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Comparative Growth Performances of First and Second Filial Generations of *Clarias gariepinus* (Burchell, 1822) Fed Processed *Azanza garkeana* Pulp Meal

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Abstract
This study was to evaluate the growth performances of First Filial (F_1) and Second (F_2) of *Clarias gariepinus* (Burchell, 1822) fed processed *Azanza garckeana* pulp meal. Phytochemical analysis *A. garckeana* revealed the presence of high (+++) Flavonoids, Steroids and Carbohydrates, while the Alkaloids, Carotenoids, Saponins and Glycosides were moderate (++); Tannins, Phenols and Oxalates were low (+). The growth performance of the F_1 generation showed the highest mean weight gain in T3 (809.68±0.89g) and the lowest in T5 (784.93±0,89g). The highest mean length gain was observed in T3 (41.00±0.07 cm) and the lowest in T5 (38.80±0.11 cm), while the condition factor (K) was highest in T4 (2.59±0.11) and lowest in T1 (2.35±0.11). Growth performances of F_2 generation showed that the highest mean weight gain was in T5 (827.18 ± 0.11g). The lowest was in T1 (707.77 ± 0.11g). The highest mean length gain was observed in T5 (32.02±0.18 cm) and the lowest in T2 (30.00±0.17 cm), while the condition factor (K) was highest in T2 (2.76±0.11) and lowest in T1 (2.53±0.12). The comparative growth performances between the F_1 and F_2 showed that F_2 had better growth indices than F_1 suggesting that the genetic material in F_2 has been unmasked and the fish is now regarded as domesticated; hence the improved performance. It was concluded that the performance in F_2 was due to both genetic and environmental (*A. garkeana*) factors. It is therefore recommended that *A. garkeana* could be used as part of feed in domesticating *C. gariepinus*

Keywords: Growth Performance, First Filial Generation (F_1), Second Filial Generation (F_2), *Azanza garckeana, Clarias gariepinus.*

Introduction

Artificial breeding for fish species constitutes the only practicable means of providing enough quality fingerlings for aquaculture and possible production of important species at a widely separated geographical means (Moses *et al.*, 2005). Research on catfish genetics and breeding was responsible for the first release of genetically approved Channel catfish to the aquaculture industry (Dunham and Smitherman, 1984). According to Dunham and Smitherman (1981), the domestication of catfish increases growth rate 2-6% per generation. Size variability is more pronounced in some strains than others (Brooks, 1977). According to Chevassus and Coche (2016). productivity in carp, catfish and tilapia has been improved upon by intraspecific hybridization.

A. garckeana popularly known as "morajwa" (African chewing gum) in Botswana (Onyia *et al*., 2015) is also widely known as tree hibiscus, snot apple, wild hibiscus (Orwa *et al*., 2009) and "Goron Tula" in Northern Nigeria (Gombe State). *A. garckeana* is a valuable edible indigenous fruit tree species. It is a deciduous shrub or small spreading tree, 3-13 m high, with a diameter at breast height of up to 25 cm (Orwa *et al*., 2009). FAO (1983) reported that *A. garckeana* grows naturally in semi-arid areas receiving lowest annual rainfall of 250 mm and height rainfall of 1270 mm.

Researches on intraspecific hybridization of first generation of family Clariidae have been reported by several authors (Aguigwo, 1993; Aluko, 1998; Moses *et al.*, 2005; Adewolu *et al*., 2008; Onyia *et al*., 2010 and Ataguba *et al*, 2010) but little comparison of first generation and second

generation had been carried out. Onyia *et al.* (2011) examined the growth performance of first and second generations of *C. anguillaris* hybrids from three ecological zones of Nigeria. This study was carried out to compare the growth performance of the first and second generations of *C. gariepinus* fed different inclusion levels of *A. garkeana* pulp meal.

Materials and Methods

Study location

The research was conducted at the Research Farm of the Department of Fisheries, Faculty of Agriculture, Modibbo Adama University (MAU), Yola. The University is located at Girei Local Government Area of Adamawa State at the North Eastern part of Nigeria. It lies between latitude 7^{o} and 11^{o} of the equator and between Longitude 11^{o} and 14^{o}E of the Greenwich meridian. It boreders Taraba State in the south and west, Gombe State in the north-west and Borno State to the north. Adamawa state has an international boundary with Cameroun Republic along its Eastern part. The State covers a land area of about 38,741 km^{2} and has 21 local Government Areas (Ochokwu *et al*., 2014).

Proximate Composition and Phytochemical Analysis of A. garckeana

Proximate composition of *A. garckeana* was determined using standard methods according to the Association of Official Analytic Chemists (AOAC, 2012). The proximate values of moisture, crude protein, lipid, ash, nitrogen free extract NFE and crude fibre were determined. The phytochemical analysis of *A. garckeana* was carried out as adopted by Ochokwu *et al.* (2015) and Michael *et al*. (2015). The following qualitative data were determined; steroids, saponins, phenols, tannins, alkaloids and flavonoids.

Growth Parameters of C. gariepinus:

Growth indices were estimated using the following formulae.

Weight Gain:

Weight gain (g) = (final weight- initial weight)

Mean Daily Weight Gain (MDWG)

Mean daily weight = $\frac{W_I - W_0}{T}$

W_I: Final mean weight (g)
W_0: Initial mean weight (g)
T: culture period in days

Specific Growth Rate (SGR)

Specific growth rate = $\frac{\ln W_I - \ln W_0}{T}$

(Michael *et al*., 2015)
ln= natural log
W_1: Final mean weight
W_0 : Initial mean weight
T: culture period in days

Survival Rate:

Survival rate = $\frac{\text{final No. of fry}}{\text{Initial No. of fry}} \times 100\%$

(Ochokwu *et al*., 2020)

Statistical Analysis:

Data collected were analysed using Analysis of Variance (ANOVA) in SPSS (18) Statistical Package. Means were separated using least significant difference (LSD) at significance level of $P \leq 0.05$.

Results

Phytochemical Analysis of A. garckeana Pulp Meal

The phytochemical analysis of *A. garckeana* pulp meal is presented in Table 1, where the qualitative composition shows high presence of flavonoids, steroids and carbohydrate, while alkaloids, carotenoids, Saponins and glycosides are moderate and tannins, phenols and oxalate are low. The quantitative analysis showed carbohydrate was (4.70) highest, followed by steroids with 4.50 mg and lowest oxalate with 0.09 mg.

Table 1: Phytochemical Analysis of *A. garckeana* Pulp meal

Elements	Qualitative	Quantitative (mg)
Alkaloids	++	1.09
Tannins	+	0.19
Carotenoids	++	2.80
Flavonoids	+++	4.00
Steroids	+++	4.50
Carbohydrates	+++	4.70
Glycosides	++	3.00
Phenols	+	0.20
Terpenes	–	–
Anthraquinones	–	–
Oxalate	+	0.09
Saponins	++	1.22

Key: + = Low. ++ = Moderate. +++ = High. - = None.

Growth Performances of F_1 Generation of C. gariepinus fed different Inclusion of Processed A. garckeana Pulp Meal

The growth performance of F_1 generation of *C. gariepinus* fed with different inclusion of processed *A. garckeana* pulp meal as shown in Table 2. The highest mean initial weight was in T5 (68.75g) and lowest in T1 (66,67g). Highest mean final weight was in T3 (877.40g) and lowest in T1 (851.60g), while the highest mean growth rate was in T3 (4.46g)/day and lowest in T4 and T5 (3.43g)/day. The specific growth rate (SGR) was highest in T3 (0.045% /day) and lowest in T4 and T5 (0.034% /day). Highest feed intake was in T1 (4.00kg) and the lowest in T3 (3.75kg), while highest feed conversion rate FCR was in T1 with 0.0051 and lowest in T3 with 0.0046. Highest mean length gain was in T3 with 54.12 centimetres and lowest in T1 with 50.72 centimetres, while the highest condition factor (K) was in T1 with 16.79 and lowest in T3 with 16.21.

Growth of Performances F_2 Generation C. gariepinus fed different Inclusion of Processed A. garckeana pulp meal

The growth performance and survival of *Clarias gariepinus* fed each of the experimental treatments (Table 3) results vary between fish fed with the control diet and other experimental diets with *A. garckeana* pulp meal. Highest mean weight gained of 827.18±0.11g was recorded in T5 and the lowest mean weight gain of 707.77±0.11g was recorded in diet T1. Specific growth rate ranged between 3.13±0.05g and 3.05±0.05g. Highest specific growth rate (SGR) was recorded in T5 (3.13±0.05g) and the lowest specific growth rate (SGR) (T1 and T2) (3.05±0.05g). The values of feed conversion ratio ranged between 0.005±0.13 and 0.004±0.13; the highest FCR of 0.005±0.13 was recorded in T1 and lowest FCR was in diet T2 (0.004±0.13).

Table 2: Growth Performance of F_1 Generation of *C. gariepinus* Fed Different Inclusion of processed *A. garckeana* Pulp Meal

Parameters	Treatment1	Treatment2	Treatment3	Treatment4	Treatment5
Mean initial weight(g)	66.67±0.89	67.72±0.89	67.72±0.89	68.33±0.89	68.75±0.89
Mean final weight (g)	851.6 ± 0.90^{d}	865.4 ± 0.90^{c}	877.4 ± 0.90^{a}	868.0 ± 0.90^{c}	873.0 ± 0.90^{b}
Mean weight gain (g)	784.93 ± 0.89^{d}	797.68 ± 0.89^{c}	809.68 ± 0.89^{a}	799.67 ± 0.89^{c}	804.25 ± 0.89^{b}
Daily growth rate(g/day)	3.69 ± 0.11^{b}	3.60 ± 0.11^{c}	4.46 ± 0.11^{a}	3.43 ± 0.11^{d}	3.43 ± 0.11^{d}
Specific growth rate(%/day)	0.037 ± 0.011^{b}	0.036 ± 0.011^{b}	0.045 ± 0.011^{a}	0.034 ± 0.011^{c}	0.034 ± 0.011^{c}
Feed intake (kg)	4.00 ± 0.067^{a}	3.85 ± 0.11^{b}	3.75 ± 0.11^{d}	3.80 ± 0.11^{c}	3.85 ± 0.11^{b}
Feed conversion rate	0.0051 ± 0.11^{a}	0.0048 ± 0.11^{b}	0.0046 ± 0.11^{c}	0.0048 ± 0.11^{b}	0.0048 ± 0.11^{b}
Survival rate (%)	83 ± 0.11^{a}	75 ± 0.11^{b}	67 ± 0.11^{c}	75 ± 0.11^{b}	83 ± 0.11^{a}
Mean length gain(cm)	40.72 ± 0.11^{b}	39.50 ± 0.07^{c}	41.00 ± 0.07^{a}	39.70 ± 0.11^{c}	38.90 ± 0.11^{d}
Condition factor(K)	2.35 ± 0.11^{c}	2.55 ± 0.11^{a}	2.37 ± 0.11^{b}	2.59 ± 0.11^{b}	2.44 ± 0.12^{c}

Means with different superscript are significantly different ($p<0.05$)

Table 3: Growth Performance of F_2*Clarias gariepinus* fed different Inclusion Levels of Processed *Azanza garckeana* pulp meal

Parameters	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5
Mean initial weight (g)	14.23±0.51	14.22±0.51	14.12±0.49	14.30±0.48	14.821±0.5^{b}
Mean final weight (g)	722±0.21^{bc}	722±0.21^{bc}	792±0.20^{b}	802±0.23^{ab}	842±0.22^{a}
Mean weight gain (g)	707.77±0.11^{bc}	707.78±0.11^{bc}	777.88±0.10^{b}	787.71±0.10^{ab}	827.18±0.11^{a}
Mean initial length (cm)	1.21±0.21^{c}	1.20±0.22^{c}	1.18±0.22^{d}	1.30±0.21^{a}	1.28±0.21^{b}
Mean final length (cm)	32.10±0.34^{b}	31.20±0.34^{c}	32.02±0.33^{b}	32.33±0.33^{b}	33.30±N0.33^{a}
Mean length gain (cm)	30.89±0.17^{c}	30.00±0.17^{d}	30.84±0.17^{c}	31.03±0.18^{b}	32.02±0.18^{a}
Daily growth rate(g/day)	3.16±0.34^{c}	3.16±0.34^{bc}	3.47±0.33^{b}	3.52±0.33^{ab}	3.69±0.34^{a}
Specific Growth Rate (%/day)	3.05±0.05^{bc}	3.05±0.05^{b}	3.12±0.04^{ab}	3.12±0.04^{ab}	3.13±0.05^{a}
Feed intake (kg)	4.18±0.87^{a}	3.88±0.86^{ab}	3.70±0.86^{bc}	3.67±0.85^{c}	3.68±0.85^{c}
Feed conversion ratio	0.39±0.15^{a}	0.23±0.14^{b}	0.38±0.15^{a}	0.25±0.14^{b}	0.24±0.14^{b}
Survival ratio	83±5.77^{a}	83±5.77^{a}	75±5.75^{b}	75±5.75^{b}	75±5.75^{b}
Condition factor (k)	2.53±0.12^{c}	2.76±0.11^{a}	2.68±0.11^{b}	2.69±0.11^{b}	2.55±0.12^{c}

Means with different superscript are significantly different ($p<0.05$)

Discussion

Growth Performance

The growth performance as observed in this study showed a significant increase in performance of *C. gariepinus* fed *A. garckeana* Pulp Meal. It was observed that all fish fed processed experimental diet performed more than the control which disagrees with the observation of Olukunle (2006). He reported that control diet had better result than the experimental diets. These positive performances increased as the levels of *A. garckeana* Pulp meal increased and this also disagreed with the work of Tiamiyu *et al*. (2015) in which the control diet had better result also than the other treatment diets. Aliu *et al*., (2017) had earlier reported that biological indicators such as growth performance, survival, feed utilization efficiency, nutrient availability, gross or sub-clinical abnormal signs are basic means employed in determining the efficacy and adequacy of treatment of feeds. The growths of the fish were significantly affected positively at higher inclusion levels of *A. garckeana* Pulp meal.

The efficiency of fish in converting feeds to flesh is usually assessed in fish nutritional study by determining the FCR. The lower the value of FCR, the better for the farmer. The highest specific growth rate (SGR) was recorded in T1 and the lowest specific growth rate in T4 and T5 for first filial generation, while in second filial generation and this agree with Tiamiyu *et al*. (2015). The inclusion of different inclusion level of *A. garckeana* Pulp Meal brings improvement in MWG and FCR but not SGR of catfish as compared to the control group. The current findings are in harmony with El-Naggar (2016), who indicated that mean weight gain (MWG) and SGR significantly improved as a result of experimental processed meal diet.

In this study, there was a general increase in mean weight gain in all treatments which is an indication that the fish were able to convert feed protein to extra muscles. Weight gain and growth rate are usually considered as the most important measurement of productivity of diets. The increased weight gain recorded in all the processed meal diets compared to control also indicated that the fish responded positively to their surroundings. The best feed conversion rate (FCR) recorded for diet T3 is an indication of an optimum level of utilization of the diet by the *C. gariepinus*. This corresponds with Bassey *et al.* (2018)) who stated that the lower the FCR, the better the feed utilization by the fish. In this study, the lowest FCR value is an indication of better feed utilization by the fish and this accounted for better growth performance of *C. gariepinus* fed T3 meal diets among other processed meal diets. This corresponded with observation made by Adeniyi and Lawal (2017) in related studies on feeding trials.

Conclusion

The growth performance as observed in this study revealed significant increase in performance of *Clarias gariepinus* fed processed *A. garckeana* pulp meal. It was observed that all fish fed processed meal diet performed more than the control diet. These positive performances increased as the levels increased. The growths of the fish were significantly affected positively at higher inclusion levels. However, from the result of this study it may be concluded that the F_1 had better growth performance than F_2 *C. gariepinus*.

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