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Evaluation of Reproductive Indices and Growth of Normal, Albino, Clarias Gariepinus and Their Reciprocals in Hatchery Conditions

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Abstract
Normal pigmented and albino *Clarias gariepinus* fingerlings, and their reciprocal crosses were compared to estimate the percent fertilization, hatchability and evaluate growth performance of normal pigmented, albino *Clarias gariepinus* and their reciprocal crosses. The offspring were reproduced artificial through induced breeding and raised for eight weeks in plastic bowls with water level 30L and each treatment was replicate in three bowls. Normal pigmented purebred(NN) had the highest percent fertilization of 98.7%, followed by purebred albino (AA) 96.6%, while the hybrids NN x AA and AA x NN had 70.1% and 85% respectively. There was significant difference ($p<0.05$) in the fertilization. NN *Clarias gariepinus* had the higher hatchability of 97% than the AA *Clarias gariepinus* 94% followed by AA x NN 75%, NN x AA hybrid had the lowest, there was significant different($p<0.05$) in hatchability. There was significant difference($p<0.05$) in mean weight gain, 7.44±0.25g was the highest in NN x AA hybrid crosses followed by AA x NN hybrid crosses 6.40±0.04g, NN pigmented 6.29.±0.13g and AA albino 4.23 ±0.15g was the lowest fed for 56 days. The ratio of albino to normal pigmented *C. gariepinus* in all the crosses showed significant difference ($p<0.05$), AA x AA was 4:1, NN x NN all normal pigmented (100% normal pigmented), NN x AA and AA x NN were 3:1. There was no significant difference ($p>0.05$) in the feed conversion ratio, since all had 0.05:1. Tere was no significant difference ($p>0.05$) in the percentage survival between NN x NN and AA x NN (66.65% and 66.66%) but there was significant difference ($p<0.05$) between AA x AA and NN x AA (55.6% and 60.65%).
Keywords: Fertilization, hatchability, growth, albino, normal, *Clarias gariepinus*

INTRODUCTION

Clarias gariepinus (Burchell, 1822) are economically important fresh water fish species of the Clariidae family that contribute immensely to the annual fresh water fish production in Nigeria. They are also readily acceptable among Nigerian fish farmers and consumers, hence command high commercial values. They are commonly referred to as mud fishes or African catfish in various parts of Nigeria and are important source of animal protein. Among the freshwater species for culture in Nigeria, *Clarias gariepinus* are the most common and have received much attention because of their economic importance and high rate of success in rearing them.

Albinism in catfish is the best known potentially valuable qualitative traits and inherited as a single homozygous recessive traits (Bondari, 1981). In Neotropical freshwater fish fauna, albinism cases are extremely rare, with only 14 species recorded (Nobile *et al.* 2016) among more than 6000 described (Reis *et al.* 2003). Different authors have worked on various catfishes, *Imparfinis mirini* a South American catfish (Manoel, *et al.,*2017), the marine catfish (*Genidens barbus*) in Argentine waters(Milessi *et al* 2013), *Clarias gariepinus* from Yola Nigeria(Onyia *et al.* 2016) and *Rhinelepis aspera* from the Upper Paraná Basin Brazil(Nobile *et al.*2016). An albino specimen of any of the larger catfish species can be a truly magnificent sight, such as large albino catfish(Goudie *et al*.1992).

Albino *Clarias gariepinus* has all the traits of the normal pigmented *Clarias gariepinus*. They have the same taste meat, and grow to the same size. However the albino form of this catfish has some additional values. The Albino form of the catfish is an appreciated aquarium fish and can be sold in large quantities to aquarium stores. Albino catfish are also preferred by some to stock fishing lakes, since the Albino catfish are more easily spotted and allows the fishermen to see that there are fish in the lake even if they are unsuccessful in catching any. There is no doubt that commercial breeding of catfish in captivity has increased the amount of Albino catfish available both in the aquarium trade and in the wild as a result of different restocking efforts.

The task facing the fish breeder is to determine the amount and type of genetic control over the albino catfish performance to implement a system of breeding and selection to improve production efficiency. An undisputed need exists for improving albino catfish production in aquaculture through planned breeding programs. The objectives of this study are to estimate percentage fertilization,hatchability of normal pigmented and albino *Clarias gariepinus* as well as to compare the growth performance of hatchlings and their reciprocal hybrids..

MATERIALS AND METHODS

Study Location

The research was conducted at Modibbo Adama University of Technology (MAUTECH), Yola. The experimental site is located within the Guinea Savanna zone and lies between latitude 9^0 and 11^0 north and latitude 11^0 and 14^0 east. Rainfall usually begin in late March and end around October, while the dry season starts in late October between 700mm to1000mm with average minimum temperature of 32^0 C and maximum of 42^0C (Adebayo and Tukur 1997).

Source of Broodstock

The normal pigmented broodstock was collected from the Research Farm of the Department of Fisheries Modibbo Adama University of Technology Yola. The Albino was collected from a private farm in Jimeta and transported to the Modibbo Adama University of Technology Yola. Where they were acclimatized in concrete tank for one week before artificial induced breeding was carried out. The selected samples were properly maintained separately by ensuring good water quality management and adequate feeding before being used for breeding.

Brood stock Selection

The artificial breeding of the research was two males, Albino and normal pigmented, and two females, normal pigment and albino from each tank were randomly selected for the breeding excises

Ripe and matured broodstock were carefully selected and examined for gonad development according to the method of Blythe *et al.*, (1994). Males were examined for rigid and reddish infusion of the genital orifice and for females, genital orifice for reddish infusion, distension of the belly and release of eggs with gentle pressure was applied on the abdomen. The male and female fishes were weighed separately with weighing balance. The fishes were injected base on their weight using synthetic hormone Ovaprim according to the method of Goudie *et al*., (1992). Injection was given intra-muscularly at the recommended rate of 0.5ml per kg of female fish and 0.25ml per kg of male fish and they were kept separately in four plastic bowl containing water, and was covered with netting in other to ensure that the fishes did not jump out from the bowls for latency period of about 10 to 12 hours with water temperature of between 25-27 0C.

Percentage Fertilization

The milt obtained by sacrificing the males and dissecting the testis by using incision and diluted with physiological salt solution. Stripping of the eggs was by applying light pressure on the abdomen, pressing toward genital opening. The milk and eggs were mixed together gently with a plastic spoon for 2-3 minutes. Small quantity of saline solution was then poured onto the eggs to avoid sticking together. The fertilized eggs were rinsed with distilled water and introduced into the incubation tank for incubation Table1. Incubating tray, placed inside incubation tanks that contain clean water was used for the purpose. The rate of fertilization was calculated as follows.

$$\text{Percentage fertilization} = \frac{\text{number of fertilization of eggs}}{\text{Total number of eggs}} \times 100$$

The crosses

Normal *Clarias gariepinus* x Normal *Clarias gariepinus*
Albino *Clarias gariepinus* x Albino *Clarias gariepinus*
Normal *Clarias gariepinus* × Albino *Clarias gariepinus*
Albino *Clarias gariepinus* × Normal *Clarias gariepnus*

Table 1 Crosses of Normal pigmented and Albino

♀/♂	N	A
N	NN	NA
A	NA	AA

KEY:
NN----NORMAL PIGMENTED
AA----ALBINO
NA----NORMAL PIGMENTED\ ALBINO
AN----ALBINO\NORMAL PIGMENTED

NN♀ x NN ♂ = NN
AA♀ x A A ♂ = AA
NN ♀ x A A ♂ = NA
AA ♀ x NN ♂ = AN

Incubation and Hatching

Fertilized eggs were spread in a monolayer on the tray in the incubator. Aeration was maintained by flow through system. The tray was constructed from a coated nylon net with 1.5 mm mesh size. The net withholds normal size fish eggs and egg shell but allowed the hatchlings swim out into the incubation tank and the tray with un- hatched eggs and shells was lifted out of the incubation tank and washed. The development process

from fertilized eggs to hatching is dependent upon water temperature while hatching rate is, next to egg quality, dependent on the water quality temperature, oxygen level, pH and water hardness. The percentage number of hatching in each mating combination were obtained by direct counting of number that will be hatched eggs as well as number of hatching in incubating tray. Percentage number of hatching Albino. Albino normal, normal Albino and normal pigmented,

$$\text{Percentage hatchability} = \frac{\text{Number of hatching}}{\text{Total number of eggs fertilized}} \times 100\%$$

Rearing in the Hatchery

When hatching was completed two hundred and forty fry seven days old were randomly selected in the four crosses and stocked in twelve plastic bowl at 20 fry per bowl containing 25ml of water in triplicate. The fry were fed with hatched Artemia cysts after yolk absorption, there after the fry were fed with Coppens feed of 0.2-0.3mm, 0.5-.8mm and 2mm. The experiment lasted for fifty six days and weight, length, and survival in each bowl was determined every week beginning from the day they were stocked in the bowls for eight weeks. Water quality parameters such as temperature, Dissolved Oxygen and pH were monitored and maintained at optimum level. Mortality and survival rates were determined.

Growth performance

Weight and length recorded during the experimental period were analysed subsequently for the determination of the growth performance of the fish viz mean weight gain(MWG) specific growth rate (SGR) and mean length gain(MLG) parameters. The mean final weight(MFW) and mean final length (MFL)were taken weekly.. Measurement were carried out for weight with electric balance and total length with metre rule.. Length gain weight gain and specific growth rate (SGR) where determine by formula adopted from Adebayo (2006).

$$\text{Percentage Survival} = \frac{\text{Cumulative Survival}}{\text{Total number stocked}} \times 100$$

Weight gain = mean final body weight (MFW)- Mean initial body weight (MIW);

Length gain (MLG) = mean final length (MFL) – Mean initial length (MIL)

$$\text{Mean daily weight daily gain} = \frac{W_1 - W_o}{T}$$

$$\text{Specific growth rate (\%day)} \quad \frac{\ln W_1 - \ln W_o}{T} \times 100$$

Statistical analysis

Data obtained from the experiment were subjected to one-way analysis of variance (ANOVA). The difference between the means were determined using Least Significant Difference (LSD) at 95% confidence level ($P<0.05$).

RESULTS

Percentages Fertilization and Hatchability

The percentages of fertilization in the hybrids were the lower in NN♂ x AA♀ (70.10 %) and AA♂ x NN♀ (85.00%) and the purebreds AA♀ x AA♂ (96.6 %) and NN♂ x NN♀ (98.7 %) were the higher as indicated in Table 2. The values of Normal pigmented C *gariepinus* (NN♂ x NN♀) and Albino (AA♂ x AA♀) were significantly different ($P<0.05$) from the hybrid crosses. On the other hand, there was significance different ($P<0.05$) among the hybrids. Hatching rate was highest in NN♂ x NN♀ (97.9%) followed by purebreed AA♂ x AA ♀ (94.00 %) as shown in Figure. The values in the hybrids AA ♂ x NN♂ (75.00%) and NN♂ x AA♀ (60.00%) were the lower than the purebreds.

Growth and Feed Utilization Parameter of Experiment

The final mean weight was highest in NN♂ x NN♀ (7.63±1.33g) in figure 3 followed by AA♂ x NN♂(6.63 ±0.64g), NN♂ x AA♀ (6,47±0.80g) and AA♂ x AA♀ (4.40±0.00g) was the lowest. There was significant different ($P< 0.05$) in final mean weight gain of the crosses. The crosses from all the breeding trials increased in length during the rearing period. The corresponding growth curve illustrated in terms of length increase (cm) for each cross was presented in Table 4 and Figure 4. The maximum values for mean final length (5.83±0.10cm) was in AA♂ x NN♀ followed by NN♂ x AA♀ (5.35±0.10cm), NN♂ x NN♀ (5,03±0.03cm) whereas the minimum size for MFL (4.44±0.00 cm) was observed in AA♀ x AA♀ . The statistical analysis showed significant difference ($P<0.05$) among the crosses.

The mean weight gain for the hybrid crosses NN♂ x AA♀ (7.44±0.25g) and AA♂ x NN♀ (6.40±0,04g) were significantly different ($p < 0.05$) larger than those of the pure crosses NN♂ x NN♀ (6.29±0.13) and AA♂ x AA♀ (4.23±0.15) which were also not significant different (P-0.05) from each crosses. The specific growth was high (2.86) in hybrid (NN♂ x AA♀) followed (2.77) purebred NN♂ x NN♀, the lowest value were obtained (2.61) AA♂ x NN♀ and (2.52) AA♂ x AA♀ showing significant difference compare to the other crosses. The

result in the studies showed that AA♂ x NN ♀ (5.23±1.18cm) was the highest mean length gain and the least was the purebred AA♂ x AA♀ (3.75±0.75cm) while there were no significant difference ($p < 0.05$) in the mean length between crosses of NN♂ X NN♀ (4.60±0.12) and NN♂ x AA♀ (5.00±1.19). The highest survival value of (66.66%) recorded in hybrid AA♂ x NN♀ followed by NN♂ x AA♀ (66.65%) and differed significantly ($p < 0.05$) among the other crosses as recorded in NN♂ x NN♀ (60.00%) and AA♂ x AA♀ (55.60%) was the lowest in the crosses. No significant difference ($p > 0.05$) was observed in the feed conversion ratio value among the entire crosses. Water temperature .dissolved Oxygen pH was checked every week to maintain the quality of water.

The result on the ratio of albino to normal in NN x NN and AA x NN was 100% normal pigmented, there was no significant difference($p > 0.05$) between the two crosses. In AA x AA and NN x AA showed significant difference($p < 0.05$) with other crosses. The ratio for (AA♂ x AA♀) was 4:1, that is, 80 pure albino and 20 normal pigmented. The cross (NN♂ x AA♀) had a ratio 3:1.

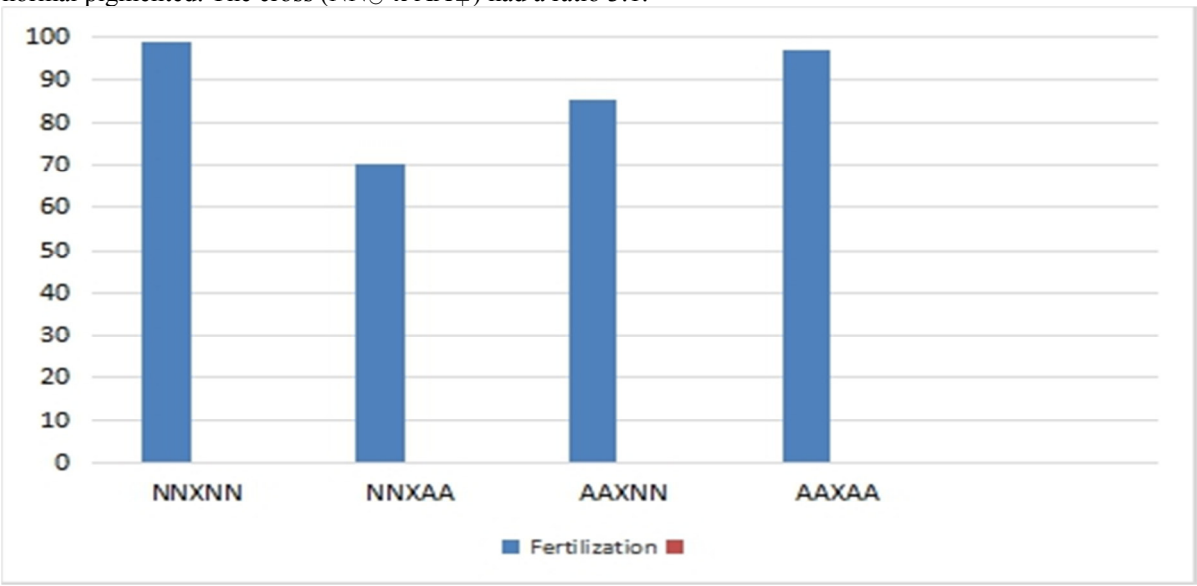

Figure 1: Percentage fertilization of Normal pigmented and Albino *Clarias gariepinus* and their reciprocal crosses

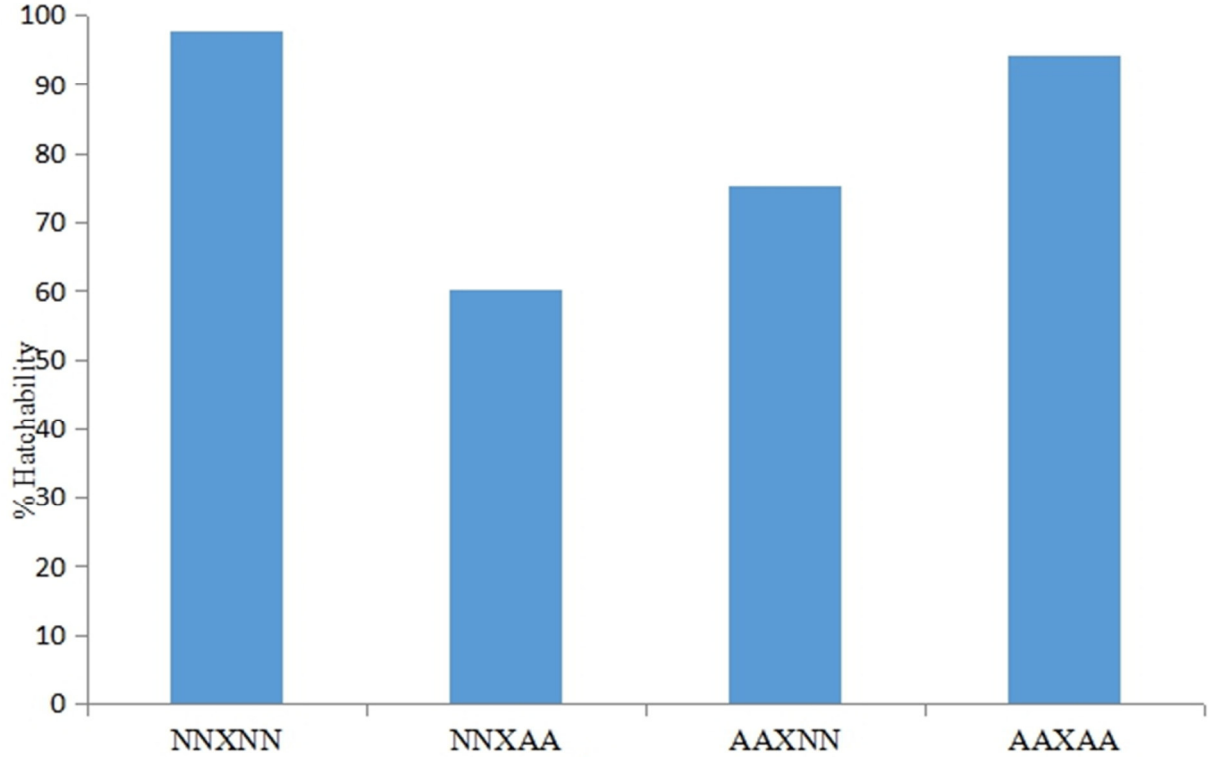

Figure 2: Percentage Hatchability of Normal Pigmented, Albino *Clarias gariepinus* and their reciprocal crosses

Table 2. Weekly Mean Weight Gain of Normal Pigmented and Albino *Clarias gariepinus*

	Weekly Mean Weight Gain								
Crosses	Initial	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
NNXNN	0.18±0.2[a]	1.63±0.08[a]	3.28±0.60[a]	3.75±0.63[a]	4.15±0.1[a]	4.36±0.77[a]	5.91±1.23[a]	6.7±1.35[a]	6.47±0.80[a]
NNXAA	0.19±0.1[a]	1.58±0.36[a]	4.12±0.50[a]	5.49±0.7[b]	6.1±1.10[ab]	6.23±1.15[ab]	6.73±2.74[ab]	7.41±2.99[ac]	7.63±1.33[a]
AAXNN	0.23±0.00[a]	1.87±0.12[a]	4.1±0.13[a]	4.86±1.26[ad]	5.14±1.18[ac]	5.53±0.93[ac]	5.83±1.34[ad]	6.27±1.39[a]	6.63±0.64[a]
AAXAA	0.17±0.00[a]	1.61±0.00[a]	3.2±0.00[a]	3.29±0.00[ac]	4.33±0.00[ac]	4.34±0.00[ac]	4.37±0.00[ac]	4.38±0.00[bd]	4.4±0.00[b]

Means with different superscripts are significantly different ($p<0.05$).

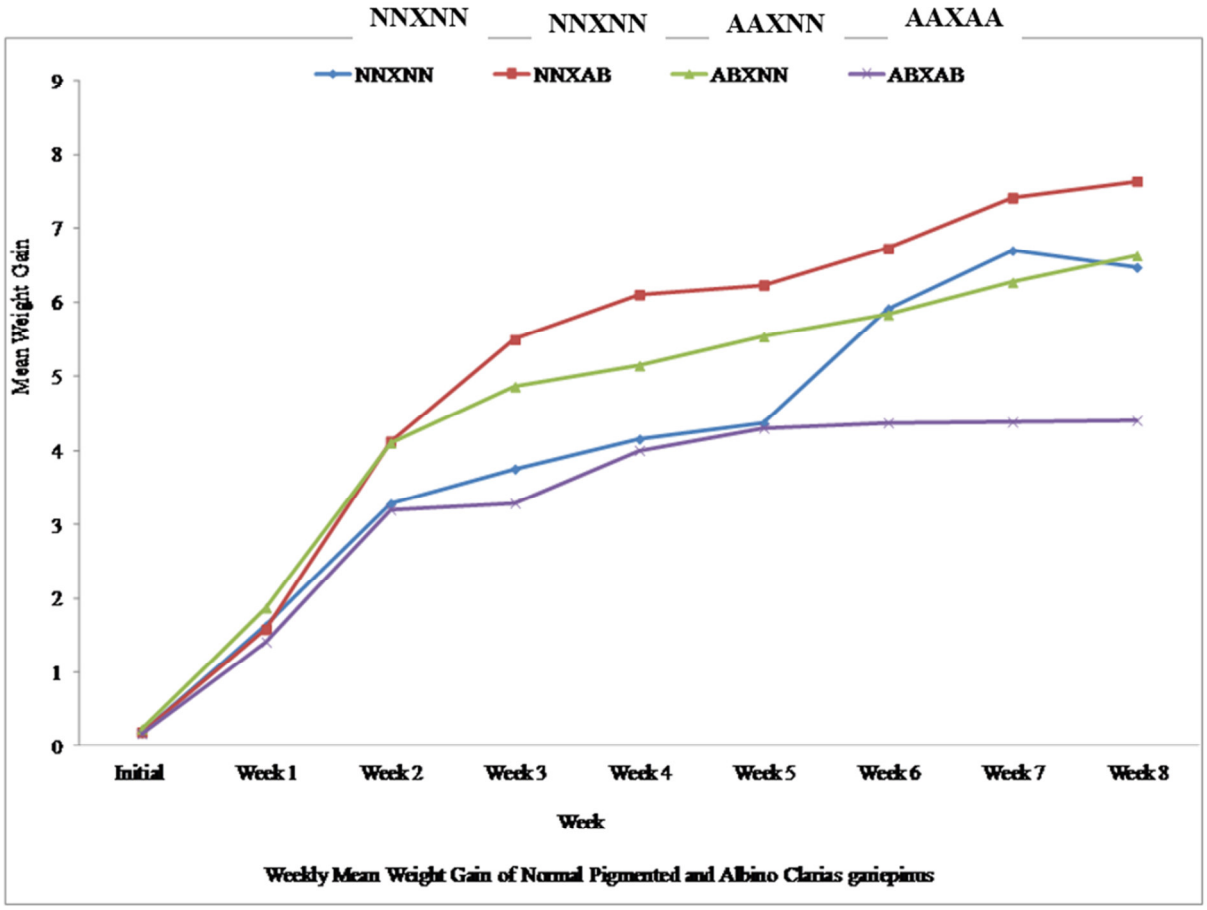

Table 3: Weekly mean Length gain of Normal Pigmented and Albino *Clarias gariepinus*

	Weekly Mean Length Gain							
Crosses	Initial	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
NNX NN	0.43±0.06[a]	1.5±0.10[a]	2.87±0.91[a]	2.9±0.35[a]	3.57±0.58[a]	3.67±0.42[a]	4.47±0.15[a]	4.8±0.17[a]	5.03±0.06[a]
NNX AA	0.53±0.06[a]	2.23±0.12[ab]	3.77±0.21[ab]	3.26±1.06[a]	3.87±0.15[a]	3.8±0.17[a]	5.17±0.29[ab]	5.4±0.26[a]	5.53±0.21[a]
AAX NN	0.6±0.10[a]	2.27±0.23[a]	3.77±0.15[ab]	3.33±0.49[a]	3.33±0.40[a]	4.13±0.25[ab]	5.53±0.06[ab]	5.7±0.15[a]	5.83±0.21[a]
AAX AA	0.69±0.00[a]	1.64±0.00[ac]	2.25±0.00[ac]	2.31±0.00[a]	2.35±0.00[b]	3.37±0.00[ac]	4.4±0.00[ac]	4.42±0.00[b]	4.44±0.00[b]

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

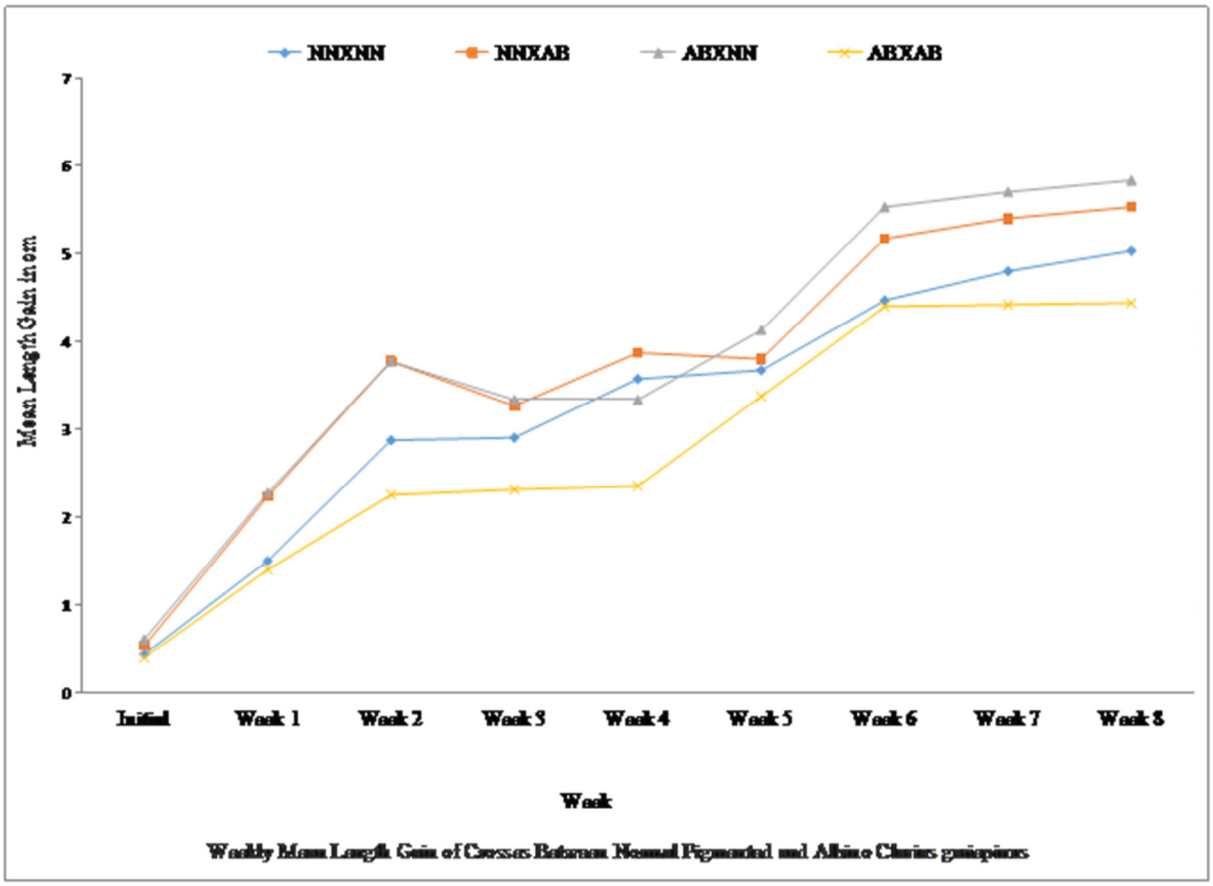

Figure 2: Weekly mean Length gain of Normal Pigmented and Albino *Clarias gariepin*

Table 4: Growth and Nutrient Utilization of Normal Pigmented and Albino *Clarias gariepinus*

parameters	NN x NN	NN x AA	AA x NN	AA x AA
Initial Mean Weight(g)	0.18 ± 0.01[a]	0.19 ± 0.01[a]	0.23 ± 0.00[a b]	0.17 ±0.00[c]
Final Mean weigh(g)	6.47 ± 0.80[a]	7.63 ± 1.33[a]	6.63 ± 0.64[a]	4.40 ± 0.00[a]
Initial Length(cm)	0.43 ± 0.03[a]	0.53 ± 0.03[a]	0.60 ±0.05[a]	0.69 ±0.00[a]
Final Mean Length(cm)	5.03 ± 0.03[a]	5.53 ± 0.01[a]	5.83 ±0.10[a]	4.44 ± 0.00[b]
Mean Weight Gain(g)	6.29 ±0.13[a]	7.44 ±0.25[a]	6.40 ±0.04[a]	4.23 ±0.15[b]
Mean Length Gain(g)	4.60 ±0.12[b]	5.00 ±1.18[a]	5.23 ±[a]	3.75 ±0.75[b]
S G R(%day)	2.77 [a]	2.86[a]	2.61[a]	2.52[a]
Condition factor(K)	6.46[b]	5.95[b]	4.47[c]	8.02[a]
FCR	0.05[a]	0.052[a]	0.051[a]	0.053 [a]
Survival rate(%)	66.65[a]	60.00[a]	66,66 [a]	55.6 [b]

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

DISCUSSION

The mean fertilization and hatchability rate for the four crosses investigated in this study were quite high. This notwithstanding, the purebred Normal pigmented 98% and 97% give the highest fertilization and hatchability rate in comparison with the other genetic groups. lower fertilization and hatchability in Normal x Albino (70% and 60%).The study agree with the work of Bondari (1984), that report that Albino are more difficult to spawn than the Normal pigmented. However he reported in another that there no significant differences as a result of pigmentation because percentage hatchability between albino and normal pigmented Channel catfish was. 60 and 61 respectively. The temperature may account for some of the difference in brood stock performance during this study. Albino female may have more rigid requirement for spawning and lower tolerance for deviation from optimum condition compare to Normal pigmented female.

The study was performed to compare the growth performance of Albino and Normal *Clarias gariepinus crosses*. The mean weight gain of the four genetic crosses under study for eight weeks was between 4.44g and 7.44g. The hybrid of the Normal pigmented showed the highest final mean weight gain of 7.44g. This agree with the work of Onyia *et al* (2016) who studied the growth and survival of normal coloured and Albino

Clarias gariepinus and had the highest growth rate in the same crosses 11.82g. There was difference in growth performance between Albino and Normal *Clarias gariepinus* crosses. The Normal *Clarias gariepinus* exhibited a higher growth performance then the Albino in the crosses. This was similar with earlier studies which reported Normal pigmented channel catfish (*Ictalurus punctatus*) had body weight and total length (77.8g vs 74.7cm and 41.7 vs 35.5cm). The result of this present study also agree with the work of Karatas and Kocaman (2014) who reported that Normal coloured Rainbow trout had the highest growth in weight and specific growth rate (19.3g and 2.2) than the Albino Rainbow trout(17.2g and 2.0).Michael *et al*.2000 reported also that normally pigmented channel catfish grew from 83 g to 494 g in 142 days of feeding. Albino catfish grew from 83 g to 392 g in the same period .However, these studies differ from the work of Gaudie *et al* (1992) that revealed that growth of albino catfish was similar to Normal *Clarias* catfish. It should be noted that the hybrids (NN x AA and AA x NN) had higher growth performance than the parents and this could be attributed to hybrid vigour. The difference in growth performance of albino and normal pigmented may be attributable to the pigmentation and its possible pleiotropic effect.

The result of findings showed that the survival rates of larvae up to the first feeding stage are similar in all the genetic groups investigated. The survival rate was high in the Normal *Clarias gariepinus* than the albino. This also agree with the work of Bondari (1984) who reported that Albino catfish had lower survival rate than Normal fish, dress-out percentage are nearly equal. There was no difference in the feed conversion ratio in all the genetic crosses of normal pigmented and albino *C. gariepinus*. This was in agreement with Michael *et al.*2000 where FCR result had no significant difference in Channel catfish (FCR was 1.56:1 for the normal catfish and 1.67:1 for the albino catfish).

Conclusion

In conclusion base on the finding of the present study, the purebreds achieve better fertilization and hatchability than the hybrids. It also showed that Albino hatched well in the early stage but are fragile in survival at the fingerling stage. The hybrids crosses had the highest growth performance and proved that hybrids crosses had improved traits for better growth and greater survival in fry up to stocking stage. However, growth performance of the normally pigmented *Clarias gariepinus* was substantially better than that of the albino *Clarias gariepinus*.

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