International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Growth Performance of Catfish (*Clarias Gariepinus*) Fed Sun – Dried Housefly Maggot Meal (*Musca Domestica)*

[1]Oyedapo, F. A., [2]Akpa, L.E. [1]Duwil, R., [1]Garba, H. B., Mohammed, M. Y. and *[1]Oshibanjo, D. O.

[1] Department of Animal Production, faculty of Agriculture, University of Jos.

[2]Department of Zoology, Faculty of Natural Sciences, University of Jos.

Email: oshibanjoo@unijos.edu.ng

ABSTRACT

This study was to investigate the growth performance of catfish (*Clarias gariepinus*) fed sun-dried maggot meal and concentrate feed (Coppens). This experiment was aimed at testing the sole feeding of housefly maggot to fish in order to replace concentrate feed completely, thereby reducing the cost of production. This study was completely randomized and had two treatments and three replicates. Student T-test was used to compare the growth parameters and water quality parameters measured. The result of growth showed that mean weight gain of 1.43g and 1.91g for maggot meal and concentrate feed (coppens feed) respectively was not statistically significant at P<0.05. It also revealed that there was an increase in length of fish with mean values of 6.04cm and 6.61cm for maggot and coppens feed respectively. Length gains of 2.94cm and 3.51cm for maggot and coppens respectively, was not statistically significant at p <0.05. Similarly, the mean specific growth rate (SGR) of 1.07 and 1.27 for maggot meal and coppens, feed intake of 3.25 and 3.25, the feed conversion of 1.33 and 1.12 respectively were not statistically significant (P>0.05). Among all the mean physico-chemical attributes of the pond water only nitrite varied significantly (P<0.05). A significantly (P<0.05) drop in performance of fingerlings fed solely maggot meal after 3 months of age. From the results obtained, it can be inferred that maggot-based meal can be a perfect substitute for concentrate feed in the culture of African catfish (*Clarias gariepinus*) fingerlings that are less than 3 months of age. The use of housefly sun- dried maggot only to feed young catfish (*Clarias gariepinus.*) between the age of 0-3 months of age is highly recommended to reduce the cost of production.

Keywords: Growth performance, catfish (*Clarias gariepinus*), sun-dried maggot, *Musca domestica***,** commercial feed

INTRODUCTION

The most direct remedy for diminishing capture fisheries is aquaculture, but it is hindered from realizing its full potential by a number of issues, including antiquated culture systems and the high cost of fish feeds brought on by competition for raw materials (Barbu et al., 2016; Huntington et al., 2017). A crucial link in the Clarias gariepinus production value chain is fish feed. The cost, availability, and quality of fish food may be the most limiting factors in aquaculture development. The purchase of food accounts for a significant portion of the costs associated with fish production (Adewolu et al., 2010). Commercial feeds are often costly, and as other animal feed producers compete for components, their costs keep rising (FAO, 2014). The utilization of inexpensive and nutrient-dense components in formulation is necessary to achieve economic viability (Munguti et al., 2009). In order to lower the cost of fish feeds, it is crucial to replace the often used, pricey ingredients with unconventional, locally accessible, and reasonably priced items like life food (Chepkirui-Boit et al., 2011). One such live food source that can be used for this is houseflies (Musca domestica). They are the most varied group of flies, able to transform decomposing materials into nutrient-dense animal-based meals (Hussien et al., 2017). They are inexpensive and simple to make from the majority of organic wastes, such as wheat brand, calf blood, and the dung of pigs and chickens. .(Ajani *et al* 2004; Aniebo and Owen, 2010; Pastor *et al*., 2011; Anene *et al*., 2013;)

Prior research has demonstrated that when creating fish diets, housefly larvae (maggots) can serve as a viable source of protein and a substitute for fish meal (FM) (Stamer et al., 2014; Matteo et al., 2020). Production of maggots is environmentally beneficial. According to Xiao et al. (2018), the larvae's approximate composition revealed a high crude protein content of up to 45% as well as the availability of microelements, amino acids, and fatty acids in the necessary amounts for fish growth.

Notwithstanding the possible advantages, no thorough research has been done on the precise impacts of sun-dried maggot meals on Clarias gariepinus development performance. A targeted study is required to give a better knowledge of the connection between this alternate feed source and *Clarias gariepinus* growth, as previous research may not be consistent. In order to evaluate for improved food efficiency in comparison to commercial diet-formulated experimental meals, the current study focused on feeding catfish only maggot (Musca domestica).

MATERIALS AND METHOD

Experimental site

The experiment was carried out in the Fishery and Aquaculture Laboratory, Department of Animal production, Faculty of Agriculture, University of Jos. Jos Plateau situated between latitude 9º 50'N and Longitude 8º 50'E and 8º 55'E is a highland area that projects from the plain of Central and Northern Nigeria. The city consists of climatic condition that differs from that of neighbouring plains as a result of periodic movement of the Inter-Tropical Coverage Zone (ITCZ), which has given rise to three distinctive sequences of seasons in the city. That is the cool dry season that commences from October to February, a hot season from March to April and a wet season between May to September. There is a mean annual temperature of 21.8ºC and a mean monthly temperature ranging from 30.2ºC to 24.3ºC. Mean annual rainfall between May and September, while the peak period (August) is characterized by mean monthly rainfall of about 321mm and outside of these months, rainfall declines rapidly.

Proximate Composition of Experimental Diets

Maggot Meal was Analyzed for Proximate Indices Including Crude Protein, Lipid, Crude Fiber, Ash, Moisture and Energy Contents Following Standard procedures provided by AOAC (2017) in African Regional Aquacultural Center (ARAC). Moisture was determined using the Oven Drying Method, Crude Protein Content was Determined Using the Micro-Kjeldahl Method, Lipid content was determined by the Soxhlet Extraction Method, Ash Content was determined by incinerating at 5500c and Carbohydrate was also Calculated by Differences.

Weighing of Experimental Fish

The weight of fish was determined Immediately after acclimatization using an Electronic Weighing Scale. The average and total mean weights of fish Per tank was recorded. The weighing of fish continued weekly until the experiment was terminated.

Growth Performance and Feed Utilization Parameters

Growth performance and feed utilization parameters were calculated in terms of fish Feed Conversion Ratio (FCR), Feed Intake (FI), Specific Growth Rate (SGR), Protein Efficiency Ratio (PER), Percentage survival, mean weight gain, and mean length gain, were determined after the trials as follows:

I. Feed Conversion Ratio (FCR): From the Weight Gained and Feed Consumed by each of The Fish, The Feed Conversion Ratio (FCR) was calculated using the expression:

FCR = (Woke and Aleleye-Wokoma, 2010)

II.Feed Intake (Fi): This was estimated by the addition of weekly feed Intake during the study Period.

III.Specific Growth Rate: Specific Growth Rate was calculated using the formula: (Woke and Aleleye-Wokoma, 2010)

Where:

Ln = Natural Logarithm

W2 = Final Weight

W1 = Initial Weight of The Fish

T = Culture Period

IV. Protein Efficiency Ratio (Per): Protein Efficiency Ratio was calculated using the Formula
Woke and Aleleye-Wokoma, 2010)

V. Percentage Survival: Percentage survival was calculated using the Formula
Ps = X

VI. Mean Weight Gain: The Mean Weight Gained was calculated by Subtracting Initial Weight from The Final Weight. (W2-W1).

VII. Mean Length Gain: The Mean Length Gained was calculated by Subtracting Initial Length from Final Length. (L2-L1).

Collection of Experimental Fish and Experiment Set Up

Four hundred and fifty *Clarias gariepinus* fingerlings was sourced form a reputable farm in Ibadan, Oyo state. The fish was acclimatized for 3 days in the rearing unit. After acclimatization, the experimental fish was stocked randomly into six (6) rearing containers carrying 20 litrers of water at 50 fish per plastic tanks. There was treatment and a control, which were replicated 3 times, water was changed twice on daily basis (morning and evening).

Feeding regime

Fish was fed at 5% body weight twice daily. Feed intake was increased with increasing body weight of the fish. The experimental fish was weighed at intervals of 7 days for 12 weeks.

Data Collection

Data on water quality parameters, Dissolved Oxygen (DO), Temperature, pH, Ammonia, Total solid, General hardness, Nitrate, Nitrite, carbon phosphate and mean weight gain from the experimental fish was taken at 7 days interval (weekly). Other parameters investigated include Specific Growth rate, Feed Conversation Ratio, Protein Efficiency Ratio, Feed Conversation Efficiency and Survival (%).

Treatment and Experimental Design

The treatment and control which were replicated three (3) times were was laid out in a completely randomized design. Therefore, six (6) rearing units were used in conducting the research.

Data analysis

Data obtained at the end of the experiment was subjected to statistical analysis. Data was compiled using Microsoft Excel sheets. Statistical differences between initial weight and final weight, mortality rate of fish feed maggot meal and coppens were analyzed using students T-test.

RESULTS

Proximate Analysis

The results comparing the proximate values of experimental diets is shown on Table 1. The result showed very high significant ($P<0.01$) variations in all the parameters measured.

Growth Performance Indices

The growth performance of catfish fingerlings (*Clarias gariepinus*) fed with maggot-based feed compared with formulated feed (coppens) across several parameters revealed that feed intake was identical for both groups at 3.25 grams, with a P-value of 1.000, confirming no difference in the amount of feed consumed (Table 2). The feed conversion ratio (FCR), which measures the efficiency of converting feed into body mass, was 1.33 for the maggot-fed group and 1.12 for the formulated feed group, with a P-value of 0.107, indicating no significant difference but a slight improvement for the formulated feed (Table 2). The specific growth rate (SGR), which indicates the growth rate relative to the size of the fish, was 1.07 for the maggot-fed group and 1.27 for the formulated feed group, with a P-value of 0.396, showing no significant difference. Protein efficiency was 0.03 for the maggot-fed group and 0.05 for the formulated feed group, with a P-value of 0.127, suggesting a trend towards better protein efficiency with the formulated feed but not with a significant difference (Table 2).

Mortality

Percentage survival was 52.00% for the maggot-fed group and 60.00% for the formulated feed group, with a P-value of 0.000, indicating a statistically significant higher survival rate for the formulated feed group. The total body length was 6.04 cm for the maggot-fed group and 6.61 cm for the formulated feed group, with a P-value of 0.300, showing no significant difference. Finally, the length gained was 2.94 cm for the maggot-fed group and 3.51 cm for the formulated feed group, with a P-value of 0.300, indicating no significant difference in the length gained between the two groups (Table 2). The effect of feeds on mortality per week revealed that at week 1, mortality was significantly higher in catfish fed maggot, while the least mortality was obtained at week 5 in treatment 2 fed control diet. It was observed that as the weeks progressed, the mortality decreased. Catfish fed maggot meal had or recorded the highest mortality rate (Figure 4).

Table 1: Proximate composition of Maggot-based meal and concentrate feed (Coppens)

Parameter (%)	Maggot	Formulated feed	P-value
Crude protein	46.74^{a}	29.70^{b}	0.000
Fat	27.37^{a}	5.82^{b}	0.000
Ash	5.76^{b}	8.85^{a}	0.000
Crude fibre	5.83^{b}	16.79^{a}	0.000
Moisture content	6.52^{a}	5.68b	0.000
Nitrogen free extract	7.79^{b}	33.18^{a}	0.000

^{ab} different superscript on the same row meams they are significanltly ditfferent ($P<0.05$)

Table 2: Growth performance and feed utilization of catfish fed Maggot-based meal and concentrate feed (coppens)

Parameters	Maggot	Concentrate feed (coppens)	P-value
Final body Weight (g)	2.27	2.75	0.300
Weight gained (g)	1.43	1.91	0.300

Feed intake (g)	3.25	3.25	1.000
Feed Conversion Ratio	1.33	1.12	0.107
Specific Growth Rate (SGR)	1.07	1.27	0.396
Protein Efficiency	0.03	0.05	0.127
Percentage Survival	52.00[b]	60.00[a]	0.000
Total body Length (cm)	6.04	6.61	0.300
Length gained	2.94	3.51	0.300

[abc] Different superscript shows there is significant difference

Effect of Feeds on the fish Morphometrics Index (body weight, width and length)

The effect of feeds on the body width per week as shown in Figure 1 revealed a pattern that shows the catfish body width increased as the week progressed. Fish fed control diet or meal had higher body width or gained higher body width from week 1 to week 5, whereas, fish fed control diet recorded the least body width from week 6 to12. On the other hand, fish fed maggot meal recorded or had a higher body week from week 6 to week 12. The effect of feed on total body length per week as shown on Figure 2 revealed a trend whereby fish fed control died had high total body length throughout the study period, from week 1 to 12, whereas, fish fed maggot meal had or recorded the least total body length. It was also observed that fish fed maggot meal recorded a high total body length at the 4th week having mean values of 6.30 and 6.00 for control diet. The effect of feeds on body length as shown on figure 3 revealed a pattern whereby, fish fed control diet recorded high body length at weeks 1,2,9,10,11 and 12. Fish fed maggot meal recorded high body length starting from week 3 to week 8.

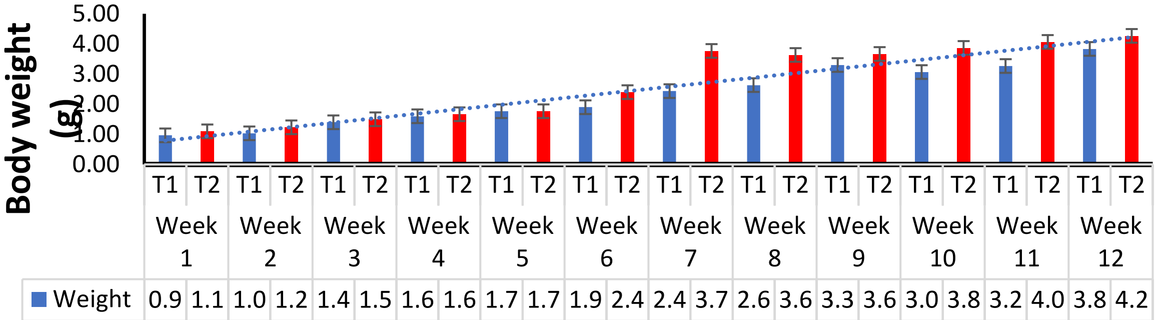


Figure 1: Weekly Variation in fish body weight during the study

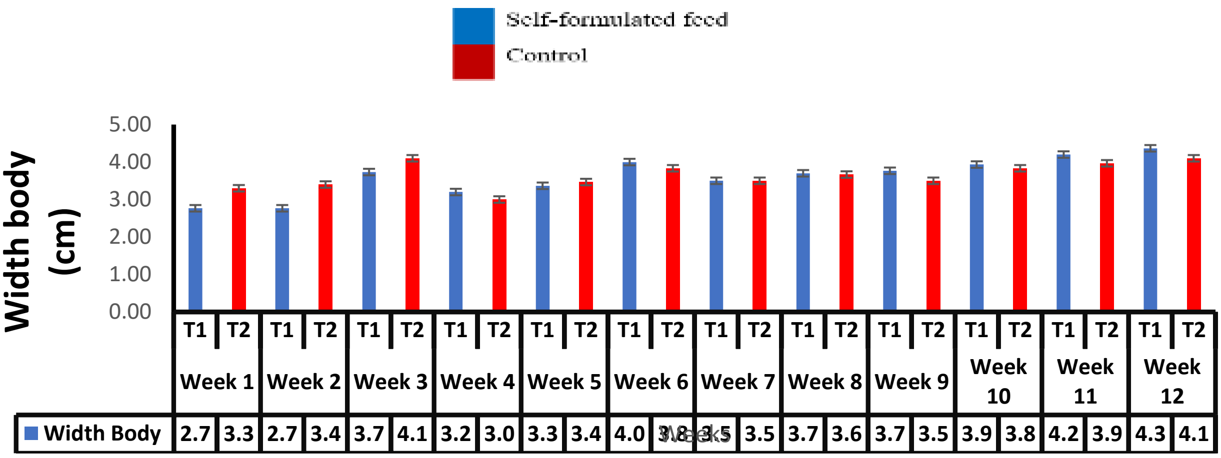


Figure 2: Mean Weekly body width

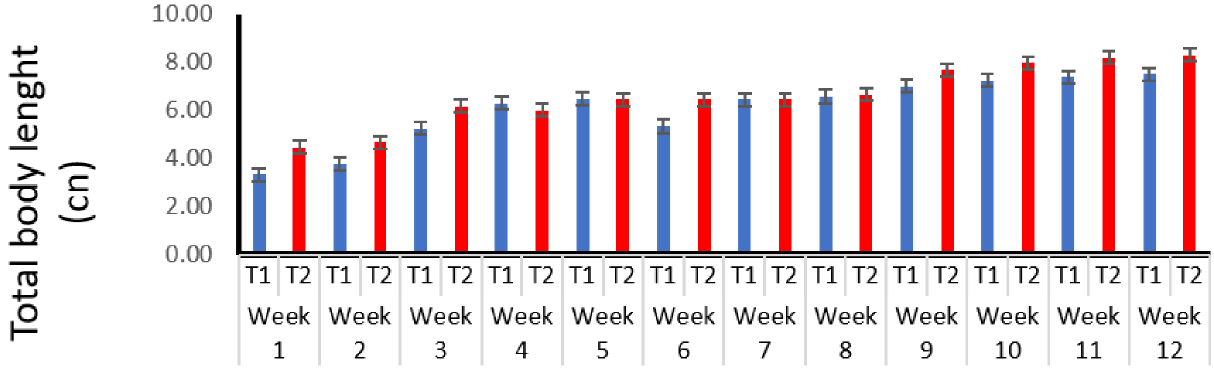
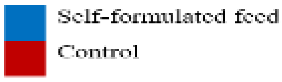


Figure 3: Effect of feeds on Total length per weeks



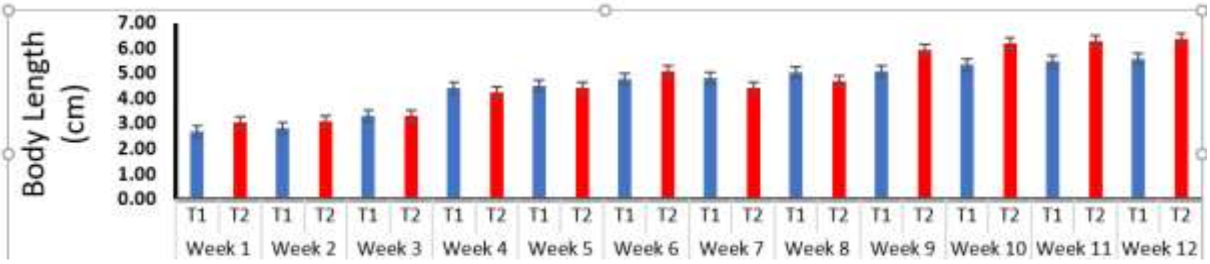
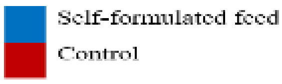


Figure 4: Weekly Increase in Body Length



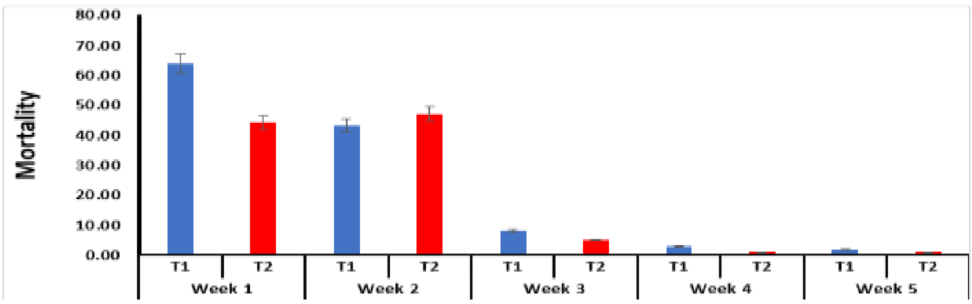
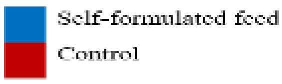


Figure 4: Weekly Mortality Rate of *Clarias* gariepinus fingerling



Water Quality Parameters Measured during the Study Period

The mean water quality parameters values determined during this study is presented in Table 1. The result showed only nitrite varied significantly ($P<0.05$) between the two treatments. There was a marked difference in nitrite values between the diets, with the maggot- based diet having significantly higher (3.08±0.50 (mg/L) levels than that found in the pond of fingerlings fed commercial feed (0.5±0.10). Other parameters namely pH, carbon hardness, dissolved oxygen and general hardness showed no significant differences between the maggot-based meal and the control diet.

Table 3: Water Quality Parameters Measured during the Twelve Weeks Study Period

Parameters	Maggot meal-based diet	Control	P-value
Temperature	24.17 ±0.10	24.27±0.10	0.116
Total solid (mg/L)	70.67±0.10	72.50±4.17	0.116
Nitrate (mg/L)	1.67±2.89	1.83±2.75	0.894
Nitrite (mg/L)	3.08±0.50^{a}	0.5±0.10^{b}	0.023
Ammonia (mg/L)	6.00±0.87	1.68±0.50	0.283
Phosphate (mg/L)	0.00	0.00	
pH	6.33±0.29	6.50±0.50	0.561
Carbon hardness (ppm)	61.60±8.80	44±8.80	1.000
Dissolve oxygen (mg/L)	7.32±1.52	7.76±1.06	0.730
General hardness (ppm)	44.00±8.80	35.20±0.01	0.116

4.2 Discussion

The two experimental diets' large significant difference in the proximal comparison suggests that the feeds are not identical. However, feeding data indicated that both feeds had nearly identical outcomes in terms of body length (BL), protein efficiency (PE), percentage survival (PS), feed conversion ratio (FCR), and weight gain (WG). The value of crude protein was consistent with the values suggested by Bolorunduro (2002) as the crude protein requirement for fingerling catfish (Clarias gariepinus). According to Anene et al. (2013) and Hussien et al. (2017), maggots have a comparatively high number of micronutrients, 10.2% moisture, 56.3% crude protein, and 22.3% crude fat.

Maggot-based meal can be utilized as an alternative feed in the hatchery to feed young fries and fingerlings, as evidenced by the fair competition in growth performance between weeks 1 and 6 in terms of weight increase, body length, and width. According to the proximate composition of the two diets in Table 1, the high carbohydrate content of the feed may be the cause of the noteworthy weight growth values for fish given coppens between weeks 7 and 12. This is consistent with the findings of Woke and Nweke (2020), who found that diets incorporating maggot performed better than those fed concentrate.

Table 2 shows the percentage survival outcome. There was a significant difference ($p<0.01$) between fish fed coppens and fish fed maggot-based food. The fish in the pond fed sundried maggot-based food may have a higher nitrite buildup than the other fish, which could explain the high significant value seen. This supports the findings of Lorente and Soler (2021), who claim that nitrite accumulation is hazardous to fish at relatively low concentrations and can result in significant losses for catfish. They also claim that exposure to high nitrite concentrations causes an increase in methemoglobin and disrupts fish physiological processes. Fish fed concentrate diet had the highest percentage survival rate, albeit this difference was not statistically significant ($P<0.05$).

The ponds containing fish given sundried maggot-based food were found to have much higher levels of nitrite than any other water quality indicator, including temperature, total solids, nitrate ammonia, pH, carbon hardness, dissolved oxygen, nitrite, and general hardness. This could be because the presence of organic materials increases the number of bacteria that break down those materials. These microbes use the dissolved oxygen in the water to produce nitrite buildup, which irritates fish and eventually kills them. According to Thompson et al. (2002), the ideal range for catfish (Clarias gariepinus) development and survival was met by the mean temperature, dissolved oxygen, pH, and ammonia.

Conclusion

According to the study's findings, assessing the growth performance of Clarias gariepinus fingerlings fed Coppens and sundried maggot-based diet has given sufficient insight into a substitute protein source that produces good outcomes in terms of growth, survival, and nutrient utilization. Based on the findings, it can be said that using a meal derived from maggots would be very helpful in the culture process and production of Clarias gariepinus starting at the fingerling stage. Farmers can then introduce commercial feed for the best growth. The study shown that catfish fingerlings younger than three months old can be fed maggot meal exclusively as a substitute for other feeds.

One significant issue identified by this study is that maggot meal contaminates the water with nitrite and ammonia gasses, which are poisonous to fish and cause mortality. For this reason, trash should be removed as soon as possible. Therefore, while using maggot meal to feed fish, it is imperative to regularly change the water in the ponds or to utilize flow through with high-quality biofilters. The use of maggot meal in fish aquaculture requires adherence to these safety regulations.

References

Adewolu, M. A., Ikenweiwe. N. B., & Mulero., S. M. (2010). Evaluation of an animal protein mixture as a replacement for fish meal in practical diets for fingerlings of *Clarias gariepinus* (Burchell, 1822). *Israel Journal of Aquaculture-Bamidgeh, 62*, 237-244.

Ajani, E. H., Nwanna, L. C. & Musa, B. O. (2004). Replacement of fishmeal with maggot meal in the diets of catfish. *World Aquaculture 35* (1):52-54.

Anene, A., Olivia, C., Ike, K., & Ekekwe, N. H. (2013). Preliminary investigation on quantity and proximate quality of maggots produced from four different sources of livestock wastes. Journal on Research in Biology *3* (6): 2-7.

Aniebo, A. O., Owen, O. J., (2010). Effect of age and method of drying on the proximate composition of housefly lavae (*Musa domestica Linnaeus*) meal (HFLM). Pakistan Journal of Nutrition 9 (5):485-487.

Bolorunduro, P. I. (2002). *Feed formulation and feeding practices in fish culture. National Agricultural Extention and Research Liason Services, Amadu Bello University, Zaria. Extension Bulletin no.152, Fish Series* No.7.

Barbu M., Ceanga E., & Caraman s. (2016). water quality modelling and control in recirculating aquaculture system; Intech Open Limited, The Shad 25th floor, 32 london bridge, street London, SE19SG, United Kingdom. 53pp. DIO: 10.5772/63202.

Chepkurui-Boit, V., Ngugi, C. C., Bowman, J., Oyoo-Okoth, E., Rasowo, J., Bundi, M. J. & Cherop, L., (2011). Growth performance, survival, feed utilization and nutrients utilization of African catfish (*Clarias gariepinus*).

FAO, (2014). Success factors in aquaculture enterprises in the pacific: Farm Assets and Farm Performances of Private Aquaculture Enterprises, www.fao.org/contactus/licen

Huntington, T., Avarre, J. C., Focken, U., Osward, M., Pucher, J., Sorgeloos, P., & Aoac, D., (2017). Opportunities and challenges for aquaculture in developing countries

Hussien, M., pillai, V.V., Goddard, J. M., Park, H. G., Kothapalli, S., Ross, D. A., Ketterings, Q. M., Brenna, J. T., Milstein, M. B., Marquis, H., Johnson, P. A., Nyrop, J. P., & selvaraj., (2017). Sustainable production of housefly maggots (Musa domestica) larvae as a protein –rich feed ingredients by utilizing cattle manure. PLoS ONE, *12* (4):1-19.

Idowu, E. & Afolayan E., Kolawole, K & Ugwumba., (2013). The effect of supplementing of fish with maggots at varying levels in the diets of Clarias gariepinus. International Archive of applied sciences and Technology, *4* (4):41-47.

Matteo, Z., Basilio, R., Giorgia, G., Christina, T., Elisabetta, G., Paola, R., Giorgin. G., Cristiona, B., Andrea, O., Gloriana, C., Tyrone, L., Vesna, M., Anna, A., Francesca, T., Valentina, N., Sara, R., Francesca, C. & Like, O., (2020). Zebra (Danio rerio) physiological and behavioural responses to insect-based diets.

Munguti, J., Obiero, K., Odame, H., Kirimi, G. J., Kyule, D., Josiah, A. & Liti, D., (2021). Key limitation of fish feeds, feed management practices, and opportunities in Kenya's aquaculture enterprise, *African Journal of Food, Agriculture, Nutrition and Development, 12* (21):17415-17434. https://doi.org/10.18697/ajf & 97.20455.

Munguti, J. M., Waidbacher, H., Liti, D. M., Straif, M., & Zollitsch, W., (2009). Effect of substitution of freshwater shrimp meal (*Caridina nilotica Roux*) with hydrolysed feather meal on growth performance and apparent digestibility in Nile tilapia (*Oreochromis niloticus L.*) under different culture conditions. Livestock Research for Rural Development, 21, 1-13.

Munguti, J. M., Safina, M., Orina, P. S., Kyule, D. N., Opiyo, M. A., Karisa, H. C., & Ogello E. O., (2014). An overview of current status of Kenyan fish feed industry and feed management practices, challenges and opportunities: *International Journal of Fisheries and Aquatic studies*. Vol *1* no 6 pp. 128-137.

Pastor, B. E., Elena, H., Kova, I., Kozanek M. I., Martinez,-Sanchez, A. N &Taka, P. E.,(2011). Effect of the size of the pupae, adult diet, oviposition substrate and adult population density of egg production in *Musa domestica* (Diptera: Muscidae) 108:587-596.

Stamer, A., Wesselss, S., Venold., Neidigk, R. & Hoersten, G., (2014). Black soldier fly (Hermetia illucens) larval-meal as an example of a new feed ingredients' class in aquaculture diets. Rahmann, G., & Aksoy, U., (Eds)., (2014). Proceedings of the 4th ISOFAR Scientist conference. 13-15 Oct, Istanbul, Turkey (e-print ID 24223)

Sogbesan, O. A., Kaushik., & Metian., (2014). Performances of Heterobranchus longifilis fed full-fat maggot mealsupplemented diets in mini-flow through systems. IOSR journal of Agriculture and Veterinary Science *7* (12):84-40.

Walker, A. B., Fournier, H. R., Neefus, C. D., Nard, G. C., Ologhobo., Wang, G., Fasakin, J. T. & Berlinsky D. L., (2009). Partial replacement of fishmeal with Larval Pophyra Spp. In diets for Atlantic cod. *North American Journal of Aquaculture, 71*, 39-45

Woke, G.N., & `Aleleye-Wokoma (2010). General fish biology and fisheries policy. M & Grand Orbit Communication Ltd. Portharcourt. 18pp.

Xiao, X., Jin, P., Cai, M., Yu, Z., Yu, J., & Zheng, J., (2018). Effects of black soldier fly (Hermetia illucens) larvae meal protein as a fishmeal replacement on the growth and immune index of yellow catfish (Pelteobargrus fulvidraco); *Aquaculture Research*. 1-9 https://doi.org/10.1111/are.13611.