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Full Length Research Article

Carcass and Organ Quality of Broiler Chickens Fed with Black Soldier Fly Larva Meal

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Abstract

The effect of black soldier fly larvae meal (BSFLM) inclusions on the carcass and organ quality of broiler chickens was studied using eighty-one, 2-weeks old *Arbor acres* chicken strain procured from May Farms, Gombe. The BSFL were collected from chicken wastes and waste and spoilt watermelon and pineapple fruits. They were oven dried, analysed on Dry matter basis and milled using local milling machine and incorporated into poultry diets by replacing dietary fishmeal at 0% (Control, A), 50% (B) and 100% (C). Twenty-seven birds were randomly assigned to each of the dietary treatments at the rate of nine birds per replicate and three replicate per treatment in a completely randomized design. The birds were randomly allotted into pens demarcated with plywood. The birds were fed the experimental diets throughout the six weeks period of the experiment and were subjected to similar managerial and dietary conditions. After six weeks of the experiment, carcass quality and organ weight measurements were analysed using appropriate statistical analysis. The result obtained showed that birds subjected to Treatment C attained significantly ($P \leq 0.05$) higher body weight (2356.20±34.36 g), de-feathered carcass weight (2130.30±47.38 g), eviscerated carcass weight (1853.70±24.11) and weights of carcass cut-up parts compared to those on Treatments B and A. Moreover, the weights for all these characteristics showed significant improvement ($P \leq 0.05$) with increase in the level of BSFLM from treatment A (0% BSFLM) to treatment B (50% BSFLM) and then to treatment C (100% BSFLM). The result revealed that insect meal specifically BSFLM can effectively replace fishmeal as a major protein source in poultry feed formulation.

Keywords: *Arbor acres*, BSFLM, carcass weight; cut-off parts; internal organs weight; Insect protein

Introduction

With the rapidly increasing population in Nigeria, meeting the demand for animal protein has become a challenge. Despite efforts to enhance animal protein availability through improved management and feeding of conventional animals, the available resources remain insufficient (Okeke and Mogbo, 2013). Broiler chicks' production has been identified as a viable means of achieving sustainable and rapid production of high-quality animal protein. However, the cost of concentrates made from plant and animal origins makes poultry production uneconomical, hence there is a shortage of animal protein in the diets of many Nigerians (Amobi *et al*., 2024).

Feed is the major input, and feed cost is the major constraint in poultry production (Suarez *et al*., 2009). Researchers have suggested using feeds with low levels of fishmeal and high levels of less expensive, high-quality plant protein sources as a solution to reducing production costs and increasing profitability (Amobi and Ebenebe, 2018a, b). Insect meals, which have appreciable high-quality protein, could be used as a sustainable source of protein in feed formulation for poultry production. Despite this, farmers are yet to adopt such meals fully into feed formulation which could be as result of lack of awareness (Amobi *et al*., 2020; 2024).

Black soldier fly larvae meal (BSFLM) has been identified as an economically convenient alternative protein for commercial poultry production (Okpoko *et al*., 2023). It is a safe product that contains natural anti-microbial polypeptides to control infections or diseases (Ushakova *et al*. 2016). BSFL has been confirmed to be a valid alternative protein source and sustainable feed ingredient for chicken production (Seyedalmoosavi *et al*., 2022; Salaahuddin *et al*., 2024; Fiorilla *et al*., 2024 & Purnamasari *et al*., 2024). This study aimed to assess the effect of BSFL meal inclusion in feed formulation of broiler chicken on its carcass and organ weight performance.

Materials and method

Experimental site

The study was carried out in a mini-animal house at Federal Low-cost Gombe, located on Longitude 10°17'0" N, 11° 10'0" E, Gombe Local Government Area, Gombe State (Oruonye *et a*l. 2016).

Experimental Design

Three formulated broiler starter diets were used for the experiment designated as Treatment A, Treatment B and Treatment C. Treatment A (T1) which served as control had 100% conventional feed and 0% black soldier fly larva meal. Treatment B (T2) contained 50% black soldier fly larva meal and Treatment C (T3) contained 100% black soldier fly larva meal. The experiment followed a 1 × 3 factorial arrangement in a Completely Randomized Design (CRD) whereby each experimental unit was replicated three times. Each treatment level comprises 27 birds and 9 birds per replicate.

Ethical Approval

This work followed ethical approval and consent for the use of animals for research purposes. The ethical approval (Ref No: FUK-AEC/2025/004) was obtained from Animal Ethical Committee, Federal University of Kashere, Gombe.

Procurement and acclimatization of the birds

The experimental birds, consisting of 81 *Arbor acre* broiler chicks aged two weeks were procured from May farm in Gombe. To minimize transit stress, the birds were packed into a ventilated box (1m × 1m) and transported via vehicle by 6.00am hours of the morning. Upon arrival, the birds were given 4 litres of glucose water to help alleviate the stress. Brooding was carried out for two weeks, with heat supplied by a charcoal stove under a metal hover supplemented with an electric bulb. Tarpaulin sheets were also used to cover the wire netted walls of the building to prevent cold temperatures during brooding. The birds were provided with uniform management conditions in terms of feed quantity, watering, vaccination, medication, and sanitary conditions, with the only source of variation between the replicates being the feed offered. The feeding trial continued for six weeks.

Source of the Black Soldier flies Larva and processing

The Black Soldier Fly Larvae (BSFL) were collected from chicken wastes and poultry droppings. Then the harvested BSFL were oven dried at a temperature of 50C^{o} until they were dried and crispy and was then analysed for proximate composition based on dry matter basis, and then milled with other feed ingredients using milling machine of the brand name Maxson (Model A2, Benin, Nigeria) to formulate the broiler starter diets using Pearson square method (Amobi and Ebenebe, 2018a).

Feed Formulation for the experimental birds

The milled BSFL and other experimental ingredients were analyzed for proximate composition in accordance with the standard of the Association of Official and Analytical Chemist (AOAC. 1990). Three diets were formulated: Treatment A which serve as control had no BSFL meal (0%) and 100% fishmeal, Treatment B contained 50% BSFL meal and 50% fishmeal while Treatment C contained 100% BSFL meal and 0% Fishmeal.

Table 1: Composition percentage of the experimental feeds

Ingredients	Treatment A	Treatment B	Treatment C
Maize (g)	47.0	47. 0	47.0
Wheat offal (g)	16.0	15.0	15.0
PKC (g)	22.78	22. 78	22.78
Fishmeal (g)	10.0	5.0	–
BSFL meal (g)	–	5.0	10.0
Bone meal (g)	3.0	3.0	3.0
Lysine (g)	0.2	0.2	0.2
Methionine (g)	0.25	0.25	0.25
Premix (g)	0.25	0.25	0.25
Salt (g)	0.3	0.3	0.3
Enzyme (g)	0.2	0.2	0.2
Toxynil (g)	0.02	0.02	0.02
Total	**100**	**100**	**100**

*** 1 kg of premix contains: vitamins A (5,000,000 I.U),Vitamin D3 (1,000,000 I.U), Vitamin E (16,000 mg),Vitamin K3 (800 mg), Vitamin B1 (1,200 mg), VitaminB2 (22,000 mg), Niacin (22,000 mg), Calcium pantothenate (4,600 mg), Vitamin B6 (2,000 mg), VitaminB12 (10 mg), Folic acid (400 mg), Biotin (32 mg), Choline chloride (260,000 mg), Manganese (948,000 mg), iron(40,000 mg), Zinc (32,000 mg), Copper (3,400 mg),Iodine (600 mg), Cobalt (120 mg), Selenium (48 mg), Anti-oxidant (48,000 mg).**

Housing and Feeding of Experimental Animal

The experimental birds were randomly assigned to each of the nine brooding pens created by demarcating the brooder house using sealing boards. Each pen measuring 2.6m × 3m housed nine (9) birds in each of the three replicates representing the dietary treatments. The birds were given the formulated diets at 7.00am in the morning and 7.00pm in the evening and water using clean feed and watering trough. The birds were given 180g of the formulated feed per treatment. Sixty (60) watt bulb were used to supply light at night through electricity to provide illumination for continuous feeding.

Data collection

After the six-week experiment, two birds from each replicate were selected at random to undergo evaluation for carcass, carcass cut-ups, and organ weight. Prior to the evaluation, the birds were starved overnight, while ad-libitum water was made available to them. The weight of the birds was taken before they were slaughtered through the severing of the jugular vein, and they were allowed to bleed thoroughly based on the methods recommended by Amobi and Ebenebe, 2018b. The birds were then subjected to scalding at 75ºC in a water bath for approximately 30 seconds, after which they were de-feathered. The dressed chickens were subsequently eviscerated and weighed. The wings were removed through anterior cutting at the humero-scapular joint, with cuts made through the rib head to the shoulder girdle. The back was removed intact by pulling anteriorly. Using a sensitive weighing balance (Camry EK 5055: Zhongshan Camry Electronic Co. Ltd, Zhongshan China) in grams, the wings, thighs, breast, and organs were harvested from each carcass and weighed separately. The weight of the carcass and body organs were recorded on a fresh basis.

Statistical Analysis

The collected data were summarized and subjected to one-way analysis of variance (ANOVA) using IBM SPSS (version 26) and the differences between treatments means were separated using Least Significance Difference (LSD) at 95% confidence level.

Results

Table 2 presents the proximate composition of the black soldier fly larva (BSFL) meal, while **Table 3** show the composition and proximate composition of the experimental diets, respectively. The effect of black soldier fly larva meal on the carcass weight (g) and cut-up parts (g) in broiler chickens is shown in Table 4, while the effect on organ weights (g) is shown in Table 5. The chicks under treatment C had the highest mean defeathered weight (2130.30g ± 47.38) followed by treatment B (1820.40g ± 11.51), while the lowest was observed in treatment A (1677.20g ± 14.63). Statistical analysis revealed a significant difference ($P<0.05$) in the means of defeathered weight (Table 4) between the treatment groups. In addition, a significant difference ($P<0.05$) was observed in the eviscerated weight (g) of birds subjected to the three dietary treatments (Table 5). The chickens under treatment C had the highest mean eviscerated weight (1853.70 ± 24.11), followed by treatment B (1677.00g ± 14.44), while the lowest was recorded in the birds under treatment A (1300.10g ± 25.29).

Table 2: Proximate composition analysis of BSFL Meal in % DM basis

Component	Nutrient composition
Dry matter	172 ± 2.10

Crude protein	42.70 ± 0.50
Crude fat	16.20 ± 1.00
Ash	6.40 ± 2.00
Metabolic energy (kcal)	688.42 ± 4.50

Table 3: Proximate Composition of Experimental diets (Starter feeds) in %DM basis

Parameters	Treatment A	Treatment B	Treatment C
Crude protein	20.01± 0.42^{c}	20.10± 0.50^{a}	20.09± 30^{b}
Moisture	8.40± 0.35^{c}	9.01± 0.40^{b}	9.15± 0.50^{a}
Crude fibre	5.40± 0.40^{a}	4.10± 0.30^{b}	4.05 ± 0.20^{c}
Crude fat	7.10 ± 1.00^{c}	8.10 ±1.20^{b}	8.25±1.00^{a}
Ash	6.80 0.50^{a}	6.80±0.45^{a}	6.80 ± 0.25^{a}

**means with different superscript in a row are significantly different (p<0.05).

Table 4: Effect of black soldier fly larva meal on carcass weights (g) and Cut-up parts (g) in broiler chickens

Parameters	Treatment A	Treatment B	Treatment C
Live weight	2091.10^{c} ± 47.08	2260.30^{b} ± 30.46	2356.20^{a} ± 34.36
De-feathered weight	1677.20^{c} ± 14.63	1820.40^{b} ± 11.51	2130.30^{a} ±47.38
Eviscerated weight	1300.10^{c} ± 25.29	1677.00^{b} ±14.44	1853.70^{a} ± 24.11
Head	48.70^{c} ± 0.35	53.40^{b} ± 2.11	58.13^{a} ± 1.27
Drumstick	368.43^{c} ± 0.84	389.53^{b} ± 6.18	405.67^{a} ± 7.43
Wing	138.70^{c} ± 0.68	143.33^{b} ± 0.44	147.20^{a} ± 1.11
Neck	64.70^{c} ± 0.32	68.46^{b} ± 0.98	70.76^{a} ± 0.85
Shank	60.86^{c}± 0.44	62.80^{b} ± 0.30	65.16^{a} ± 0.60
Breast	538.57^{c} ± 1.78	579.13^{b} ± 4.78	600.43^{a} ± 6.08

**means with different superscript in a row are significantly different (p<0.05).

Table 5: Effect of Black soldier fly larva meal on organ weights (g) in broiler chickens

Parameters	Treatment A	Treatment B	Treatment C
Lungs	7.10^{c} ± 3.25	12.06^{b} ± 0.94	13.63^{a} ± 0.73
Liver	37.33^{c} ± 1.04	41.07^{b} ± 0.81	42.66^{a} ± 0.75
Oesophagus	3.70^{c} ± 0.15	4.26^{b} ± 0.29	4.90^{a} ± 0.20
Heart	7.06^{c} ± 0.29	7.16^{b} ± 0.60	8.73^{a} ± 1.13
Pancreas	2.30^{c} ± 0.15	3.03^{b} ± 0.26	3.73^{a} ± 0.30
Intestine	157.30^{c} ± 3.62	152.87^{b} ± 6.37	154.33^{a} ± 6.64
Crop	13.23^{c} ± 0.08	13.86^{b} ± 0.18	14.90^{a} ± 0.10
Spleen	3.10^{c} ±0.05	3.80^{b} ± 0.12	4.50^{a} ±50
Kidney	2.30^{c} ± 0.152	2.80^{b} ± 0.12	3.30^{a} ± 0.62
Gizzard	64.43^{c} ± 0.71	67.73^{b} ± 0.48	69.33^{a} ± 0.70

**means with different superscript in a row are significantly different (p<0.05).

Discussion

The results showed that treatment C had the highest mean defeathered weight, followed by treatment B, while treatment A had the least. These findings support those reported by Fiorilla *et al* (2024) on the linear increase in carcass weight of broiler chickens with the replacement of fishmeal with insect-based feeds. The mean eviscerated weight of

birds was also highest in treatment C, followed by treatment B, and least in treatment A (Table 4). This result was consistent with previous studies that showed an increase in carcass weight with increased dietary levels of black soldier fly larvae meal (Okpoko *et al*., 2023; Salahuddin *et al*., 2024 and Purnamasari *et al*., 2024) and African palm weevil larvae and winged termite meals (Amobi and Ebenebe, 2018b). The impressive result recorded could be as a result of the high digestibility and bioavailability of nutrients of the BSFL meal.

Furthermore, significant differences were observed in the weights of the cut-up parts of the broiler chickens under different feeding treatments. Treatment C had the best performance, followed by treatment B, while the control feed had the least (Table 4) which reveals that the BSFL meal did not enhanced feathering at the expense of fleshiness and also improved the gut microbiota in the chickens. This result agreed with previous findings on the linear increase in the weights of cut-up parts of broilers with increased dietary levels of Black solider fly larvae meal (Salahuddin *et al*., 2024 and Purnamasari *et al*., 2024). The insect-based feeds did not negatively affect the fleshiness of the chickens, as observed in the control diets (Amobi and Ebenebe, 2018b).

In addition, significant differences were observed in the weights of the internal organs of the broiler chickens under different feeding treatments. Treatment C had the best performance, followed by treatment B, while the control feed had the least (Table 5). The increase in the weights of the internal organs in treatments C and B could be due to the increase in the metabolic activities of the birds. These results are consistent with the findings of previous studies on the effects of insect-based feeds on broiler chickens (Seyedalmoosavi *et al*., 2022; Fiorilla *et al*., 2024 and Purnamasari *et al*., 2024), who also reported that the increased level of Black solider fly larvae meal inclusions on chicken's diets results in increase in the weight of internal organs of the birds.

Conclusion

The research findings indicate that the organ weight and carcass qualities of broiler chickens significantly increased when the birds were subjected to 100% Black solider fly larvae meal inclusion levels. This shows that BSFL is a nutritious and reliable feed ingredient for broiler chicken production.

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Authors contributions

MIA contributed in the Research design, Introduction and compilation of the Research result. SY contributed in developing the Literature review and the Materials and methods. DA contributed in running the statistical analysis.

Conflict of interest

The authors hereby declare that there is no conflict of interest

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References

Amobi, M.I., Adamu, D., Okpoko, V.O., Yusuf, S and Adike, J.I (2024). Growth performance of Broiler Chickens fed on black soldier fly larva meal inclusions. *Cavendish*

International Journal of Science and Technology (CIJST), 1(1): 18 – 22

Amobi, M. I. and Ebenebe, C.I. (2018a). Performance of broiler chicks fed on two insects based-diets in South Eastern Nigeria. *Journal of Insect Food & Feed,* 4(4): 263-268.

Amobi, M. I. and Ebenebe, C. I . (2018b). Quality of the carcass and organs of chicken fed with two different insect meals. *Journal of Insects Food & Feed,* 4(4): 269-274.

Amobi, M.I., Saleh, A., Okpoko, V.O and Abdullahi, A.M (2020). Growth performance of broiler chickens based on grasshopper meal inclusions in feed formulation. *The Zoologist*, 18: 39 – 43.

Fiorilla, E., Gariglio, M., Gai, F., Appolito, C., Dabbou, S., Mangiagalli, M and Garavaglia, M (2024). Black solider fly larvae: a one health approach to investigate gut and organ health and meat quality response in slow-growing chickens. *BMC Veterinary Resource*, 20: 580

Okeke, J.J. and Mogbo, T.C. (2013). Comparative growth performance of grasscutter fed with diverse food stuff in captivity. *International Journal of Advanced Biological Research*, 3 (1), 85– 89.

Okpoko, V.O., Ebenebe, C.I., Okeke, J.J., Utor, B.G., Amobi, M.I., Asolo, C.H., Okoji, C.N and Adipere, E (2023). Effect of Black soldier fly larvae as a meal on proximate composition and carcass quality of African Catfish (*Clarias gariepinus*). *International Journal of Research, Innovation and Applied Science*. DOI:10-51584 8(2): 35 – 42

Oruonye, E., Iliya, M. and Ahmed, Y. 2016. Sustainable Mining practices in Nigeria. A case study of Maiganga coal Mining in Gombe state. *International Journal of Poultry & Soil Science* 11: 1-9.

Purnamasari, D.K., Syamsuhaidi, S and Ryan, A.P (2024). Black soldier fly larvae: Cultivation and its potential as an alternative protein source for poultry. *Livestock Research for Rural Development*, 2: 36

Salahuddin, M., Ahmed, A.A., Kohzy, H., Jeffery, K.T., Daylan, L and Jayant, L (2024). Flight towards sustainability in poultry nutrition with Black soldier fly larvae. *Animals*, 14(3): 510

Seyedalmoosavi, M.M., Mielenz, M., Veldkamp, T., Das, G., Metges, C.C (2022). Growth efficiency, intestinal biology and nutrient utilization and requirements of black soldier fly larvae compared to monogastric livestock species. A review. *Journal of Animal Science and Biotechnology* 13:31

Ushakova, N., Bastrakov, A., Kozlova, A., Ponomarev, S. Bakaneva, Y. M., Fedorovykh, Y. V., Zhandalgarova, A and Pavlov, D (2016). Features of the effect of a complex probiotic with Bacillus bacteria and the larvae of *Hermitia illucens* biomass on Mozambique tilapia (*Oreochromis mossambicus x O. niloticus*) and Russian sturgeon (*Acipenser gueldenstaedt*). Biology Bulletin 43 (5), 450 – 456.