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Growth Performance of *Clarias gariepinus* (Buchell 1822) Fed Varying Inclusion Levels of Cassava Flour

EZEAFULUKWE C.F.[1]*, ONUOHA L.C.[1] and AHAOTU E.O.[2]

*[1]Department of Fisheries and Aquaculture Technology, Federal University of Technology Owerri, Imo State, Nigeria.
[2]Department of Animal Production and Health Technology, Imo State Polytechnic Umuagwo, Nigeria.

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****Corresponding Author***
Ezeafulukwe C.F.
E-mail: *emmaocy@ yahoo. com*

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ABSTRACT

This research was carried out to determine the dietary inclusion of cassava flour on growth performance of *Clarias gariepinus* fingerlings. Fifteen plastic containers were used and ten *Clarias gariepinus* fingerlings with mean weight (2.29±0.08g) were randomly distributed into each of the plastic container. Four treatments were fed diets containing 40% crude protein with varying levels of cassava flour as carbohydrate source against yellow maize except the control (T_0) where cassava flour was not included. Diet T_1 contain 25% inclusion levels, T_2 50%, T_3 75% and T_4 100% inclusion levels of the experimental diets respectively. Results showed that fish fed with diet T_3 had the best specific growth performance of (2.63±0.01) and weight gain of (7.49±0.76) being significantly different ($p<0.05$) with other treatments including the control (2.60±0.09). The weight gain of T_3 (7.49±0.76), feed conversion ratio (1.67±0.27) and protein efficiency ratio (11.62±0.01) were significantly different ($p<0.05$) with the control and favourable when compared with other diets.

INTRODUCTION

Protein sparing action of non-protein nutrients such as carbohydrates can effectively reduce feed costs (Shiau, 1997). Food is a key factor for all living organism including fish for reproduction, growth and maintenance. Evaluation of carbohydrate to minimize the high cost of protein, demand for man and animal response which (FAO, 2006) reported that aquaculture production has increased at an average of about 13-14% annually from 1970-2012. All over the world, aquaculture has become the fastest growing food production sector of the world with an average annual increase of about 10% since 1984 when compared with 3% increase for livestock meat and 1.6% increase for capture fisheries (FAO, 1997). To sustain such a high rate in aquaculture production, a similar increased level of fish feed production is required.

Fish is a major constituent source of human protein source in many tropical and sub-tropical countries (Ezeafulukwe *et al.,* 2013). In order to maintain such a high rate of growth and effective production, there is need to develop cost effective and good quality feeds. Fish meal covers a major proportion of diet to fulfill the demand of protein (Tacon and Metian, 2008). The major problems confronting the fish farming industry are the increasing cost and inadequate supply of fish meal and the competition of other livestock industries for fish meal (Siddhuraja and Becker, 2003 and Ali *et al*., 2005). Due to the high cost of fish meal, its fluctuating quality and uncertainty on the availability which is the principal protein source in fish feed, it has become necessary to spare protein using carbohydrate of different sources such as corn starch, wild cocoyam corm (Ahaotu *et al.,* 2013), cocoyam tubers, unripe plantain peel (Uwalaka *et al.,* 2013), sweet potato tuber (Ahaotu *et al.,* 2011, 2012), yam tubers, cassava tubers (Ahaotu *et al.,* 2009) and cassava starch. The availability and non-competition of these carbohydrate energy sources with protein sources in livestock and human consumption, as well as industrial use make their cost more affordable and put them within the reach of fish farmers (Fasakin *et al*., 1999).

Modalities to lower the high cost of protein demand and its competition between livestock, aquatic animal and man posited that when carbohydrates are incorporated in fish diet, it will increase fish yield, meet market target as well as to reduce the high cost of feed. This will further enhance the feed pelletability since carbohydrate can be effectively utilized by fish including Clarias gariepinus.

MATERIALS AND METHODS

Study area

Owerri the capital city of Imo State, Nigeria lies within latitude 06^0 29 06s and longitude 07^0 02 06s. The area experiences a longer wert season which lasts from April to November than dry season which last for the rest of the year. It has mean daily maximum temperature range of 28^{0}C to 35^{0}C, while daily minimum values ranges from 19^{0}C to 24^{0}C, with average humidity of 80%. The vegetation is dominated by semi-deciduous forest that has already been altered by agricultural and other anthropogenic activities and the dominant topsoil is moderately humus in composition.

The study was carried out in the Fisheries and Aquaculture Research Farm of the Federal University of Technology Owerri, Nigeria which provided the farm-raised specimens used for the study. It is bounded by longitudes of 65^0 8''E- 7^0 03E and latitudes of 5^0 20'N – 5^0 28'N. The institution has an annual rainfall between 192-194cm and temperature of 32.18^{0}C.

Experimental Procedure

Diets with different inclusion levels of cassava flour at 0%, 25%, 50%, 75% and 100% were formulated. A total of 150 fingerlings of *Clarias gariepinus* collected from a commercial hatchery with a mean weight 3.00±0.06g were used for the study. The fish were held inside 15 (fifteen) plastic containers each having 10 (ten) *Clarias gariepinus* fingerlings which were randomly distributed into each of the plastic container. Fish were allowed to acclimatize for a period of 7 days before the commencement of the experiment and were starved for 24 hours to empty their gastro intestinal tract.

Each diets was assigned to a group of ten (10) *Clarias gariepinus* fingerlings in triplicate, fish were fed twice daily in the morning hours (8am -9.30am) and in the evening hours (4pm -5.30pm) respectively.

Fish inside the 15 plastic containers were weighed simultaneously in batches at the end of every two weeks using digital weighing balance and return to their respective enclosures. The feed were adjusted every two weeks when the new mean weight of fish for the experiment were determined, unconsumed feed were siphoned out each week, stale water were renewed in the containers after 3 days from a bore hole at the farm unit. The experimental containers were monitored daily to remove mortality while physic chemical parameters were monitored for temperature, dissolved oxygen, ammonia, P^H and hardness throughout the duration of the experiment for 56 days.

Analysis of Fish samples for nutrient composition

Samples were analyzed chemically in accordance (AOAC, 2005).

Crude protein determination

Crude protein was determined in accordance with AOAC (2005). The crude protein in the sample was determined by the routine semi micro Kjeldahl, procedure and technique. This consists of three techniques of analysis, namely, digestion, distillation and titration.

Statistical analysis

The two sets of data on nutrient composition emanating from fish were subjected to analysis in accordance with DNMRT (Gordon and Gordon, 2014).

RESULTS

Table 1-3 presents the gross composition of the experimental diet, proximate analysis of *Claris gariepinus* fingerlings and proximate analysis of experimental diets as evaluated. A total of five parameters were considered including crude protein, crude fat, crude fibre, ash and moisture

Table 1: Shows the Gross Composition of the Experimental Diet

Ingredients	T_0 0%	T_1 25%	T_2 50%	T_3 75%	T_4 100%
Fish meal	33.94	25.47	16.97	8.49	33.94
Soybean meal	33.96	33.96	33.96	33.96	33
Yellow maize	19.85	14.89	9.93	4.96	0.00
Cassava flour	0.00	4.96	9.93	14.89	19.85
Wheat bran	5.00	5.00	5.00	5.00	5.00
Fish meal	1.50	1.50	1.50	1.50	1.50
Vitamin C	0.50	0.50	0.50	0.50	0.50
Cod-liver Oil	1.00	1.00	1.00	1.00	1.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Palm Oil	1.00	1.00	1.00	1.00	1.00
Common Salt	0.25	0.25	0.25	0.25	0.25
Corn Starch	1.00	1.00	1.00	1.00	1.00
Bone Meal	1.50	1.50	1.50	1.50	1.50
Total	100.00	100.00	100.00	100.00	100.00

Table 2: Proximate Analysis of *Claris Gariepinus* fingerlings as Evaluated

Parameters	Initial	T_0	T_1	T_2	T_3	T_4
Moisture	63.29	63.50	63.13	62.70	60.70	61.31
C. Protein	19.60	19.80	20.40	20.70	21.90	20.10
Ash	21.46	1.84	1.99	2.04	2.71	2.69
Fat	0.48	21.85	21.93	22.40	24.10	23.24
Fibre	0.01	0.10	0.18	0.18	0.20	0.13

Table 3: Proximate Analysis of Experimental Diets

Parameters	T_0	T_1	T_2	T_3	T_4
Moisture	10.80	10.20	10.40	10.00	10.64
Ash	0.36	0.40	0.42	0.38	0.40
Fat	4.80	5.12	5.18	5.16	5.12
Fibre	0.10	1.20	1.18	1.20	0.12
Crude Protein	40.0	40.01	40.05	40.08	40.05
Carbohydrate	74.92	74.88	74.82	74.66	75.70

Table 4: Growth Performance of Experimental Fish

Parameters	T_0	T_1	T_2	T_3	T_4
Initial weight gain (g)	2.18±0.12	2.30±0.57	2.29±0.08	2.24±0.30	2.22 ± 0.01^{ns}
Final weight gain (g)	4.78 ± 0.14^{a}	7.22 ± 0.90^{b}	7.49 ± 0.08^{b}	9.73 ± 0.10^{c}	$4.88\pm0.04^{a*}$
Weight gain (g)	2.60 ± 0.09^{a}	4.92 ± 0.31^{b}	5.18 ± 0.74^{b}	7.49 ± 0.76^{c}	$2.66\pm0.03^{a*}$
Daily weight gain (g)	0.05 ± 0.01^{a}	0.08 ± 0.01^{b}	0.09 ± 0.01^{b}	0.13 ± 0.02^{c}	$0.05\pm0.01^{a*}$
Specific growth rate	1.40 ± 0.06^{a}	2.04 ± 0.02^{b}	2.12 ± 0.05^{b}	2.63 ± 0.01^{c}	$1.41\pm0.01^{a*}$
Feed conversion ratio	2.80 ± 0.01^{a}	2.08 ± 0.31^{a}	2.79 ± 0.02^{a}	1.67 ± 0.27^{b}	$2.80\pm0.67^{a*}$
Percentage weight gain	119.0 ± 7.44^{a}	214.27 ± 4.14^{b}	226.89 ± 8.96^{b}	334.57 ± 2.80^{c}	$121.56\pm1.20^{a*}$
Feed intake	19.10 ± 0.01^{a}	24.39 ± 0.02^{b}	25.05 ± 0.02^{b}	29.04 ± 0.03^{c}	$19.61\pm0.01^{a*}$
Protein intake	5.64 ± 0.01^{a}	9.76 ± 0.01^{b}	10.02 ± 0.02^{b}	11.62 ± 0.03^{b}	$5.84\pm0.01^{a*}$
Protein efficiency ratio	0.34 ± 0.10^{a}	0.61 ± 0.01^{b}	0.52 ± 0.01^{b}	0.64 ± 0.61^{b}	$0.37\pm0.31^{a*}$
Nitrogen metabolism	39.97 ± 24.34^{a}	75.68 ± 0.49^{b}	79.68 ± 1.12^{b}	113.82 ± 1.60^{c}	$40.84\pm0.43^{a*}$
Survival	86.67 ± 3.33^{a}	90.67 ± 3.33^{b}	93.33 ± 3.33^{b}	93.34 ± 3.33^{b}	$86.67\pm3.32^{a*}$

Mean on the same row having different superscripts are significantly different.

The cassava flour used in this study was said to have undergone processing technique to yield into powdered form as (FAO, 1997 and Booth *et al*., 2001) reported that processing conditions have great impact starch digestibility of fish in formulated diets.

Starch or dextrin is consumed more efficiently by catfish than sugars such as glucose or sucrose as it was postulated by (Shiau, 1997; Edwing and Meng, 1996). In this research, assertion made available revealed that there was significant difference in the body composition in protein efficiency ratio and percentage weight gain. Similar results found in another study revealed increase in high lipid content in the fish due to availability of sufficient energy with increasing levels of carbohydrate as conducted by (Anderson *et al*., 1984 ; Erfanullah and Jafri, 1995).

Better growth rate observed in T_3 of this experiment can be attributed to the ability of Clarias gariepinus fingerlings to utilize effectively the high level of carbohydrate provided relative to T_1, T_2 but exceptional to T_4 respectively as this was in relation to earlier works of (Wilson, 1987) who reported that channel catfish (*Ictalurus puntatus*) being a fresh water fish basically in temperate region were able to utilize over 70% of corn starch as carbohydrate and energy sources in the formulated diets. The research also contradicts the findings made by (Robinson and Li, 1996) which stated that the optimum carbohydrate requirement for African fresh water catfish (*Clarias gariepinus*) was in the ranges of 25 -35%) inclusion levels.

CONCLUSION

Carbohydrate inclusion in diets of *Clarias gariepinus* favours growth performance feed conversion ratio, protein efficiency ratio and survival rates. The inclusion of carbohydrate sources in the diets of fish improved the growth of channel catfish but up to 100% inclusion level, growth rates will be reduced drastically.

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