

## EFFECT OF COUNTRY ALMOND (*Terminalia catappa*) MEAL ON REPRODUCTIVE INDICES OF AFRICAN CATFISH (*Clarias gariepinus*, BURCHELL 1822) IN MAIDUGURI, NIGERIA

\*<sup>1</sup>YAGANA, A., <sup>2</sup>M. Y. DIYAWARE<sup>2</sup>, <sup>3</sup>I. IBRAHIM, AND <sup>2</sup>Z. B. MOHAMMED

<sup>1</sup> Department of Fisheries Technology, Yobe state Collage of Agriculture Gujba

<sup>2</sup>Department of Fisheries, University of Maiduguri, Nigeria

<sup>3</sup>Department of Pharmaceutical Chemistry, University of Maiduguri, Nigeria

\*Corresponding author: yaganafish@gmail.com, +2347036895099

### Abstract

The effects of *Terminalia catappa* meal on reproductive performance of *Clarias gariepinus* were carried out. A total of seventy-two (72) broodfish were randomly divided into four experimental groups, each having male and female in the ratio of 1:1 per treatment, replicated 3 times. The fish were fed with feeds containing *T. catappa* meal at the concentrations of 0 (Control), 10, 20 and 30% inclusion levels. Three each of the females and males broodfish were randomly collected from each treatment group and used for evaluating the reproductive performances. The result shows no significant differences ( $P > 0.05$ ) between the fertilization and hatching rate of the fry among. However, the fry from brood fish treated with 30% *T. catappa* leave meal showed a higher survival rate. The fertilization rate, fecundity rate and gonadosomatic index were better in the control diet. *Terminalia catappa* leaves meal did not have significant effect on the reproductive indices of *C. gariepinus*.

**Keywords:** *Terminalia catappa*, fertilization, gonadosomatic, fecundity, *Clarias gariepinus*

### INTRODUCTION

*Clarias gariepinus* belong to the genus *Clarias*, order Siluriformes and family Clariidae. The fish were considered as air-breathing species because of their ability of living for a long time out of water (Froese and Daniel, 2007). The genus of this specie is mostly found in North and South Africa. North African catfish live in a variety of fresh water environments, including quiet waters like lakes, ponds, and pools (Teugels, 1986). They also live in very prominent inflowing rivers, rapids, very turbid waters and around dams. They are very adaptive to extreme environmental conditions and can live in water with a pH range of 6.5-8.0, and temperatures of 8-35°C though their optimal temperature for growth is 28-30 degrees Celsius (Teugels 1986). They have also been found in Europe, the Middle East, and parts of Asia. *Clarias* are potamodromous, which means they migrate within streams and rivers (Teugels, 1986; Kelvin *et al.*, 1999). They are also able to secrete mucus to prevent drying and can burrow in the muddy substrate of a drying body of water (Teugels, 1986; Skelton, 2001). Countries, where one or several *Clarias* species have been introduced, include Indonesia, USA, Hong Kong, Taiwan, China, UK, Papua New Guinea, Guam, Taiwan and Thailand (Heok, 2001).

Reproductive indices are those factors (such as fecundity, gonadosomatic index, hatchability, and fertilization) that are used for ascertaining the reproductive performance of fish. Studies on reproductive performance of fish are crucial to plan for better fish seed production and a basic requirement for better conservation and management of fisheries resources (Ali and Kadir, 1996; Ezenwaji, 1998; Brewer *et al.*, 2008;

Grandcourt *et al.*, 2009; Muchlisin *et al.* 2010). Also, information on the reproductive system is essential for the development of commercial aquaculture (Muchlisin, 2004). Studies on reproduction performance have been Popular in the last decades, besides its importance for conservation purposes, information on reproduction performance is also useful for the selection of target fish from the wild for diversification of fish species in the aquaculture industry (Muchlisin, 2013). Under intensive fish production, attempts have been made to obtain quality eggs and milts, to produce the highest possible number of good quality seeds. Several factors which affect fish seed quality includes different strains, genetics, nutrition, contents of the feed, pH, temperature, and activities of modern aquaculture, which introduces several substances such as organic matter and chemicals such as fertilizers and insecticides into the water used as a culture medium (Canyurt and Akhan, 2008). The need for high-quality fish seed has necessitated research into various ways of improving egg quality and enhancing fertility in fish to meet the high protein demand. However, the continuing expansion of aquaculture requires shifting from synthetic drugs to natural plant materials for the improvement of reproduction in highly economic fish species. According to Adedeji *et al.* (2006), plant materials have the potential of enhancing egg quality and milt fertility. Hence the use of plant materials to improve egg quality and enhance fertility is now receiving some attention.

*Terminalia* belongs to the family *Combretaceae*, which is a pantropical genus comprising about 150 species (Smith, 2005). *T.*

*catappa* is among the most common trees found in Nigeria. It grows in the wild but is sometimes cultivated for ornamental purposes. It is found in almost all the regions of the country as it thrives well in the tropics, hence its name Tropical almond. It has a single stem that grows up to a height of about 10 meters and then branches horizontally with leaves at the end of the branches that form a rosette (Arbounier 2002; Thomson (2006). Extracts from the leaves and bark of the plant have been proven anti-carcinogenic, anti- HIV and hepatoprotective properties (liver regenerating effects), including anti-diabetic effects (Esposito-Avella *et al.*, 1985). The leaves and bark have been used traditionally in the South Pacific, for fungal related conditions. It has the potential benefit for overall immune support, liver detoxification, and antioxidant support. The leaves contain agents for chemo-prevention of cancer and probably have anti-carcinogenic potential (Esposito-Avella *et al.*, 1985). They also have an anticlastogenic effect (a process that causes breaks in chromosomes) due to their antioxidant properties. The kernel of Indian almond has shown aphrodisiac activity; it can probably be used in the treatment of some forms of sexual inadequacies (Whistler, 1996).

Studies on *Clarias gariepinus* to improve its reproductive performance have been done by several researchers such as Dada and Victoria (2015) on dietary fluted pumpkin (*Telfeiria occidentalis*) to improve reproductive indices in male African catfish (*Clarias gariepinus*) broodstock; Agbugui (2013) on sex ratio, gonadosomatic index, stage of gonadal development and fecundity of the grunt, *Pomadourys belini* (Cuvier 1830) in New Calabar-Bonny River; Benedict *et al.* (2010) on the aspect of ecology of *Clarias anguillaris* (Teloeste Clariidae) in the Cross river, Nigeria; Fehri *et al.* (2010) on activities of antimicrobial peptides and weight gain of *Clarias gariepinus*; Onyia *et al.* (2015) on growth performance and cost benefit analysis of *Clarias gariepinus* fed with different commercial and compounded feed; Diyaware (2012) on effects of *Garcinia kola* (Bitter cola) on milt quality of African catfish; Onada and Ogunola (2017) on the effect of African Catfish (*Clarias gariepinus*) broodstock egg combination on hatchability and survival of fish larvae; Gashaw *et al.* (2017) on assessing fishery activity, fish production and demand outlook in Illu Abba Bore zone Oromia region State, South west Ethiopia; Sukran *et al.* (2000) on certain reproductive characteristic of catfish (*Clarias gariepinus* Burchell, 1822) living in the river Asia; and Gabriel *et al.* (2013) on locally produced fish and feed potentials for aquaculture development in sub-Saharan. Despite these efforts, the seasonality of their reproductive cycle in ponds hampers the continuous production of fry and fingerlings for teaming fish farmers. The single-time spawning of the female

also lowered the quantity of fingerlings production. On average, only 50% of the female spawn (Pawiroredjo, 2004). The need for high quality and quantitative fish seed necessitated the search for ways of improving the performance of the *Clarias gariepinus*. Therefore, the objective of this study is to know the effect of *Terminalia catappa* leaves meal on the reproductive performance of *Clarias gariepinus*.

## Materials and Methods

### Study area

The experiment was conducted at the hatchery complex of teaching and research fish farm of Department of Fisheries, University of Maiduguri situated between latitude 11° 51' N and longitude 13° 05' E. The study area is characterized by cold dry climate from January to March and on average, the warmest month is April. It has a mean annual rainfall of 800mm. The rainy season usually begins in June and ends in October with the relative humidity of 5-54.5% and atmospheric temperature ranging from 38-40°C during the day which drops to 29-31°C during the night (Premium Time Nigeria, 2015)

### Collection and preparation of *Terminalia Catappa* Leaves Meal

Fresh leaves of *Terminalia catappa* were obtained in Maiduguri Metropolitan around 6:00 to 7:00 am to avoid it being exposed to sunlight during collection. The plant materials were packed in black polyethylene bags to prevent drying and were taken to the Department of Forestry and Wildlife, University of Maiduguri for identification. After the identification, the leaves were chopped with a knife to reduce the size and then spread on mats inside the hatchery for shade drying. After three days of shade drying, the plant materials were grounded into powdered using wooden pestle and mortar. The ground leaves were packed in airtight containers until required.

### Experimental Fish

Thirty-six (36) each of males and females *Clarias gariepinus* brooders of 300 – 800g (weight) and 26 – 36cm (length) were obtained from the Teaching and Research Fish Farm, Department of Fisheries, University of Maiduguri. The brood fish were acclimatized for 5 days in 2m<sup>2</sup> concrete tanks using a flow-through system. During the acclimatization, the fish were fed with a commercial diet containing 30% crude protein before the commencement of the study.

### Experimental Diet

Thirty percent (30%) crude diet was formulated using fish meal, toasted soybean meal, wheat bran, ascorbic acid, mineral premix, lysine, methionine, table salt, and cassava starch, procured from a local market in Maiduguri. Toasted soybeans,

wheat bran, and fish meal were ground separately into powdered using grinding machine. The required quantities of the powdered ingredients were weighed using salter balance, mixed and packed in black

polyethylene until required. Proximate composition of the experimental diet (Table 1) were conducted according to AOAC (2002) before incorporating the *T. catappa* leaves meal.

**Table 1: Proximate Composition of the Experimental diet**

| Feed ingredients          | <i>Terminalia catappa</i> inclusion levels (%) |       |       |       |
|---------------------------|--|-------|-------|-------|
|                           | 0  | 10    | 20    | 30    |
| Soybeans                  | 31.25  | 31.25 | 31.25 | 31.25 |
| Fish meal                 | 31.25  | 31.25 | 31.25 | 31.25 |
| Wheat bran                | 34.48  | 34.48 | 34.48 | 34.48 |
| Premix                    | 0.50   | 0.50  | 0.50  | 0.50  |
| Methionine                | 0.50   | 0.50  | 0.50  | 0.50  |
| Lysine                    | 0.50   | 0.50  | 0.50  | 0.50  |
| Vegetable oil             | 0.30   | 0.30  | 0.30  | 0.30  |
| Ascorbic acid             | 0.50   | 0.50  | 0.50  | 0.50  |
| Salt                      | 0.20   | 0.20  | 0.20  | 0.20  |
| Starch                    | 0.50   | 0.50  | 0.50  | 0.50  |
| <i>Terminalia catappa</i> | 0.00   | 10.0  | 20.0  | 30.0  |
| <b>Total</b>              | 100  | 100   | 100   | 100   |

**Proximate composition of *Terminalia catappa* based diet**

| Nutrients                      | Analyzed     |
|--------------------------------|--------------|
| <b>Crude protein (%)</b>       | <b>28.16</b> |
| <b>Moisture content (%)</b>    | <b>5.80</b>  |
| <b>Dry matter (%)</b>          | <b>96.9</b>  |
| <b>Ash (%)</b>                 | <b>2.40</b>  |
| <b>Fiber (%)</b>               | <b>18.90</b> |
| <b>Metabolized energy (ME)</b> | <b>68.72</b> |
| <b>Fat (%)</b>                 | <b>3.00</b>  |

**Experimental Design**

The thirty-six (36) each of male and female *Clarias gariepinus* brood fish (300g – 800g weight and 26 – 36.1 cm total length) were randomly divided into four treatment groups, each having 3 males and 3 females in the ratio of 1:1 male to female. Different concentrations of the *T. catappa* leaves meal were incorporated into the 30% crude protein diet at 0, 10, 20 and 30% as treatments 1 (control) 2, 3 and 4, respectively. The treatments were replicated three times in a complete randomized manner. The *T. catappa* leave based diets were fed to the brood fish at 3% of their body weight for twelve (12) weeks twice daily, morning and afternoon (9: 00 am and 3:00 pm).

**Gonadosomatic Index and Fecundity**

At the end of twelve weeks treatment with the *T. catappa* leave meal-based diet, three each of the females and males broodfish were randomly collected from each treatment and used for the evaluation of the gonadosomatic index and fecundity using the formulae below;

**GSI** =  $\text{GW} / \text{TW} \times 100$ , Where, GSI = gonadosomatic index, GW = gonad weight and TW = fish weight.

**Fecundity** = product of the number of eggs in 1 g of the egg-mass and total weight of the ovary.

**Fertilization and Hatching Rate**

Three males and females each of brood fish fed varying quantity of *Terminalia catappa* were collected from each treatment and weighed for induced breeding according to their sizes using a weighing scale. The female brooders were induced with Ovaprim hormone (Syndel Lab Canada) at the dosage of 0.5ml per kilogram of the fish. The hormone was administered via intramuscular injection. The induced fish were kept in well-aerated water in a small tank for latency period. At the end of the expiration of 10 hours latency period, the egg was stripped, and the milts collected from males by scarifying. The testes were cut from the two lobes and the spermatozoa were squeezed onto the strip eggs. An equal volume of saline water was added to the mixture of the eggs and the milts after 1 minute of stirring of the egg. Cleaned water hyacinth was used as a substrate for the eggs and spread in each plastic container containing water. One hundred grams (100g) of the fertilized eggs were collected from each treatment and transfer into 15 cm x 2 cm deep plastic tray to test for fertilization and hatching rates in triplicates. The eggs having embryo were considered to be fertilized and counted to calculate for the fertilization rates, opaque eggs were counted as unfertilized/dead eggs. The fertilization and hatching rate was estimated using the below formulae;

Fertilization rate (%) =  $(\text{No of fertilized eggs} / \text{No estimated eggs}) \times 100$

Hatching rate (%) =  $\text{Total No of hatched eggs} / \text{Total No. of fertilized eggs} \times 100$

**Water Quality Parameters**

The water quality parameters monitored during the experiment includes temperature, pH using digital EC/TDS/ pH meter (Model: ES500 meter SANXIN- China), and dissolved oxygen

using DO (Model: JPB-608 Shanghai REX) .the readings were taken two times a week i.e. morning (08:00 am) and evening (4:00pm) respectively.

### Data Analysis

Data obtained from the experiment were subjected to One-way Analysis of Variance (ANOVA). The differences between the means were determined using Fisher's Least Significant Differences (LSD) at 95% confidence level ( $P \leq 0.05$ ) with the aid of Statistix 8.0.

### Results and Discussions

#### Gonadosomatic Index and Fecundity rate

Table 2 shows the effects of *T. catappa* leave meal on gonadosomatic index and fecundity rate of *Clarias gariepinus* brood fish treated with *T. catappa* leaves meals. The testicle weight of the male *Clarias gariepinus* broodfish were statistically ( $p > 0.05$ ) similar among the entire treatment. *Clarias gariepinus* brood fish treated with *T. catappa* leaves meal at 0% showed higher (71,250) fecundity rate, followed by those treated with 30, 20 and 10% *T. catappa* leaves meal (64,500, 54,750 and 48,750 respectively). There was statistical variation ( $p > 0.05$ ) between fish treated with the control diet compared to those fed 10% *T. catappa* levels meal in term of the fecundity rate. There were slight decreases in the fecundity rate of the fish with an increase (at 20 to 30%) in the concentration of *T.*

*catappa* leaves meal. However, there was no significant variation ( $p > 0.05$ ) between the fecundity rate of fish treated with 20 and 30% *T. catappa*. Similarly, no significant differences were observed between fish treated with the control diet compared to those treated with 20 and 30% *T. catappa* diet.

Absolute fecundity was observed to be statistically similar ( $p > 0.05$ ) across the entire treatment. Brood fish treated with 30% *T. catappa* leaves meal showed better (1917.4) relative fecundity, followed by those treated 0 and 20% *T. catappa* leaves meal (1738.4 and 1240.3). Least value (1176.3) was recorded in broodfish fed 10% *T. catappa* leaves meals. No statistical differences ( $p > 0.05$ ) were observed in the relative fecundity.

Gonadosomatic index for both male and female *C. gariepinus* treated with different levels of *T. catappa* leave meal did not show any significant ( $p > 0.05$ ) variation among the entire treatment. The gonadosomatic indices presented in this research were higher than the results presented by Benedict *et al.* (2010), Fehri *et al.* (2010); Data and Victoria (2015). Contrary to the result of the present study on gonadosomatic index, Elias (2000) reported a higher value of the gonadosomatic indices of 38 and 31% indices for male and female *C. gariepinus* caught from natural water. The differences in the gonadosomatic index might be attributed to the differences in the plant used and may be the plant has more steroid content than *T. catappa*.

**Table 2: Effects of *T. catappa* leaves meal on the gonadosomatic Index and fecundity rate of *C. gariepinus* brood fish**

| Parameters | <i>Terminalia catappa</i> inclusion levels (%) |                     |                     |                     |                      |
|------------|--|---------------------|---------------------|---------------------|----------------------|
|            | 0  | 10                  | 20                  | 30                  | SE (P= 0.05)         |
| FW(g)      | 2066.8 <sup>a</sup>                            | 1860.9 <sup>a</sup> | 1954.9 <sup>a</sup> | 1989.5 <sup>a</sup> | 192.31 <sup>ns</sup> |
| FL(cm)     | 76.40 <sup>a</sup>                             | 74.23 <sup>ab</sup> | 73.30 <sup>ab</sup> | 72.30 <sup>b</sup>  | 1.58 <sup>*</sup>    |
| TW(g)      | 2.66 <sup>a</sup>                              | 3.53 <sup>a</sup>   | 4.33 <sup>a</sup>   | 4.76 <sup>a</sup>   | 83.0 <sup>ns</sup>   |
| FR(g)      | 71250 <sup>a</sup>                             | 48750 <sup>b</sup>  | 54750 <sup>ab</sup> | 64500 <sup>ab</sup> | 8958 <sup>*</sup>    |
| AF (g)     | 67.43 <sup>a</sup>                             | 45.60 <sup>a</sup>  | 61.40 <sup>a</sup>  | 66.93 <sup>a</sup>  | 12.43 <sup>ns</sup>  |
| RF (g)     | 1738.4 <sup>a</sup>                            | 1176.3 <sup>a</sup> | 1240.3 <sup>a</sup> | 1917.4 <sup>a</sup> | 686.7 <sup>ns</sup>  |
| FGSI (g)   | 8.96 <sup>a</sup>                              | 6.10 <sup>a</sup>   | 8.16 <sup>a</sup>   | 8.93 <sup>a</sup>   | 1.66 <sup>ns</sup>   |
| MGSI (g)   | 9.76 <sup>a</sup>                              | 8.133 <sup>a</sup>  | 7.40 <sup>a</sup>   | 7.73 <sup>a</sup>   | 1.62 <sup>ns</sup>   |

Means within the same row having similar superscripts are not significantly different ( $P > 0.05$ ).

**Key:** FW = Fish weight, Final length, TW= Testicle weight, FR= Fecundity rate, AF= Absolute fecundity, RF= Relative Fecundity, FGSI= Female gonadosomatic index, MGSI= male gonadosomatic index.

#### Fertilization and Hatching rate

Table 3 shows the effects of *T. catappa* leave meal on the fertilization and hatching rates of *C. gariepinus* brood fish. Numbers of eggs were recorded to be higher (436.0) in *C. gariepinus* brood fish treated with 20% *T. catappa* leave meals followed by *C. gariepinus* brood fish treated with 10 and 0% *T. catappa* leave meal as 409.33 and 370.33 respectively. *C. gariepinus* brood fish treated with 30% *T. catappa* leave meal presented the least value of the number of eggs as 314.67. There was no

significant difference ( $p > 0.05$ ) shown throughout the entire treatments in the number of eggs recorded. The number of death eggs was observed as 160, 210, 168 and 200 for 0, 10, 20 and 30% respectively). There was no significant variation ( $p > 0.05$ ) observed among the entire treatments (0, 10, 20, and 30% *T. catappa* levels).

Higher number of fertilized eggs (268.00) was observed in *C. gariepinus* brood fish treated 20% *T. catappa* leave meals while brood fish treated with 0, 10 and 30% *T. catappa* leave meal reveals

the number of fertilized eggs as 210.33, 199.33 and 114.67 respectively. No Significant variation ( $p>0.05$ ) was observed in all the inclusion levels of the *T. catappa* leave meal. The highest (77.00%) fertilization rate was observed in brood fish treated with the control diet. *C. gariepinus* treated with 20 and 10% showed 60.43 and 49.10, respectively. While those *C.gariepinus* brood fish treated with 30% *T. catappa* leave meals shows the least (27.06%) value. *C. gariepinus* brood fish treated 0% *T. catappa* leave meal differ significantly ( $p>0.05$ ) from those treated with 30%. However, *C.gariepinus* brood fish treated 10 and 30% inclusion levels did not differ statistically with those

treated 10 and 20% *T. catappa* leave meals inclusion level in the fertilization rate. Total number of hatched eggs was higher (143.33) in *C. gariepinus* brood fish treated 10% *T. catappa* leave meals followed by those *C. gariepinus* brood fish treated 20 and 0% *T. catappa* leave meal as 141.67 and 194.33 respectively. *C. gariepinus* treated 30% *T. catappa* leave meals inclusion level presents least value of 100.33 as the number of hatched eggs. There was a significant difference ( $p>0.05$ ) observed between the *C. gariepinus* brood fish treated 0, 10, 20 and 30% inclusion levels of the *T. catappa* leaves meals).

**Table 3: Effects of *T. catappa* leave the meal on the fertilization and hatching rate of *C. gariepinus***

| Parameters | <i>Terminalia catappa</i> inclusion level (%) |                     |                     |                     |                      |
|------------|---|---------------------|---------------------|---------------------|----------------------|
|            | 0   | 10                  | 20                  | 30                  | SE (P=0.05)          |
| No. EG     | 370.33 <sup>a</sup>                           | 409.33 <sup>a</sup> | 436.00 <sup>a</sup> | 314.67 <sup>a</sup> | 53.99 <sup>ns</sup>  |
| No. DE     | 160.00 <sup>a</sup>                           | 210.00 <sup>a</sup> | 168.00 <sup>a</sup> | 200.00 <sup>a</sup> | 109.54 <sup>ns</sup> |
| No. FE     | 210.33 <sup>a</sup>                           | 199.33 <sup>a</sup> | 268.00 <sup>a</sup> | 114.67 <sup>a</sup> | 85.13 <sup>ns</sup>  |
| FR (%)     | 77.00 <sup>a</sup>                            | 49.10 <sup>ab</sup> | 60.43 <sup>ab</sup> | 27.06 <sup>b</sup>  | 21.01 <sup>*</sup>   |
| No. NHE    | 141.67 <sup>a</sup>                           | 143.33 <sup>b</sup> | 194.33 <sup>a</sup> | 100.33 <sup>a</sup> | 61.68 <sup>*</sup>   |
| No. DL     | 11.00 <sup>a</sup>                            | 12.00 <sup>a</sup>  | 17.00 <sup>a</sup>  | 12.66 <sup>a</sup>  | 5.83 <sup>ns</sup>   |
| HR (%)     | 55.00 <sup>a</sup>                            | 52.40 <sup>a</sup>  | 62.93 <sup>a</sup>  | 36.30 <sup>a</sup>  | 22.77 <sup>ns</sup>  |
| FS (%)     | 44.67 <sup>ab</sup>                           | 14.33 <sup>b</sup>  | 37.33 <sup>ab</sup> | 49.00 <sup>a</sup>  | 14.28 <sup>*</sup>   |

Means within the same row having similar superscripts are not significantly different ( $P>0.05$ ).

**Key:** No. EG= Number of egg, No. DE= Number of dead eggs, No. FE = Number of fertilized egg, FR = fertilization rate eggs, No. NHE= Number of hatched egg, No. DL = Number of dead larvae, HR (%) = hatchability, FS = fry survival

The number of death larvae ranged between (160- 200). There were no significant differences ( $P>0.05$ ) between the numbers of death larvae among the entire treatments. Hatchability rate of the brood fish ranges between 36.30 – 62.9%. *C. gariepinus* brood fish treated with 20% *T. catappa* leaves meal present the value of 62.93. The values of 55.00, 52.40 and 36.30 were discovered in *C. gariepinus* brood fish treated 0, 10 and 30% of the *T. catappa* leave meal respectively. The hatching rate of *C. gareipinus* treated with *T. catappa* was not significantly ( $p>0.05$ ) different among the entire treatments. The fertilization rate achieved in this work was lower than the works documented by Kareem *et al.* (2017), Onada and Ogunola (2017), Dada and Aguda (2015), Onyia *et al.* (2015), Oyebola and Awodiran (2015); Saadea *et al.* (2014). The differences in the fertilization rates between the present and previous research might be attributed to method of fertilization used (dry and wet fertilization). The Hatching rate reported by Aluko and Ali (2001), Gabriel *et al* (2013), and Gashaw *et al* (2017) opined higher hatching rate of *C. gariepinus* while Oyebola and Awodiran (2015) reported lower value of hatching rate as 26%. The differences in the hatching rate of the researches

might be brought about by differences in the strain of the fish used.

## CONCLUSION

*Terminalia catappa* leaves meal fed to *C. gariepinus* broodstocks to enhance their reproductive performance shows better gonadosomatic indices of both males and females; fecundity and fertilization rate in the broodstocks treated 0% *T.catappa* leaves meal while the hatching rate was best in broodstocks treated 20% *T. catappa* leaves meal. This signifies that *T. catappa* leaves meal did not influence the gonadosomatic indices, fecundity, and fertilization rate of *C. gariepinus* brood fish but has an effect on the hatching rate of the brood fish.

## REFERENCES

- Adedeji, O.S., G.O. Farimi, S.A. Ameen and Olayemi, J.B. (2006). Effects of bitter kola (*Garciniakola*) as a growth promoter in broiler chicks from day old to four weeks old. *Journal Animal Veterinary. Advance*.5(3): 191-193.
- Agbogui M.O, (2013). The sex ratio, gonadosomatic index, stage of gonadal development and fecundity of the grunt, *Pomadasys jubelini*

- (Cuvier 1830) in New Calabar-Bonny River. Report and Opinion 5(11): 132-145.
- Ali, A.B. and Kadir, B.K.A. (1996). The reproductive biology of the cyprinid, *Thynnichthysthynnoides* (Bleeker), in the Chenderoh Reservoir. A small tropical reservoir in Malaysia. *Hydrobiology* 318: 139-151.
- Aluko, P.O. and M.H. Ali, 2001. Production of eight types of fast-growing intergeneric hybrids from four *Clariid* species. *Journal of AquacultureTropic.* (16): 139-147.
- AOAC (2002). Official methods of analysis of AOAC international. Cunniff association of official analytical chemist. Washington, D. C. 16P.
- Arbounier, M. (2002). Trees, shrubs, and lianas of West Africa dry zones, Margraf Publishers Great Britain, 273pp.
- Benedict O.O., Yemi A.S. and Isacc T.O. (2010). Aspect of ecology of *Clariasanguillaris* (Teleostei: Clariidae) in the Cross River, Nigeria *Journal of Fisheries and Aquatic Science* 5(2): 101-110.
- Brewer, S.K., Rabeni, C.F. and Papoulias, D.M. (2008). Comparing histology and gonadosomatic index for determining spawning condition of small-bodied riverine fishes. *Ecology of Freshwater Fish* 17: 54–58.
- Canyurt, M.A. and Akhan, S. (2008). Effect of ascorbic acid supplementation on sperm quality of Rainbow trout (*Onchorynchus mykiss*). *Turkish Journal of Aquatic Science* (8): 171-175.
- Dada, A.A. and Aguda, V.O. (2015). Use of ethanol extracts of *Garcinia Kola* as fertility enhancer in female catfish *Clarias gariepinus* broodstock. *International Journal Fisheries Aquaculture* 1(1): 1-5.
- Dada, A.A. and Victoria C.E. (2015). Dietary fluted pumpkin (*Telfeiria occidentalis*) improves reproductive indices in male African catfish (*Clarias gariepinus*) broodstock *Journal of Agricultural Science* 7: 1916-9752.
- Diyaaware, M.Y., Kwaji P.J., and T.A. Tagogo. (2012). Effects of *Garcinia kola* (bitter cola) on milt quality of African catfish (*Clarias gariepinus*, Burchell 1822). *Journal Agricultural Environment*, 8(2): 43-49.
- Elias, D. (2000) Reproductive biology and feeding habits of the catfish *Clarias gariepinus* (Burchell) (Pisces: Clariidae) in Lake Awassa, Ethiopia. *Ethiopian Journal of Science.* 23(2). 231-246
- Esposito-Avella, M., Brown, P., Tejeira, I., Buitrago, R., Barrios, L and Sanchez, C (1985). Pharmacological screening of Panamanian medicinal plants part 1. *International Journal of Crude Drugs Resource.* (23). 17-25
- Ezenwaji, H.M.G. (1998). The breeding biology of *Clarias albopunctatus* in semi-intensively managed pond in the floodplain of the River Anambra, Nigeria *Ecology of Freshwater Fisheries*, 7: 101-107.
- Fehri, F.L., Wroblewsdki, H., Blanchard, A. (2010) Activities of antimicrobial peptides and weight gain of *Clarias gariepinus* 10(5): 468-474.
- Froese, R. and Daniel, P. (2007). Species of *Clarias* in *Fish Based* 101-109.
- Gabriel, U.U., Akinsotimi, O, A., Bekibele, D.O., Onunkwo, D.N. and Anyanwu, P.E. (2013). Locally produced fish and feed; potentials for aquaculture development in sub-Saharan Africa *Journal of Aquaculture Research*, 2(7):287-295.
- Gashaw T, Tulu T, Argaw M, Worqlul AW (2017). Evaluation and prediction of land use/land cover changes in the Andassa watershed, Blue Nile Basin, Ethiopia. *Environment System Research* 6:17.
- Heok, H. (2001). *Clarias microstomus*, a New Species of Clariid Catfish from Eastern Borneo (Teleostei: Siluriformes)" (PDF). *Zoological Studies* 40 (2): 158–162.
- Kelvin, K. P., Lim and Heok-Hee, N. G. (1999). A new species of catfish (Teleostei: Clariidae) from Pulau Tioman, Peninsular Malaysia. *Raffles Bulletin of Zoology.* 6: 157-167.
- Muchlisin, Z.A. (2004). Preliminary study on the sperm cryopreservation of bagrid catfish (*Mystus nemurus*) and evaluation of dietary protein level on the gonadal development of female broodstock. *M.Sc Thesis* University Sains Malaysia, Penang. 54-85.
- Muchlisin, Z.A. (2013). Study on the potency of freshwater fishes in Aceh waters as a basis for aquaculture and conservation development programs. *Journal Ichthyology Indonesia* 13(1): 91-96.
- Muchlisin, Z.A., Musman, M. and Siti-Azizah, M.N. (2010). Spawning seasons of *Rasboratawarensis* in Lake Laut Tawar, Aceh Province, Indonesia. *Reproductive Biology and Endocrinology* 2: 8-49.
- Onada, O.A. and Ogunola, O.S. (2017). Effect of African Catfish (*Clarias gariepinus*) broodstock egg combination on hatchability and survival of fish larvae. *Journal of Aquaculture Research and Development* 5(3):2155-9546.
- Onyia, L. U., Kama, N., Michael, K.S. and Adewayi, A. K. (2015). Growth performance and cost-benefit analysis of *Clarias gariepinus* fed with different commercial and compounded feed. *Discourse Journal of Agriculture and Food Science* 3 (1): 1-6.

- Oyebola, O.O. and Awodiran, M.O. (2015) Effect of spawning methods on fertilization, hatchability and fry size variation in *Clarias gariepinus*. *Ife Journal of Science*. 17(2). 305pp
- Pawiroredjo, P. A (2004). Temperature effects on spawning and fingerling production of channel catfish *Ictalurus punctatus*. Louisiana. State University and Agricultural and Mechanical. *Master of Science degree*. 6-135
- Premium Time Nigeria (2015). *Premium time Nigeria*. Com retrieved 20-8-2016.
- Skelton, P. (2001). *A Complete Guide to the Freshwater Fishes of Southern African*. Struit Publisher, Cape Town, 256-259.
- Smith, L., Shiba, S.G. and Kumar, P.H. (2005). Performance of cyprinus carpio (var-communis) Fingerling fed on diets containing water washed neem (*Azadirachaindica*) seed cake. *Conference proceedings on international agriculture research for development suttugarnherm*, October 11 -13.
- Sukran Y. Kemal S. and Ihsan A. (2000). Certain reproductive characteristic of Catfish (*Clarias gariepinus* Burchell, 1822) living in the river Asia, *Turkish Journal of Zoology* 433-460.
- Teugels, G. G. (1986). A systematic revision of the African species of the genus, *Clarias* (Pisces: Clariidae), Konrink Museum VoorMidden, Africa Tervuren, Belgie. *Zoological weten annals* 247:35-41.
- Thomson, L. A. J. (2006). Terminalia catappa (tropical almond), ver. 2.2. In: Elevitch, C.R. (Ed.). *Species Profiles for Pacific Island Agroforestry. Permanent Agriculture Resources (PAR) Hōlualoa, Hawaii*. 67-89.
- Whistler, W. A (1996). Samoan herbal medicine. *Isle Botanica*, Honolulu. 45pp