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Full Length Research Paper

Economics of replacement of maize with cassava peel meal in the growth performance of Nile Tilapia (*Oreochromis niloticus*)

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High demand of maize as food, feed and industrial uses resulted in its exorbitant price, thereby placing it out of the reach of average fish and livestock producer. The resultant effect causes high cost of fish products and closure of farms. Hence, there is need to seek for alternatives that are relatively cheaper and with lesser cost attached. This study was therefore conducted to evaluate the economics of replacement of maize with cassava peels in the growth performance of Nile Tilapia (*Oreochromis niloticus*). Three hundred juvenile Nile Tilapia fishes were cultured for twelve weeks with an average weight of 1.83±0.1 g. They were randomly allotted to five dietary treatment levels with three replications in each at the start of production with 20 fishes in each replication and were used to evaluate the growth and economic performance when fed with diets containing varying levels of cassava peel meal. Diet 1 (0% level of inclusion of cassava peels), diet 2 (25% level of inclusion of cassava peels), diet 3 (50% level of inclusion of cassava peels), diet 4 (75% level of inclusion of cassava peel), and diet 5 (100% level of inclusion of cassava peels) represented 0, 25, 50, 75 and 100% replacement of maize respectively. Results revealed that cassava peel meal significantly ($p<0.05$) affected the feed intake, cost of feed/fish, returns on feed, total cost of production, total revenue, gross margin and profit while it also influenced significantly the weight ($p<0.05$), the weight gain, final weight and feed conversion efficiency of the fish. Fishes on diet 4 had the highest weight gain, the minimal cost of production and the highest profit. Hence, cassava peels could be used to replace maize in the diet of Nile Tilapia (*O. niloticus*) with considerable economic gain.

Key words: Nile Tilapia (*Oreochromis niloticus*), cassava peels.

INTRODUCTION

The consumption and demand for fish as a cheap source of animal protein is increasing in Africa. In most countries, vast majority of the fish supply comes from the rivers as captured fisheries (FAO, 1996). FAO (2004) in "The State of the World Fisheries and Aquaculture" concluded that developments in world fisheries and aquaculture during recent years have continued to follow the trends that were already becoming apparent at the end of the 1990s, as capture fisheries production is stagnating and aquaculture output is expanding faster than any other animal-based food sector. Thus development policies increasingly perceive aquaculture as means for economic growth and prospect for future fish supply.

Nigeria is richly endowed with numerous natural aquatic resources like rivers, lakes, swamps, large expense of brackish and marine waters to develop the fisheries. Over the past decades, aquaculture has grown in leaps and bounds in response to an increasing demand for fish as a source of animal protein globally (Akinrotimi et al., 2007). This is because production of capture fisheries has reached its maximum potential possible, as the catch keeps dwindling with each passing day (Gabriel et al., 2007).

According to FAO (2006), fish supplies from capture fisheries will therefore not be able to meet the growing

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Table 1. Gross composition of experimental feed.

Ingredient	T1	T2	T3	T4	T5
Cassava peel meal	-	10.5	21	31.5	42
Maize	42	31.5	21	10.5	-
GNC	8.3	8.3	8.3	8.3	8.3
Soyabean meal	15	15	15	15	15
Fish meal	30	30	30	30	30
Bone meal	4	4	4	4	4
Lysine	0.1	0.1	0.1	0.1	0.1
Methionine	0.1	0.1	0.1	0.1	0.1
Fish premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100

global demand for aquatic foods. Hence, there is a need for a viable alternative fish production system that can sufficiently meet this demand, and aquaculture fits exactly into this role. As aquaculture production becomes more and more intensive in Nigeria, fish feed will be a significant factor in increasing the productivity and profitability of aquaculture (Akinrotimi et al., 2007). Jamiu and Ayinla (2003) opined that feed management determines the viability of aquaculture as it accounts for at least 60% of the cost of fish production. The need to intensify the culture of the fish, so as to meet the ever increasing demand for fish has made it essential to develop suitable diets either in supplementary forms for ponds or as complete feed in tanks (Olakunle, 2006). For the purpose of nutritional and economic benefits, previous researchers have attempted to increase the use of non-conventional feeding resources and animal materials to replace conventional feed ingredients like maize and fishmeal in fish diet (Faleye, 1998; Fagbenro, 1992; Olatunde, 1996; Baruah et al., 2003; Eyo, 2004).

According to Olurin et al. (2006), maize is the major source of metabolisable energy in most compounded diets for catfish species. This is because it is readily available and digestible. However, the increasing prohibitive cost of this commodity has necessitated the need to search for an alternative source of energy. Recently, FAO (2006) reported that shortage in the production of cereals is a serious issue in many countries including Nigeria. The use of maize in fish feeds is becoming increasingly unjustified in economic terms (Tewe, 2004), because of the ever increasing cost. Therefore, there is the need to exploit cheaper energy sources to replace expensive cereals in fish feed formulation. To relieve the feed competition between man and animal and for profit maximization, cassava peel is very appropriate for this purpose.

The need to solve the problems of feeding in aquaculture has been demonstrated through various research works in the utilization of vegetable sources and agricultural wastes such as plantain peel meal (Faleye and Oloruntuyi, 1998), poultry offals (Fasakin, 2008), fermented shrimp head waste meal (Nwanna, 2003), maggot meal (Faturoti et al., 1995), cassava peel meal (Olurin et al., 2006) and water hyacinth meal (Sotolu, 2008) which have been emphasized in the formulation of the least cost fish feed towards ensuring profitable fish. The objective of this study is to compare the growth performance and the economic effect of different levels of cassava peels' inclusion in the diet of *Oreochromis niloticus.*

MATERIALS AND METHODS

Three hundred juvenile of Nile Tilapia (*Oreochromis niloticus*) measuring 6 cm in length were procured from Oyo State Ministry of Water and Natural Resources, Ibadan and were randomly allotted into five dietary treatments, with three replications. Each replication consisted of 20 fishes and the experiment was laid out in completely randomized design (CRD). The cassava peels for the experiment were collected from a garri processing unit at Sedu Village in Ogun State. The peels were later sundried to a dry matter content of 14% and were ground and mixed with other feed ingredients such as maize, soyabean meal, fishmeal, etc., purchased from a local market at Sabo in Ikorodu north of Ikorodu Local Government Area of Lagos State. The experiment was carried out at the Departmental Concrete Pond of Lagos State Polytechnic, Department of Fisheries Technology, Ikorodu. Therefore experimental diets containing cassava peels at 0, 10.5, 21, 31.5 and 42% levels of inclusion represented 0, 25, 5, 75 and 100% replacement value for maize. Each inclusion constitutes a treatment and is represented as follows: T1 (control), T2, T3, T4 and T5 as shown in Table 1. The finished feeds were later sundried to allow for easy utilization of it and were later taken to laboratory for analysis using the A.O.A.C method (1995), while the gross energy was determined using Sanyo Gallenkamp Ballistic Bomb Calorimeter.

These feed were given to the fish at the rate of 5% of their body weight of the biomass for 84 days *ad-libitum* using a feeding regime of 3 times daily. Data on feed intake and weight gain were collected weekly, and the cost of feed and other inputs were recorded at the point of procurement. The economy of production was computed as stated below:

- Cost of feed per weight gain = Cost of feed per fish/Average weight gain.
- Returns on feed = Revenue/fish – Cost of feed/fish.
- Gross margin = Revenue – Total variable cost.
- Profit = Gross margin – Total cost.
- Feed Conversion Efficiency = Feed intake/weight gain.

RESULTS AND DISCUSSION

The result of the chemical analysis is given in Table 2. The gross energy, crude protein and ether extract

Table 2. Proximate analysis of experimental feed

Variable (%)	T1	T2	T3	T4	T5
Moisture	8.1	7.5	9.1	9.6	10.1
Crude.protein	35.1	34.8	34.5	34.1	33.8
Ether extract	11.4	11.0	10.7	10.3	10.0
Ash	8.7	9.2	9.7	10.2b	10.6
Crude fibre	1.8	2.8	3.9	4.9b	6.0
N.F.E	34.8	34.7	32.1	30.9	29.5
D.Energy (kcal/)	2881.3	2771.1	2660.8	2550.6	2440.3

Table 3. Economic performance of fishes fed with diets containing cassava peel meal.

Variable	T1	T2	T3	T4	T5
Duration of experiment (day)	84	84	84	84	84
Average feed Intake (g/fish/wk)	2.52	2.49	2.43	2.57	2.53
Cost/kg of feed (₦)	232.66^{a}	224.50^{b}	219.43^{c}	212.82^{d}	206.20^{e}
Total feed intake (kg)	0.18^{b}	0.18b	0.17^{c}	0.19^{a}	0.18b
Total cost of feed intake (₦)	41.88^{a}	40.41^{b}	37.30^{c}	40.44^{b}	37.12^{c}
Average weight gain (g/fish/wk)	9.98	9.23	9.95	11.17	10.14
Final weight gain (kg)	0.72	0.66	0.72	0.80	0.73
Selling price (₦/kg)	500	500	500	500	500
Total revenue (₦)	360^{a}	330b	360^{a}	400^{a}	365^{a}
Return on feed (₦)	318.12^{b}	289.59^{a}	322.70^{b}	359.56^{c}	327.88^{a}
Other variable cost (₦)	117.5	117.5	117.5	117.5	117.5
Total cost of production	159.38^{a}	157.91^{c}	154.8^{b}	157.94^{b}	154.62^{c}
Gross margin (₦)	200.62^{b}	172.09^{c}	2205.20^{b}	242.06^{a}	210.38^{b}
Total fixed cost (₦)	65.60	65.60	65.60	65.60	65.60
Profit (₦)	135.02^{c}	106.49^{d}	139.60^{c}	176.46^{a}	144.78^{b}

Table 3. Cont'd

Variable	SEM	R
Duration of experiment (day)	-	-
Ave feed Intake (g/fish/wk)	-	-
Cost/kg of feed (₦)	0.428	0.815
Total feed intake (kg)	0.290	0.726
Total cost of feed intake (₦)	1.325	0.901
Ave Weight gain(g/fish/wk)	-	-
Final weight gain (kg)	-	-
Selling price (₦/kg)	-	-
Total revenue (₦)	15.063	-0.736
Return on feed (₦)	15.062	-0.761
Other variable costs (₦)	-	-
Total cost of production	9.904	0.941
Gross margin (₦)	11.349	-0.615
Total fixed cost (₦)	-	-
Profit (₦)	9.370	0.932

N.B (SEM) = Standard error of means; r = Coefficient of correlation; abc = Means on the same row with different superscript differ significantly ($p<0.05$).
$1 is equivalent to ₦160.

decreased as the level of cassava peels increased while the crude fibre of the diet increased with increasing level of cassava peel meal inferring that cassava peel meal used in this study had a relatively higher crude fibre with relatively lower crude fibre when compared to maize.

The response of fishes on the experimental diets with respect to growth and economic indices is given in Table 3. Inclusion of cassava peel meal as substitution of maize did not influence significantly ($p>0.05$) the feed intake and the total cost of production, but influences significantly ($p>0.05$) the selling price, final weight, returns on feed, total revenue, gross margin and the profit. The feed intake of the fishes only increased at 75% of inclusion level while the rest remain constant except in 50% inclusion level.

Fishes on diet 4 had the highest feed intake while the lowest was observed for diet 3. The higher feed intake was observed for diet 4 containing 75% cassava peel meal. It might be attributed to the higher level of fibre in the feed and relatively lower energy to protein ratio. The finding revealed that the average weight of the fishes fed with diets containing cassava peel meal on diets 4 and 5 is higher than that on maize based diet. As such, a significant positive correlation ($p<0.05$) was observed between the level of cassava peel and the weight gain of the fishes. The higher level of weight gain of the fishes fed with diet containing cassava peel meal might be attributed to the high level of feed intake of the fishes in diets 4 and 5 respectively and may also be attributed to the high level of fibre content of the cassava peel meal.

The quantity of crude fibre has reported influence of its utilization. All the cost indices differed significantly ($p<0.05$) among the experimental fishes. The cost of feed per kg weight gain followed a similar trend as the cost per kg of feed, both variably decreased as the level of cassava peel meal increased. As such, significantly ($p<0.05$) negative correlation was observed between the levels of inclusion of cassava peel meal and the 3 variables. However, the total cost of feed intake did not follow any particular trend, with the fishes on diet (T_2 and T_4) respectively, while the significantly lowest cost of feeding was observed among fishes fed with diet 3 (T_3) and diet 5 (T_5) respectively.

The significantly lowest cost variables were observed among fishes fed with diets 3 and 5. It might be attributed to the level of inclusion of cassava peel meal and consumption rate of the fishes. At the time of the study, the market price of maize was ₦90/kg, while that of cassava peel meal was free. This result indicated that the inclusion of cassava peel meal reduces the cost of feed and also increases the economy of gain as fishes on diet containing cassava peel meal requires lesser money to gain a unit weight. The result confirms the findings of Olurin et al. (2006) that cassava peel meal could lower the cost/kg weight gain of fishes.

The total revenue, profit, gross margin and returns on feed follow a similar trend as it increases as the level of cassava peel meal increased. The highest profit and other indices mentioned above was recorded in treatment 4, followed by treatments 5, 3, 1, and 2 respectively.

Olurin et al. (2006) reported that cassava peel meal would help in reducing the cost of finished feed with an instant increase in profit margin to the farmers. Hence the cheapest feed brings about the most economy of gains. This result was similar to those obtained by Falaye and Oluruntuyi (1998) who used plantain peel meal and observed a comparable rate of production with the expensive feed. Thus, the introduction of cassava peel meal gave the best performance.

Conclusion

Conclusively, cassava peel meal gives greater potential as alternative feedstuff to reduce the cost of feeding in aquaculture enterprise. However, further study on the possibility of totally replacing maize with other agro waste products and means of preventing oxidative rancidity and nutrient loss from the waste when stored for a longer period of time is hereby advocated.

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