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GROWTH PERFORMANCE OF ALL MALE TILAPIA (*OREOCHROMIS NILOTICUS*) FED COMMERCIAL AND ON–FARM COMPOUNDED DIET

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Abstract. This study was designed to investigate the suitability of on–farm compounded feed as an alternative to commercial expensive feed for the production of all male tilapia in outdoor system. Using Pearson's square method, locally available conventional feedstuffs (Soybeans, fishmeal and maize meal) were used to formulate equivalent crude protein (45 %) diet to the popularly used commercial aqua feed (Coppens). Fingerlings of All Male Tilapia were fed for eight weeks and assessed for growth. The result obtained reveals significantly higher performance with commercial diet compared to the compounded on–farm feed. Studies on alternating feeding system using on–farm and commercial diet are proposeded to reduce the cost of Tilapia production in undeveloped nations of the world.
Keyword*:* Nile Tilapia, aqua feed, commercial diet, growth performance.

Introduction

Feeding constitutes a major factor in intensive rearing of finfishes and their fry. This is because the growth of fish depends strongly on the quality of feeds provided [SOLOMON and OKOMODA 2012].

A well prepared and carefully formulated fish feed plays a significant role in fish culture [UKAGHA, 2003]. It ensures better growth and maintains better health status of farmed fish [HAFEDH, 1999].

However, the unavailability and affordability of adequate commercial fish feed have significantly affected the development of aquaculture in many parts of the world [TIAMIYU *et al.,* 2014]. Feed is estimated to accounts for at least 60 % of the total cost of production in fish farming business [JAMU and AYINLA 2003, TIAMIYU *et al.,* 2015].

The high cost of fish feed is one of the problems hampering aquacultural development in Nigeria [GABRIEL *et al.,* 2007] and in many other underdeveloped countries of the world. It marginalizes or even nullify the profitability of fish farming thereby incapacitating the expansion of farms and lowering yield [SOLOMON *et al.,* 2015].

This ultimately results into scarcity of fish and eventually led to the high cost of the small available stock to the disadvantage of the populace [ADIKWU 1992].

Currently, research is focused on the production of on–farm feed as viable alternatives to commercial and expensive feed so as to reduce the production cost of farmed fish.

Tilapia is the common name applied to three genera of family Cichlidae which includes about 70 species [MEYER, 2002].

They are native to Africa but have been introduced to many countries of the world. Their growing dominance in the aquaculture industry is largely due to their striking attributes, which includes; resistance against harsh conditions, ease of breeding, rapid growth rate, ability to efficiently convert organic and domestic wastes into high quality protein, and good taste [YI *et al.,* 1996].

Due to their economic importance, tilapia are becoming increasingly prominent in freshwater aquaculture in many regions of the world and among the most studied groups of fish in Africa waters [ADMASSU, 1996; COWARD and BROMAGE, 1998].

However, they are largely prolific breeder, which limits their table size at harvest. The propagation of all male tilapia is fast becoming popular in most part of the world as it removes the prolific breeding characteristics associated with tilapia production. In many parts of Africa where fish production is still on a subsistent level, it is important to evaluate suitability of using on–farm feed as suitable alternative to commercially

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available but expensive feeds, hence, the objective of this research.

Material and methods

The study was conducted at the research farm of the Departmental of Fisheries and Aquaculture, University of Agriculture Makurdi, Benue State, Nigeria.

Fresh hatchlings of Nile Tilapia were collected from the mouth of the females maintained in concrete outdoor tanks and move indoor for sex reversal treatment. This was done in a well aerated 60 cm x 30 cm x 30 cm glass aquaria tanks according to the method described by Olufeagba and Okomoda [OLUFEAGBA and OKOMODA 2015]. 100 g of coppens® powdered feed were first weighed. Mixed with 30 µg of 17 α–methyltestosterone (Sigma E–4876) (already dissolved in 95% ethanol), hand mixed in a plastic bowl and oven–dried at 65℃ for an hour. This was fed to the fish for twenty–eight days before the commencement of the current study.

Fingerling were transferred after hormonal treatment into four outdoor tanks where they were fed for eight weeks with coppen® commercial diet (45 % CP) and on–farm compounded diet (45 % CP). Person's square method was used for the on–farm feed formulation. Feed ingredient used includes Maize meal (18.4%), Soybean meal (77.6 %), Fishmeal (10 %), Vitamin premixes (1.5 %), mineral premixes (1.5 %), palm oil (0.5 %) and salt (0.5 %). These were all purchased at the Makurdi Modern market, Benue state. Water quality parameters such as temperature, dissolved oxygen and pH were monitored fortnightly.

Fish were hand–fed twice a day (08:00 am and 06:00 pm) at a rate of 5 % of their body weight per day. The fingerlings were weighed weekly to determine weight gain after which feed was adjusted accordingly. After feeding the fish for eight weeks, growth performance and nutrient utilization were assessed using the relations below.

(a) Mean Initial Weight

(MIW)=total Initial Weight of fingerlings/ total number of fingerlings

(b) Mean Weight Gain

(MWG) = Mean final weight – Mean initial weight

(c) Growth rate

Growth rate = [(Mean final weight – Mean initial weight) x 100] / duration of the experiment

(d) Specific Growth Rate (%/day)

$$\text{Specific Growth Rate (\%/day)} = [\log_e(wt_2) - \log_e(wt_1)]/ t_1 - t_2$$

Where Wt_1= Initial weight; Wt_2= Final weight; $T_2 - T_1$= Duration (in days) considered between Wt_2 and Wt_1

(e) Feed Fed

(FF) = sum of total feed intake per week/ number of fish

(f) Feed conversion ratio

(FCR) = dry feed intake / wet weight gain

(g) Feed Efficiency ratio

(FER) =(wet weight gain x 100)/ dry feed intake Protein efficiency ratio

Protein efficiency ratio = wet weight gain / protein fed

Where

Protein fed = (% protein in diet x total diet consumed) /100

(h) % survival rate

% survival rate = (total number of fish mortality)/(total number of fish)x100

Proximate composition of the formulated diet was determined using the official method by AOAC [AOAC, 2002].

Summary statistics of the different variables measured across the treatment were obtained using Minitab 14 for windows software. Result was then subjected to Analysis of variance and

where significant differences occurred; means were separated using Fisher's least significant difference.

Results and discussion

Proximate composition of the compounded and commercial diet is presented in Table 1, result obtained reveals higher crude protein in the formulated diet (45 %) than the commercial diet (43 %), despite this, and all male *Oreochromis niloticus* fed commercial feed had significantly higher final weight (22.04) than fish fed the on–farm feed (Table 2).

Weight gain was recorded to be 16.91 g for fish fed commercial feed as against 7.10 g observed in on–farm feed fed fish. Similar trend was observed with specific growth rate, feed fed, feed conversion efficiency and protein efficiency ratio with higher values recorded for fish fed commercial feed (1.49, 72.27, 23.39 and 0.336 respectively). Contrary to the trend observed in the earlier mentioned parameters; feed conversion ratio was higher in fish fed on–farm feed (6.54) compared to fish feed commercial feed (2.27). There was, however, no significant difference between survival of fish fed the different diets (P>0.05).

Figure 1. shows the weekly growth of *Oreochromis niloticus* fed the different feed, trend reveals steady increase from the first week to the fourteenth week with higher growth observed in fish fed commercial diet compared to the once with on–farm feed. Result of water quality parameters shows no significant difference in pH, DO and temperature using either commercial or on–farm feed to raise the all-male Tilapia fingerlings (Table 3).

Table 1.

Proximate composition of commercial and on–farm compounded aquafeed.

Parameters	On–farm feed	Commercial	P–Value
Moisture	10.23±0.11^{a}	9.65±0.04^{b}	0.003
Ash	5.43±0.06^{a}	7.15±0.01^{a}	0.003
Lipid	5.23±0.01^{b}	10.23±0.01^{a}	0.001
Fibre	7.20±0.02^{a}	2.75±0.02^{b}	0.001
Protein	45.02±0.02^{a}	43.00±0.02^{b}	0.002
NFE	26.97±0.04^{b}	27.10±0.04^{a}	0.001

Mean in the same row with different superscripts differ significantly (P<0.05)

Weight gain was recorded to be 16.91 g for fish fed commercial feed as against 7.10 g observed in on–farm feed fed fish. Similar trend was observed with specific growth rate, feed fed, feed conversion efficiency and protein efficiency ratio with higher values recorded for fish fed commercial feed (1.49, 72.27, 23.39 and 0.336 respectively).

Table 2.

Growth Parameters and nutrient utilization of *Oreochromis niloticus* fed commercial and on–farm feed

Parameters	On–farm feed	Commercial	P–Value
Initial Wt	5.16 ± 0.04	5.13 ± 0.03	0.231
Final Wt	12.26 ± 0.17^{b}	22.04 ± 0.79^{a}	0.001
Wt gain	7.10 ± 0.13^{b}	16.91 ± 0.11^{a}	0.001
Growth rate	0.07 ± 0.01^{b}	0.17 ± 0.001^{a}	0.001
SGR	0.88 ± 0.006^{b}	1.49 ± 0.008^{a}	0.001
Feed Fed	46.44 ± 0.53^{b}	72.27 ± 1.83^{a}	0.003
FCR	6.54 ± 0.19^{a}	2.27 ± 0.06^{b}	0.015
FCE	15.30 ± 0.46^{b}	23.39 ± 0.24^{a}	0.001
PER	0.158 ± 0.01^{b}	0.336 ± 0.01^{a}	0.001
Survival	90.0 ± 2.00	90.0 ± 4.00	1.000

Mean in the same row with different superscripts differ significantly (P<0.05)

Contrary to the trend observed in the earlier mentioned parameters; feed conversion ratio was higher in fish fed on–farm feed (6.54) compared to fish feed commercial feed (2.27). There was, however, no significant difference

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between survival of fish fed the different diets (P>0.05). Figure 1. shows the weekly growth of *Oreochromis niloticus* fed the different feed, trend reveals steady increase from the first week to the fourteenth week with higher growth observed in fish fed commercial diet compared to the once with on–farm feed.

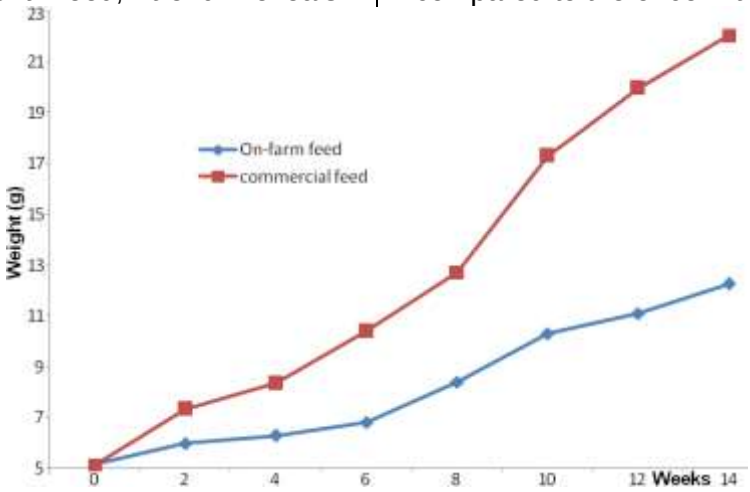

Figure 1. Weekly growth of *Oreochromis niloticus* fed commercial and on–farm feed.

Figure 1. shows the weekly growth of *Oreochromis niloticus* fed the different feed, trend reveals steady increase from the first week to the fourteenth week with higher growth observed in fish fed commercial diet compared to the once with on–farm feed.

Result of water quality parameters shows no significant difference in pH, DO and temperature using either commercial or on–farm feed to raise the all-male Tilapia fingerlings (Table 3).

Table 3.

Water quality Parameters of culture tanks.

Parameters	On–farm feed	Commercial feed	P–Value
Temperature	7.00±0.04	7.15±0.21	0.231
DO	13.36±0.11	13.23±0.53	0.350
pH	2.66±0.02	2.75±0.40	0.422

Mean in the same row with different superscripts differ significantly (P<0.05)

Although same crude protein diet in accordance with manufacturer label of the commercial diet was formulated for the on–farm feed, it was observed that crude protein of the commercial feed was lesser than reported by the manufacturer as well as the formulated diet. This could be as a result of protein aging as postulated by Shyong [SHYONG, 1998]. More so, Solomon and collab. [SOLOMON *et al.*, 2016] lately demonstrated the fact that crude protein of three commercial feed reduces significantly over a storage period of six months.

Water quality as observed in this study did not differ significantly and were within recommended range for culture of tropical fish, hence were not thought to have affected the outcome of this study.

Jamu and Ayinla [JAMU and AYINLA 2003] has earlier reported that feed accounts for at least 60 % of the total cost of fish production in Africa. This in to a large extent determines the viability and profitability of fish farming enterprise.

Hence, as aquaculture intensifies, most farmers who initially depended largely on commercial fish feeds from European countries tend to switch to on–farm formulated diet to break even. This study reveals that fish fed commercial feed grow better than those fed with on–farm feeds despite having lower crude protein. The poor growth response as recorded from the weight gained, low SGR and PER may be attributed to the quality of the feed ingredient used in the production of the on–farm feed. According

to De Silva and Anderson [De SILVA and ANDERSON 1995], the quality of a feed is a function of how well that feed meets the nutrient requirement of a fish. The good growth performance of fish fed with commercial feed is an indication of the fact that they contained well–balanced nutrients, hence leading to high nutrient utilization and possibly digestibility. Low growth recorded by Mustapha and collab. [MUSTAPHA *et al.,* 2014; SAMFIRA et al; 2014] was attributed to very low percentage crude protein of the on–farm feed compared to the commercial feed. Various researchers has demonstrated the fact that fish growth is significantly influenced by the level of protein in the feed [DEGANI *et al.,* 1989, BUTTLE *et al.,* 1995, SIDDIQUI *et al.,* 1988, GIRI *et al.,* 2003, ALI and JAUNCEY 2004, GODA *et al.,* 2007, KEREMAH and BEREGHA 2014, CORN'ELIO *et al.,* 2014].

However, since the on–farm feed had higher protein compared to the commercial feed, differences in observed growth may be attributed to protein quality of the feed ingredients used, antinutritional component of the feed *etc*.

Contrary to the finding of this study Ekanem and collab. and Eyo and collab. [EKANEM *et al.,* 2012; EYO *et al.,* 2014; RASHED and BUTNARIU, 2014b] reported that growth responses of fish fed Coppens and Unical feed (a locally produced fish feed) was statistically same. Furthermore, Auta and collab. [AUTA *et al.,* 2013] reveal that in terms of weight gain, Chivita feed a locally produced feed gave the best growth followed closely by Coppens while Aquaplus (another locally produced feed) had the lowest value. This locally produced commercial feed are product of long–range research and uses commercial extrusion machine to pellet their feed just like the commercial feeds, hence, could be reason for comparable growth observed with commercial feed.

This study recorded a high FCR for fish fed on–farm feed, hence, suggesting that it will take 6.54 Kg of feed to produce one kg of flesh for fish as compared to the value recorded for commercial feed which indicates that 2.27 kg of feed is required to produce one kg of flesh. This invariably means that high quantity of on–farm feed will be required to produce the fish to table size. Low feeding response characterized by the observed low feed intake could be attributed to less fishy odor of the on–farm feed compared to the commercial feed.

Agokei and collab. [AGOKEI *et al.,* 2011; RASHED and BUTNARIU, 2014a] noted that high growth performance of *C. gariepinus* fed on coppens could be traced to fishy odor emitted by the feed as this species is observed to uses olfactory senses during it feeding. Another reason that may have contributed to the low feeding response observed for this fish fed on–farm feed may be due to its inability to float compared to commercial feed [MUSTAPHA *et al.* 2014: IANCULOV et al., 2005].

Moreso, on–farm feed quickly dissociate in water few minutes after been dispensed, hence, on–farm feed become soaked leaching out its nutrients shortly after feeding. However, the higher water stability and high extrusion properties of the commercial feed elicits more feeding responses in the fish.

Conclusions

This study has shown that fish feed on–farm feed performs lower than those fed highly priced commercial feed. However, for farmers to break even in the production of tilapia it is recommended that further research should be done to improve feed utilization of on–farm.

Fish farmers can also adopt on–farm diet feeding to only fish that is about attaining grow out size. At this time growth is marginal, hence feeding high quality feed with no compensatory growth increase is not economically Wise.

Lastly, alternating feeding system (or rotational feeding/simultaneous feeding) of on–farm and commercial feed can be developed for better fish performance at least production cost.

References

1. Adikwu, O., Dietary carbohydrate utilization in Tilapia (*Oreochromis niloticus). Journal of Agricultural science technology.* **1992**. 2(1), p. 33–37.
2. Admassu, D., The breeding season of Tilapia, *Oreochromis niloticus* in Lake

Awassa (Ethiopian rift valley). *Hydrobiologia*, **1996**, p. 337:77–83
3. Agokei, E.O.; Oparah, C.; Aranyo, A.; Apapa, U., Growth of *Clarias gariepinus* juveniles fed five commercial feed Continental. *Journal Fisheries and Aquatic Science*, **2011**. 5(3), p. 1–5.
4. Ali M.Z.; Jauncey K., Effect of feeding regime and dietary protein on growth and body composition of *Clarias gariepinus* (Burchell, 1822). *Indian Journal of Fisheries*, **2004**. 51(4), p. 407–416.
5. AOAC 41.1.16 AOAC Official Method 96533 peroxide Value of oils and fats. Official Methods of analysis of AOAC International, 17th edition. Craithersberg, MD ADAC International. **2002**.
6. Auta, J.; Yashim, Y.E.; Dambo, A.; Tiamiyu, B.B., Growth responses of African catfish, *Clarias gariepinus*, fingerlings to commercial and local feeds. *IJABR* **2013**. 5(1), p. 55–61.
7. Buttle L.G.; Uglow R.F.; Cowx I.G., Effect of dietary protein on the nitrogen excretion and growth of the African catfish, *Clarias gariepinus*. *Aquatic Living Resources* **1995**. 8(4): 407–414. DOI: 10.1051/alr:1995048.
8. Corn'elio F.H.G.; Cunha D.A.; Silveira J.; Alexandre D.; Silva C.; Fracalossi D.M. Dietary protein requirement of juvenile Cachara Catfish, *Pseudoplatystoma reticulatum*. *Journal of the World Aquaculture Society*. **2014**. 45(1), p. 45–54. DOI: 10.1111/jwas.12090.
9. Coward, R.; Bromage N.R., Histological classification of oocyte growth and the dynamics of ovarian recrudescence in *Tilapia zilli. Journal of Fish Biology*. **1998**. 53, p. 285–302.
10. De Silva S.S.; Anderson T.A., Fish nutrition in aquaculture. *Chapman and Hall. London*. **1995**. 319 pp.
11. Degani G.; Ben–Zvi Y.; Levanon D., The effect of different protein levels and temperatures on feed utilization, growth and body composition of *Clarias gariepinus* (Burchell 1822). *Aquaculture*. **1989**. 76(3–4), p. 293–301. DOI: 10.1016/0044–8486(89)90082–3.
12. Ekanem A.P.; Eyo V.S.; Obiekezie A.I.; Enin U.I., Udo P.J., A comparative study of the growth performance and food utilization of the African catfish (*Clarias gariepinus*) fed Unical aqua feed and coppens commercial feed. *Journal of Marine Biology and Oceanography*. **2012**. 1(2), p. 1–6. DOI: 10.4172/2324–8661.1000101.
13. Eyo1 V.O.; Ekanem A.P.; Jimmy U.U., A comparative study of the Gonado–somatic index (GSI) and gonad gross morphology of African Catfish (*Clarias gariepinus*) fed Unical Aquafeed and coppens commercial feed, *Croatian Journal of Fisheries*, **2014**. 72(2), p. 63–69.
14. Gabriel, U.U.; Akinrotimi O.A; Bekibele D.O.; Onunkwu D.N.; Anyanwu P.E., Locally produced fish feed, potentials for aquaculture development in sub–saharan African. *Journal of Agricultural Research* **2007**. 297, p. 287–295.
15. Giri S.S.; Sahoo S.K.; Sahu A.K.; Meher P.K.; Effect of dietary protein level on growth, survival, feed utilization and body composition of hybrid *Clarias* catfish (*Clarias betrachus* x *Clarias gariepinus*). *Animal Feed Science and Technology*. **2003**. 104, p. 169–178.
16. Goda A.M.; El–Haroun E.R.; Chowdhury M.A., Effect of totally or partially replacing fish meal by alternative protein sources on growth of African catfish *Clarias gariepinus* (Burchell, 1822) reared in concrete tanks. *Aquaculture Research.* **2007**. DOI: 10.1111/j.1365–2109.2007.01663.x 38(3): 279–287.
17. Hafedh, Al Y.S., Effects of dietary protein on growth and body composition of Nile tilapia, *Oreochromis niloticus*, J. food resources division. *Aquaculture research*, **1999**. 30, p. 385–393 http://dx.doi.org/10.1046/j.1365–2109.1999.00343.x
18. Ianculov, I.; Palicica, R.; Butnariu, M.; Dumbrava, D.; Gergen, I. The obtaining of chlorophyll in crystalline form from fir needles (*Abies alba*) and from pine needles (*Pinus silvestris*). *Revista de Chimie*, **2005**, 56(4), p. 441–443.
19. Jamu D.M.; Ayinla O.A., Potential for the development of aquaculture in Africa NAGA **2003**. 26, p. 9–13.
20. Keremah R.I.; Beregha O., Effect of varying dietary protein levels on growth and nutrient utilization of African catfish *Clarias gariepinus* fingerlings. *Journal of Experimental Biology and Agricultural Sciences*. **2014**. 2(1), p. 13–18.

21. Meyer, D.E., Technology for successful small–scale tilapia culture (CRSP Research Report 02–179). CRSP (*Aquaculture collaborative research support program*. [Abstract from original paper published in D. Meyer (Ed). Tilapia sessions, 22–24 August 2001. **2002**, p. 97–106.
22. Mustapha M.K.; Akinware B.F.; Faseyi C. A.; Alade A.A., Comparative effect of local and foreign commercial feeds on the growth and survival of *Clarias gariepinus* juveniles, *Journal of Fisheries*. **2014**. 2(2), p. 106–112.
23. Olufeagba S.O.; Okomoda V.T., Preliminary report on the use of Androgen for the production of All–male *Oreochromis niloticus*. International *Journal of Aquaculture*. **2015**. 5(9), p. 1–3.
24. Rashed, K.; Butnariu, M. Antimicrobial and Antioxidant Activities of *Bauhinia racemosa* Lam.; and Chemical Content.; *Iranian journal of pharmaceutical research*. 2014. 13(3), p. 1073–1080a.
25. Rashed, K.N.; Butnariu, M. Isolation and antimicrobial and antioxidant evaluation of bio–active compounds from *Eriobotrya japonica* stems. *Advanced Pharmaceutical Bulletin*. **2014**. 4(1), p. 75–81b.
26. Samfira, I.; Butnariu, M.; Rodino, S.; Butu, M. Structural investigation of mistletoe plants from various hosts exhibiting diverse lignin phenotypes, *Digest Journal of Nanomaterials and Biostructures*, **2014**, 8(4), p. 1679–1686.
27. Shyong, W.J.; Haung, C.H.; Chen, H.C., Effects of dietary protein concentration on growth and muscle composition of juvenile. Aquaculture, 167:35–42. *Gariepinus* (Burchell, 1822) fingerlings fed diets containing fish oils and vegetable oils as total replacements. *World Journal of Fish and Marine Science*, **1998**. 2(2), p. 93–98.
28. Siddiqui, A.Q.; Howlander, M.S.; Adam, A.A., Effects of dietary protein levels on growth, feed conversion and protein utilization in fry and young Nile tilapia, *Oreochromis niloticus*. *Aquaculture*. **1988**. 70(1–2), p. 63–73. DOI: 10.1016/0044–8486(88)90007–5.
29. Solomon, S.G., Okomoda, V.T. Growth performance of *Oreochromis niloticus* fed duckweed (*Lemna minor*) based diets in outdoor hapas. *International Journal of Research in Fisheries and Aquaculture*. ISSN 2277–7729. **2012**, p. 61–65.
30. Solomon, S.G.; Okomoda, V.T.; Oloche, J. A. Evaluation of Sweet Potato (*Ipomea batatas*) peel as replacement for Maize meal in the diet of *Clarias gariepinus* fingerling. *Journal of Fisheries Science.com*. **2015**. 9(4), p. 63–68.
31. Solomon, S.G.; Tiamiyu, L.O.; Okomoda, V.T.; Adaga, K.; Nutrient Growth performance of *Clarias gariepinus* fed commercial feeds stored in different storage conditions. *Croatian Journal of Fisheries*, **2016.** 74, p. 30–37.
32. Tiamiyu, L.O.; Ayuba, V.O.; Okomoda, V.T.; Saidu, U., Effect of Various Levels of Raw *Citrullus lanatus* Seed Meal Diets on Growth Performance of *Cyprinus carpio* Fingerlings. *Jordan Journal of Biological Science*. **2014**. 7(4), p. 269–274.
33. Tiamiyu, L.O.; Okomoda, V.T.; Izundu, C.I., Nutritional value of hydrothermally processed *Citrullus lanatus* Seeds in the Diet of *Clarias gariepinus*. *International Journal of Aquaculture*. **2015**. 5(10), p. 1–4.
34. Ukagha B.E., Socioeconomic constraints to livestock production in Nigeria. Proceeding 8th Annual Conference Animal Society Association of Nigeria. (ASAN) FUT Minna Sept. 16–18th 2003, p. 10–14. Vandermark T. 2011. **2003**.
35. Yi, Y.C.; Lin K.; Diana J.S., Influence of Nile tilapia (*Oreochromis niloticus)* stocking density on their growth and yield in cages and ponds containing the cages *Aquaculture*. **1996**. 146 2005–215.

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