.25 ^c	4.89 ^d	0.604
Average daily growth (g/day)	0.12 ^a	0.13 ^a	0.10 ^{ab}	0.09 ^{ab}	0.07 ^b	0.009
Percentage weight gain(%)	99.09 ^b	113.14 ^a	77.97 ^c	76.03 ^c	55.01 ^d	3.106
Specific growth rate (%/day)	0.42 ^a	0.42 ^a	0.36 ^b	0.32 ^a	0.30 ^a	0.023
Feed intake	0.44	0.54	0.61	0.59	0.64	-
Protein intake	0.18	0.22	0.24	0.24	0.26	-
Feedconversion ratio	0.05 ^c	0.05 ^c	0.09 ^b	0.09 ^b	0.13 ^a	0.006
Protein efficiency ratio	48.39 ^a	41.86 ^b	29.21 ^c	26.04 ^d	18.81 ^e	0.255

Economic Analysis:

Total cost of diet

(N/Kg) 104.8^a 93.6^b 82.1^c 70.8^d 59.2^e

Cost of feed consumed

per fish(N/g). 0.046^b 0.051^a 0.050^a 0.042^b 0.038^c

Cost of weight gain

Per fish (N/g) 3.48^a 3.68^a 2.90^b 2.50^{bc} 1.96^c

^{abcde}Means in the same row with the same superscripts are not significantly different (P>0.05).N means Naira i.e Nigeria currency. 1US \$ = 150 . Cost of feedstuffs at the prevailing market prices in Nigeria(Oct. 2009).

Table 3: Proximate Carcass Composition of Catfish Sample at the Beginning and the End of the Feeding

Components	Initial	DIET NUMBER					SEM
		1	2	3	4	5	
Crudeprotein	52.53 ^b	50.14 ^e	51.53 ^c	52.75 ^a	50.14 ^e	50.87 ^d	0.29
Ether extract	10.84 ^c	10.55 ^d	10.44 ^e	6.84 ^f	11.45 ^b	12.72 ^a	0.43
Fibre	5.54 ^c	13.18 ^a	8.35 ^b	5.54 ^f	5.14 ^d	4.24 ^e	0.73
Ash	14.54 ^e	14.84 ^d	17.04 ^c	18.55 ^b	18.74 ^a	14.56 ^e	0.44
Nitrogen free Extract (NFE)	8.25 ^b	5.75 ^d	4.14 ^e	7.05 ^c	7.04 ^c	9.15 ^a	0.39

^{abcde}Means in the same row with the same superscripts are not significantly different ($P>0.05$).

Table 4: WATER QUALITY WITHIN EXPERIMENTAL BOWLS FOR THE DURATION OF THE EXPERIMENT.

PARAMETER	RANGE	MEAN	\pm SD
Temperature ⁰ C	27.0 – 29.0	27.70	\pm 1.1
PH	6.4 – 7.0	6.70	\pm 0.3
Dissolved Oxygen (mg/L)	7.5 – 10.0	8.90	\pm 1.4
Alkalinity mg/L CaCO ₃	75.0 – 100.0	87.80	\pm 13.3
Nitrate (mg/L)	1.4 – 5.8	3.60	\pm 2.24
Nitrate	0.09 – 1.12	0.11	\pm 0.10

Economic Evaluation of Diet

The feed cost per kg decreased significantly ($P<0.05$) as the dietary level of RC increased. The control diet had the highest feed cost per kg of #104.80 and the lowest was recorded for diet 5 (24%RC). Fish fed 24% RC had the best feed cost per kg (#59.2) least cost of weight gain per fish (N1.96) and cost of feed consumed per fish(N0.038). These are shown in Table 1.

Discussion

The proximate composition of Rumen content showed that RC contained 9.21% crude protein which is within the crude protein range of 9 – 20% recorded by Whyte and Wadak 2002, Adeniji 1996, and Ekwuoma, 1992. However, the crude protein, ether extract and crude fibre recorded in this study were below the values of CP 17.13%, E.E 2.81% and C.F 24.5% reported by Dairo *et al*, 2005. Even-though, Nitrogen free extract value were comparable. According to Dairo *et al* 2005 the difference was attributed to the chemical composition or the type of pasture consumed and species differences.

The MWG, ADWG, TFI FCR and PER were significantly influenced ($P < 0.05$) by the rumen content inclusion levels in the diets, this conform to the report of Adeniji and Balogun (2001, 2002) on poultry but parallel to the report of Dairo *et al*, 2005; Whyte and Wadak (2001) who reported no significant effect of RC on ADFI, ADWG FCR and PER in weaner rabbits.

Diet 2 (6% RC) recorded the highest MWG, PER and least FCR qualifying it to be the best diet in terms of growth performance and feed utilization.

The water quality parameters measured in the course of this study were within the desirable range for normal growth and survival of *C. gariepinus* (Viveen *et al* 1986). From the economic evaluation of diets, it was quite obvious that lowest feed cost was recorded by diet 5 (24% RC inclusion), while diet 2 had the highest feed cost per kg, this is different from the report of Dairo *et al*, (2005) who observed highest feed cost per kg for control diet. Despite the cheapest feed cost per kg recorded by diet 5, it had least cost of weight gain per fish, poor growth performance and feed utilization in fish fed. Diet 2 (6% RC content) recorded the best feed cost per gramme gain of flesh, growth performance and feed utilization.

Conclusion

From the results shown by the economic evaluation of diets in this study, it was quite obvious that diet 5 has the cheapest feed cost per kg but this does not make it automatically the best of the formulated diets because it had least cost of weight gain per fish, poor growth performance and feed utilization in fish fed. Therefore, RC can be included optimally at 6% in *Clarias gariepinus* fingerlings diets.

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