



Evaluation of the Effect of Replacing Maize with Cattle Rumen Waste Meal in Feed for Production of Nile Tilapia, *Oreochromis Niloticus*

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ABSTRACT: This study determined the nutritive values of cattle rumen waste (CRW) meal used for replacement of maize in the diets of Nile tilapia *Oreochromis niloticus*. CRW (20.9% CP) was used to replace maize (10.1 CP) at 0%, 25%, 50%, 75% and 100% making diets (D1-D5). The diets were fed to the fish (5.59±0.37g) to apparent satiation twice daily in three replicates. Results showed that the bacterial count of fresh CRW sample was 3.2×10^5 Cfu/g while the fungal count was 1.2×10^5 sfu/g, but after sun drying at constant moisture of 8.0%, the bacterial and fungal counts reduced by 90% and 100% respectively. The weight gain, specific growth rate and feed intake declined with increasing levels of CRM. Fish fed D1 had the best feed conversion ratio (FCR) of (1.29) while the group fed D5 gave the poorest FCR of (1.66). The results also revealed that increasing dietary levels of CRW resulted in marginal increase in carcass ash and fibre. The bacterial and fungal counts of fresh fish samples ranged between 2.4×10^4 – 3.4×10^4 Cfu/g and 0.4×10^4 – 1.5×10^4 Sfu/g, respectively, but the organisms disappeared after drying the fish at mean constant moisture of 6.21%. In conclusion, CRW can replace up to 50% of maize in the diets of Nile tilapia. The use of the rumen meal would reduce costs of fish production and increase the profit margin. It will also boost fish production and rural economy and serve as an economic means of environmental management.

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Aquaculture has been described as a means of augmenting capture fisheries to boost fish food production. With intensification in aquaculture, the major problem is what to feed the fish since the same feed ingredients are used in human and livestock feed resulting in increase in the prices of the conventional feedstuffs. This has implications that feed alone takes over 60% of the operating costs aquaculture (Nwanna, *et al.* 2014). According to Olurin *et al.* (2006) maize is the major source of metabolisable energy in most compounded diets for Tilapia species because it is readily available and digestible. But in the recent time, maize has become scarce due to environmental and socio-economic issues and the serious competition for its use between man and other livestock, culminating in increases in the price of the commodity.

Cattle rumen wastes from abattoirs usually pose environmental and disposal problems. Preliminary investigations revealed that the rumen waste contains 18.5% protein and 38.4% carbohydrate (Esonu *et al.*, 2006), an indication of its great potential as an energy source in tilapia nutrition. This study therefore investigated the nutritional values of cattle rumen waste and the effects of replacing maize with dried

cattle rumen waste meal on the production of Nile tilapia.

MATERIALS AND METHODS

Sample collection: Fresh and hygienic cattle rumen waste was collected from the University Teaching and Research Farm of the Federal University of Technology Akure. The rumen collected was divided into two parts. A part of the rumen was used to determine the microbial load of the sample, while the other part was sun-dried to constant moisture content of 8.02% and then blended into powder form and sieved as the rumen waste meal.

Feed formulation/preparation: Five diets were formulated such that they contained the cattle rumen waste meal (CRW) at 0%, 25%, 50%, 75% and 100%, respectively, in replacement for yellow maize. The diets were stored at -20°C before use.

Feeding trials: Four hundred (400) *Oreochromis niloticus* juveniles with mean weight of 5.59 ± 0.37 g used for the study were acclimatized to laboratory conditions for two weeks. The experimental design was completely randomized. Out of the four hundred (400) fish, a total of Two hundred and twenty five (225) with mean weight of 5.59 ± 0.37 g were

randomly selected and distributed into 15 glass Tanks measuring (70cmx45cmx45cm) representing five treatments and three replicates, at the rate of fifteen fish per tank. The experimental diets were administered to fish to apparent satiation, twice daily between 08:00 and 09:00 and 16:00 and 17:00 hours for 70days. After each feeding all uneaten feeds were removed one hour later. The water quality parameters (dissolved oxygen, pH and temperature were kept at optimum range recommended for warm water fishes Boyd, (1998). Evaluation of the growth performance was after Recker (1975) and Castell and Tiews (1980) while the protein efficiency ratio was calculated following the method of Stuart and Hung (1989).

Nutrient Agar (NA) and Sabouraud Dextrose Agar (SDA) were used as culture media for the determination of microbial loads according to the methods of (Pelczar *et al.*, 1977). The culturing, incubating and colony count were carried out according to the methods of (Pelczar *et al.*, 1977) while identification of the fungal and bacterial isolates was after (Domsch and Games 1970 and Holt *et al.* 1994)

Data collection and analysis: Data collected were subjected to one-way analysis of variance as described by Steel and Torrie (1980) while means were separated using New Duncan multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The results of the proximate composition of the rumen waste meal and maize used in the study (Table 1) reveal that protein content of rumen meal (20.9%) was more than double that of the maize and this value compare well with 18.7% reported by Esonu *et al.* (2006).

The lipid, ash and fibre contents of the rumen waste were much more than the values of maize. However, the carbohydrate content of maize was largely higher than that of the rumen waste.

Table 1. Proximate composition of cattle rumen waste meal and maize (%)

Parameters	Cattle rumen meal	Yellow maize
Protein	20.9	10.1
Crude Fat	8.38	2.65
Ash	12.4	1.40
Crude fibre	32.1	1.40
Moisture	8.02	8.45
N ₂ free extract	18.2	76.0

Table 2 presents the gross and proximate composition of the experimental diets. The proximate composition of the diets reveals that dietary rumen waste increased the ash, fibre and lipid contents of the diets. The result also reveals that cattle rumen meal can be a good source of minerals for the fish. This will help to reduce the quantity of mineral supplement to the diet of the fish, and consequently the cost of mineral supplements and fish production will be reduced.

The growth performance and nutrients utilization parameters of *O. niloticus* fed cattle rumen waste meal (Table 3) indicates that the rumen meal can replace up to 50% of yellow maize in the diets without compromising physiological functions. This study also shows that cattle rumen waste was better utilized by Nile tilapia than duck weed which dietary inclusion level for the production of the fish was 15%, (Ofojekwu *et al.*, (2010). The good utilization of cattle rumen meal, with relatively high fibre forage content might be due to the acidic nature of Tilapia stomach (pH<2) and presence of cellulase in the gut that facilitate the rupture of the cell wall of the vegetative matter (Fagbenro *et al.*, 2005) and perhaps the action of unidentified single cell micro-flora such as fungi, bacteria on the rumen meal that might partially digest the forage prior to collection at the abattoir.

Table 2. Gross and proximate composition of experimental diets (g/100g)

	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
	0%	25%	50%	75%	100%
	CRM	CRM	CRM	CRM	CRM
Parameters					
Fish meal (65% CP)	16.8	16.8	16.8	16.8	16.8
Soybean meal (45% CP)	30.0	30.0	30.0	30.0	30.0
Groundnut cake (48% CP)	22.1	22.1	22.1	22.1	22.1
Yellow maize	21.9	18.4	14.8	11.2	0
Cattle rumen meal	0	3.55	7.1	10.7	14.2
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Vegetable oil	5.00	5.00	5.00	5.00	5.00
Vit. Premix	3.00	3.00	3.00	3.00	3.00
Starch	0.70	0.70	0.70	0.70	0.70
Proximate composition					
Protein	37.7	37.3	36.3	35.5	35.3
Crude Fat	11.4	11.5	11.8	11.9	12.0
Ash	9.82	12.0	10.4	14.5	14.2
Crude fibre	2.96	3.24	3.98	4.20	5.18
Moisture	8.73	7.85	8.30	7.23	6.98
Nitrogen free extract	29.3	28.4	30.7	31.3	31.6

According to De-Silva (2001) feed conversion ratio is between 1.2 - 1.8 for fish fed carefully prepared diets, and the results from the present study are within this range. The proximate composition of the fish carcass (Table 4) reveals no significant differences (P>0.05) in the body composition of the fish after the experiment. The results also showed that, increasing dietary levels of cattle rumen waste meal resulted in a

numerical increase in carcass ash, fibre and lipid contents of the fish.

Total Variable Counts (TVC) for bacteria and fungi isolates from fresh fish reveals that the flesh had a total bacteria count reaching 2.9×10^4 , with the total fungi count reaching 1.0×10^4 , and these bacterial and fungal loads are within the tolerable range recommended by the International Commission for Microbiological Standards of Food (ICMSF, 1978).

After smoke drying at mean constant moisture content of 6.21%, no bacteria and fungi species were detected in the fish samples, and this supports the works of Garcia et al (2005) and Bilgin et al. (2008) who reported drastic reduction in microbial load of fish samples after drying.

Table 3. Growth and nutrient utilization of *O. niloticus* fed experimental diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
	0% CRM	25% CRM	50% CRM	75% CRM	100% CRM
Initial wt. (g)	5.43±0.56	5.63±0.57	5.53±0.15	5.58±0.61	5.59±0.37
Final wt. (g)	16.1±0.22 ^a	16.2±0.14 ^a	15.6±0.32 ^a	15.0±0.19 ^b	14.0±0.31 ^c
Wt. gain (g)	10.7±0.08 ^a	10.6±0.19 ^a	10.1±0.01 ^{ab}	9.40±0.25 ^{bc}	8.65±0.27 ^c
SGR (%/day)	1.56±0.01 ^a	1.51±0.03 ^a	1.48±0.00 ^{ab}	1.41±0.03 ^{bc}	1.34±0.02 ^c
Feed intake (g)	2.36±0.01 ^a	2.34±0.04 ^a	2.30±0.04 ^{ab}	2.14±0.03 ^{ab}	2.05±0.04 ^b
FCR	1.29±0.19 ^{bc}	1.53±0.44 ^{ab}	1.52±0.26 ^{ab}	1.60±0.50 ^{ab}	1.66±0.26 ^a
PER	16.0±0.01 ^a	16.3±0.05 ^a	16.4±0.03 ^a	15.7±0.05 ^a	15.0±0.23 ^a

Means on the same row with similar superscripts are not different (P>0.05)

Table 4. Proximate composition of *O niloticus* fed cattle rumen meal diets (%)

Parameters	Initial	Diet1	Diet2	Diet3	Diet4	Diet5
Moisture	8.90	5.64±0.21 ^a	6.40±0.56 ^a	6.23±0.45 ^a	6.12±0.52 ^a	6.67±0.18 ^a
Ash	16.8	18.0±0.81 ^a	19.2±0.59 ^a	18.6±0.28 ^a	18.7±0.69 ^a	19.1±0.70 ^a
Crude protein	54.0	32.2±1.05 ^a	32.3±0.91 ^a	32.7±0.74 ^a	31.7±1.29 ^a	29.8±0.27 ^a
Crude fiber	1.89	1.64±0.17 ^a	1.73±0.26 ^a	1.74±0.45 ^a	2.04±0.41 ^a	2.26±0.46 ^a
Crude fat	10.5	27.1±0.58 ^a	26.7±0.71 ^a	26.5±0.82 ^a	28.2±1.52 ^a	28.3±1.32 ^a

Mean in the same row with different letters are significantly different from each other at P<0.05

In conclusion, the use of Cattle rumen waste meal will reduce the costs of fish production by sparing 50% of maize and reducing the quantity and costs of mineral supplementation in the diets.

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