**THE HISTOPATHOLOGY, HAEMATOLOGY AND CARCASS QUALITY OF *CLARIAS GARIEPINUS* POST-FINGERLING FED FRESH AND DRIED HOUSEFLY MAGGOT.**

**ABSTRACT**

This study evaluates the histopathology, hematology, and carcass quality of Clarias gariepinus post-fingerlings fed fresh and dried housefly maggots, addressing the increasing demand for quality, affordable feed in aquaculture. Conducted at the Fisheries Department, Nnamdi Azikiwe University, Awka, Nigeria, the experiment involved 60 Clarias gariepinus divided into three groups: one fed fresh housefly maggots, another dried maggots, and a control group on commercial feed. Proximate analysis showed that dry maggot meal had 28.80% protein, 17.90% fat, and 23.90% carbohydrates. The control group had the highest total length, weight, liver weight, and fillet weight (p<0.05). However, fish on dry maggot feed showed the highest villi width and goblet cell number in the intestine, indicating better nutrient absorption. Haematological parameters, such as hemoglobin, red blood cells, and white blood cells, were highest in fish fed dried maggot meal, suggesting improved health status. Fish fed with maggot meal also showed higher enzyme activities (catalase and glutathione S-transferase), while histopathological examination revealed mild liver vacuolation and congestion in fish fed with fresh maggots. Overall, the study concludes that dried housefly maggot meal is a promising alternative to fishmeal due to its positive effects on growth, haematological indices, and intestinal morphology. The study recommends further investigation into anti-nutritional factors, optimization of feed formulations, scaling up production, and assessing the safety of maggot meal for other species.

**Keywords:** Hepatosomatic index, Blood, Carcass quality, Post fingerlings, Catfish, Maggots

**INTRODUCTION**

The African catfish (*Clarias gariepinus*) is a popular aquaculture species due to its fast growth, adaptability to different environments, and high market demand (Adejinmi & Ogungbenro, 2023). As aquaculture expands, sustainable feed alternatives are essential to mitigate the rising cost of conventional fish feeds, particularly fishmeal (Ogunji et al., 2022). Insects, specifically housefly maggots (*Musca domestica*), have gained attention as potential protein sources in fish diets due to their high nutritional profile and cost-effectiveness (Henry et al., 2023). Fresh and dried housefly maggots have been used as supplementary protein sources in various animal feeds, including fish, owing to their richness in essential amino acids, fats, and micronutrients. However, studies on the physiological effects of these alternative feeds on the histopathology, blood parameters, and carcass quality of *Clarias gariepinus* post-fingerlings remain limited (Mbiyu et al., 2021). Understanding these effects is crucial for evaluating the safety and efficacy of maggot-based diets in aquaculture. The increasing reliance on fishmeal in aquaculture feed has raised concerns regarding its sustainability and environmental impact, prompting the search for alternative protein sources (Yildirim et al., 2023). While housefly maggots offer a promising solution, there is insufficient research on how fresh and dried maggots affect the health and growth of *Clarias gariepinus* post-fingerlings, particularly in terms of histopathological changes, blood parameters, and carcass quality (Adebayo & Ajani, 2023). These factors are critical in ensuring the nutritional safety and market value of fish produced using maggot-based diets. Addressing this gap will provide valuable insights into the viability of insect-based feeds in commercial aquaculture. Thus, the present study seeks to evaluate the histopathology, blood and carcass quality of *Clarias gariepinus* post-fingerlings fed fresh and dried maggots.

**MATERIALS AND METHODS**

The study was conducted at the Fisheries Department of Nnamdi Azikiwe University, Awka, Nigeria, located in a tropical wet and dry climate. The experiment utilized ninety (90) pieces of Clarias gariepinus fish, divided into three groups with replicates, each fed different diets: fresh housefly maggots, dried maggots, and commercial feed. Standard pond management practices were followed throughout the study. Proximate analyses of the maggot specimen were conducted using AOAC (2010) methods to determine moisture, ash, fiber, protein, fat, and carbohydrate content. Various haematological indices, such as hemoglobin, red and white blood cell counts, and packed cell volume, were measured. Blood samples were collected post-feeding, and histological analyses were performed on the intestines and liver to assess tissue health. Enzyme activity assays were conducted to measure glutathione S-transferase and catalase activity. Additionally, plasma cortisol and whole blood glucose levels were analyzed. Biometric parameters such as total length, weight, liver weight, and fillet weight were recorded, along with the calculation of condition factor, hepatosomatic index, dressing index, and fillet weight percentage. Histopathological analysis involved preserving liver and intestine samples, which were then examined under a microscope to assess liver degradation and intestinal health, using metrics such as villi height, goblet cell count, and hepatocyte degradation. Data collected from the experiment were subjected to analysis of variance (ANOVA) test, Duncan Multiple Range Test (DMRT) was used to compare differences among individual means and the data were analyzed using SPSS version 20. Differences were considered significant at 0.05 level (P˃0.05).

**RESULTS**

The feeding trial was carried out to investigate the histopathology, blood and carcass quality of *Clarias gariepinus* post-fingerling fed fresh and dried housefly maggot meal. Proximate analysis shows dry maggot meal contains Moisture (8.40%), Ash (9.30%), Crude Fat (11.70%), Fat/Oil (17.90%), Crude protein (28.80%) and Carbohydrate (23.90%).

**Table 1: Proximate Analysis of Dried Maggot meal**

|  |  |
| --- | --- |
| **Dried Maggot meal** | **Proximate Composition (%)** |
| Moisture | 8.40±0.77 |
| Ash | 9.30±0.73 |
| Crude Fiber | 11.70±1.00 |
| Fat/Oil | 17.90±1.11 |
| Crude Protein | 28.80±0.50 |
| Carbohydrate | 23.90±2.00 |

Values are means ± standard deviation of three (3) replicates

**Table 2: Carcass quality of catfish fed maggot meal**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organ Weight** | **Control Feed** | **Fresh Feed** | **Dried Feed** |
| Total length (TL) (cm) | 19.00a ± 0.00 | 15.90c ±0.00 | 16.00b ±0.00 |
| Total weight (TW) (g) | 316.00 a ± 0.00 | 285.80c ±0.00 | 300.00b ±0.00 |
| Dressed weight (DW) (g) | 213.73a ±0.10 | 204.73c ±0.30 | 207.70b ±0.05 |
| Liver weight (LW) (g) | 18.70 a ±1.00 | 17.00c ± 0.00 | 17.50b ± 0.50 |
| Fillet weight (FW) (g) | 243.00 a ±2.00 | 215.80c ±1.00 | 223.00b ±2.00 |
| Condition factor | 4.67c ±1.00 | 5.68b ±1.00 | 7.32a ±1.20 |
| Hepatosomatic index | 16.89b ±1.10 | 16.81c ±2.00 | 17.14a ±0.70 |
| Dressing index | 1.48a ±2.00 | 1.39c ±1.00 | 1.44b ±0.50 |
| Fillet yield | 1.30c ±0.00 | 1.32b ±2.00 | 1.34a ±1.00 |

Values are means ± standard deviation of three (3) replicates.

Data in the same row bearing different superscript differed significantly (p<0.05).

The table 2 showed the growth response of fish fed maggot meal. Fish on control feed had the highest yield on Total length, Total weight, Dressed weight, Liver weight and Fillet weight and the result is significantly different from other samples (p<0.05). The values for Total length, Total weight, Dressed weight, Liver weight and Fillet weight ranged from 19.00 ± 0.00 to 15.90 ±0.00, 316.00 ± 0.00 to 285.80 ±0.00, 213.73 ±0.10 to 204.73 ±0.30, 18.70 ±1.00 to 17.00 ± 0.00 and 243.00 ±2.00 to 215.80 ±1.00 respectively. Condition factor ranged from 4.67±1.00 to 7.32±1.20, Hepatosomatotic index, 16.81±2.00 to 17.14±0.70, Dressing index, 1.39±1.00 to 1.48±2.00 and fillet yield 1.30±0.00 to 1.34±1.00. The table 3 showed the haematological parameters of fish fed maggot meal. The values for Packed cell volume, Haemoglobin, Red Blood Cell, Liver glycogen and Plasma Glucose ranges from 24.50 ±0.10 to 25.8 ±1.10, 7.80 ±0.10 to 8.83 ±1.00, 2.40 ±2.00 to 2.79 ±1.00, 38.43 ±0.50 to 45.6±1.00 and 76.00 ±2.00 to 89.00 ±1.00 respectively. The values for Catalase and Glutathione S-transferase ranged from 275.93 ±1.00 to 454.02 ±0.50 and 176.33 ±1.00 to 236.88 ±0.50 respectively. The value for White Blood Cell ranged from 16.28 ±0.50 to 18.76 ±2.00.

**Table 3: Hematological Parameters of Fish Fed Maggot Meal**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Control feed** | **Fresh feed** | **Dried feed** |
| Packed cell volume (%) | 25.17b ±1.00 | 24.50b ±0.10 | 25.8a ±1.10 |
| Haemoglobin (g/100ml) | 8.20b ±1.00 | 7.80c ±0.10 | 8.83a ±1.00 |
| Red Blood Cell(g/100ml) | 2.77b ±3.10 | 2.40c ±2.00 | 2.79a ±1.00 |
| White Blood Cell (g/100ml) | 16.28c ±0.50 | 18.76a ±2.00 | 18.70b ±1.00 |
| Liver glycogen (mg/g) | 38.43c ±0.50 | 43.55b ±2.00 | 45.65a±1.00 |
| Catalase (µg/g/1min) | 454.02a ±0.50 | 310.88b ±2.00 | 275.93c ±1.00 |
| Plasma Glucose (mmol/L) | 69.00d ±0.50 | 76.00c ±2.00 | 89.00a ±1.00 |
| Plasma Cortisol (×10ng/ml) | 6.28c ±0.50 | 8.76a ±2.00 | 8.70b ±1.00 |
| Glutathione *S*-transferase (µg/g/1 min) | 236.88a ±0.50 | 188.00a ±2.00 | 176.33b ±1.00 |

Values are means ± standard deviation of three (3) replicates.

Data in the same row bearing different superscript differed significantly (p<0.05).

**Table 4: Intestine histology of catfish fed maggot meal**

|  |  |  |  |
| --- | --- | --- | --- |
| **Intestine histology** | **Control feed** | **Fresh feed** | **Dried feed** |
| Villi length (µm) | 614a ±0.10 | 602c ±1.00 | 611b ±3.00 |
| Villi width (µm) | 83b ±3.00 | 82c ± 2.00 | 84a ±3.00 |
| Goblet cell number | 450c ±1 .10 | 462b ±3.10 | 485a ±3.10 |

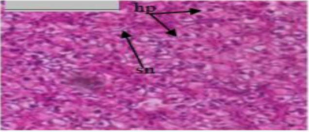
Values are means ± standard deviation of three (3) replicates.

Data in the same row bearing different superscript differed significantly (p<0.05).

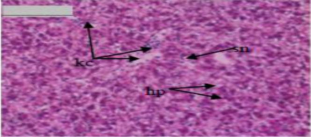
The table 4 shows the intestine histology of fish fed maggot meal. Fish on dry maggot feed meal had the highest yield on Villi width and Goblet cell number and the result is significantly different from other samples (p<0.05). The values for Villi width and Goblet cell number ranged from 82 ± 2.00 to 84 ±3.00 and 450 ±1.10 to 485 ±3.10 respectively. Fish on control feed meal had the highest yield on Villi length and the result is significantly different from other samples (p<0.05). The value for Villi length ranged from 602 ±1.00 to 614 ±0.10.

**Histopathology of Liver**

The FIG 1-2 shows the intestine histology of fish fed maggot. Arrows point to hepatocytes (hp), sinusoids (sn), Kupffer cells (kc) and blood vessels (bv). In the present study, histological changes were also observed in the liver of fish fed with dry and fresh maggot. Severe vacuolation of hepatocytes and mild congestion were seen in fish liver fed with fresh diet (Fig. 2). Also unstained portions showing fat vacuoles were observed in hepatocytes of fish fed with dried maggot (Fig. 2). Vacuolation in hepatocytes with pyknotic nuclei were observed in fish fed on fresh maggot (Fig. 3). He fresh maggot feed caused severe cytoplasmic vacuolation (Fig. 2) while dried maggot feed caused hepatocytes degeneration and mild vacuolation (Fig. 2).



**FIG 1. Liver histology in Control feed fish sample. Scale bar = 100 µm. arrows point to hepatocytes (hp), sinusoids (sn), Kupffer cells (kc) and blood vessels (bv).**



**FIG 2. Liver histology in fresh feed fish sample. Scale bar = 100 µm. arrows point to hepatocytes (hp), sinusoids (sn), Kupffer cells (kc) and blood vessels (bv).**

**DISCUSSION**

The proximate composition of dry maggot meal in this study shows Moisture (8.40%), Ash (9.30%), Crude Fat (11.70%), Fat/Oil (17.90%), Crude Protein (28.80%), and Carbohydrate (23.90%). These results align with the findings of Huis (2013), who reported similar proximate values for maggot meals, underscoring the potential of maggot meal as a valuable alternative protein source in fish nutrition. Other studies, such as those by Makkar et al. (2014), also affirm the high protein and lipid content in insect-based feeds, making them comparable to fishmeal. The study's results on carcass quality demonstrate that fish fed on dry maggot meal exhibited the highest yields in Condition Factor, Hepatosomatic Index (HSI), and Fillet Yield, which were significantly different from other treatments (p<0.05). Fish on control feed, however, had the highest Dressing Index values. This outcome supports the findings of Stamer et al. (2014), who observed superior growth performance and feed utilization in *Clarias gariepinus* when maggot meal was incorporated into their diet. Moreover, reduced feed intake and palatability in fish fed with fresh maggot meal may be attributed to anti-nutritional factors (ANFs), as noted by Kroeckel et al. (2012), who observed similar issues when fishmeal was replaced with alternative protein sources. Fish fed with dry maggot meal showed significantly higher values for Packed Cell Volume, Haemoglobin, Red Blood Cell count, Liver Glycogen, and Plasma Glucose (p<0.05) compared to other samples, suggesting better physiological health and immune response. The results resonate with the findings of Igoche (2015), who reported enhanced haematological profiles in fish fed maggot-based diets. In contrast, fish on control feed had higher values for Catalase and Glutathione S-transferase, while those on fresh maggot meal showed higher White Blood Cell (WBC) counts, indicating stress or disease response, as pointed out by Peter (2002). These variations in blood parameters suggest that dry maggot meal could serve as a sustainable alternative to conventional fishmeal. Histological examination of the intestine in this study revealed that fish fed dry maggot meal had significantly higher villi width and goblet cell numbers (p<0.05), indicating enhanced nutrient absorption and protective mucus secretion. These results are in agreement with Igoche (2015), who reported similar observations in maggot-fed fish, linking increased goblet cell numbers to an immune response against dietary irritants. According to Poleksić et al. (2006), the structural integrity of the intestinal mucosa, submucosa, and muscular layers was maintained, with no observed pathological changes, supporting the idea that maggot meal does not induce adverse intestinal effects.The liver histology showed no significant abnormalities, although fish fed with both dry and fresh maggot meal exhibited slight vacuolization, which could indicate metabolic stress. This is consistent with findings from Parpoura and Alexis (2001), who observed hepatocyte necrosis in fish fed animal protein supplements. Furthermore, Caballero et al. (2004) and Hossain and Jaunecy (1989) reported similar liver pathologies when fish were fed suboptimal diets. The present study underscores the liver's role as an indicator of nutritional adequacy, as suggested by Tacon (1992).

**CONCLUSION**

In summary, the results of this study indicate that dry maggot meal is a promising alternative to fishmeal, with superior effects on fish growth performance, haematological health, and intestinal morphology. The findings align with previous research, such as that of Huis (2013) and Igoche (2015), supporting the potential of maggot meal in aquaculture nutrition. Future studies should focus on optimizing maggot meal inclusion levels to minimize potential anti-nutritional effects and further enhance the performance of fish.

**RECOMMENDATIONS**

**Further Studies on Anti-Nutritional Factors (ANFs):** Future research should focus on identifying and quantifying the types and concentrations of ANFs in maggot meals to better understand their impact on feed intake and nutrient absorption.

**Optimization of Feed Formulation:** To improve the palatability and nutritional balance of maggot-based feeds, blending maggot meal with other ingredients may help mitigate the effects of ANFs and enhance feed intake.

**Scaling Up Production:** Efforts should be made to scale up the production of dry maggot meal for commercial use in aquaculture, given its proven efficacy as a fishmeal substitute.

**Nutritional Safety for Other Species:** Additional studies are recommended to assess the nutritional safety and efficacy of maggot meal across a broader range of fish species, particularly in high-value aquaculture sectors.

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