



CARCASS AND ORGAN CHARACTERISTICS OF ROSS 308 BROILER CHICKENS FED BLACK SOLDIER FLY LARVAE MEAL

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ABSTRACT

The study investigated the effect of feeding black soldier fly larvae meal (BSFLM) as a substitute for soybean meal (SBM) in broiler finisher diets on the carcass and organ characteristics of Ross 308 broiler chickens. A total of 120 broiler chicks were randomly assigned to five treatments with eight birds per replicate. The BSFLM was incorporated into the diets at 0% (control, T1), 25% (T2), 50% (T3), 75% (T4) and 100% (T5) on a protein basis. The birds were subdivided into three replicates of eight birds each in a Completely Randomized Design arrangement. At the end of eight weeks feeding trial, 2 birds per replicate were randomly selected according to average group weight and slaughtered for carcass and organ evaluation. The results demonstrated that carcass yield parameters, including breast, drumstick, thigh, and back weights, were significantly improved ($P < 0.05$) in birds fed BSFLM. The wing weights were significantly ($P < 0.05$) higher in T2 and T4 when compared with the 100% inclusion level. The shank weights were not significantly different ($P > 0.05$) within all the treatment means. The large intestine was significantly ($P < 0.05$) influenced when birds were fed diets with T2 and T4. The weight of the gizzard was similar across all treatments except for T5. It was observed that birds fed BSFLM diets elicited better cut part weights. Therefore, black soldier fly larvae meal improved carcass and organ characteristics of ROSS 308 broiler finishers without any adverse effect and 75% inclusion gave an optimum performance on carcass and organ traits.

Keywords: Larvae, Carcass, Organ, ROSS 308, Broiler, Soybean

INTRODUCTION

Poultry production has proven to be the most economically sustainable production and also of great nutritional benefits to consumers (Butani *et al.*, 2024). Although due to high market demands, the poultry production faces increasing challenges as regards to sustainability, cost of production, environmental impact and others so the search for alternative feed sources has greatly intensified (Butani *et al.*, 2024). Fish meal is the most significant source of traditional animal protein in developing countries. It can increase the omega-3 content in poultry products. However, the limitation in availability and the fluctuation of fish meal and soybean meal prices entices the demand for alternative feed ingredients (Huber *et al.*, 2018). Insects could be a potential replacement of protein rich ingredients in poultry diets. The Black Soldier Fly larvae (BSFL; *Hermetia illucens*) are known for their suitability for mass production and a nutrient composition allowing them to be used especially in monogastric animal feed (Alagappan *et al.*, 2022). Black soldier fly larvae also have the capacity to reduce the amount of organic waste sent to landfill, and are a potential alternative feed ingredient in different monogastric animal diets including poultry, pigs, fish, and dogs (Lei *et al.*, 2019). The BSFLM contains consistent essential amino acids and fatty acids when grown in diverse substrates (Gasco *et al.*, 2018). These larvae are rich in protein, essential amino acids, and healthy fats, making them an excellent ingredient for animal feed, particularly for broiler chickens (Larouche *et al.*, 2019). The BSFL can be used live, chopped, dried or in ground forms. Black soldier fly larvae possess a good amount of saturated and unsaturated fatty acid to meet the nutritional requirement of poultry (Larouche *et al.*, 2019). The nutritional value of BSFL makes it an excellent attractive feed ingredient



especially with its high source of protein, fat, calcium, amino acids (Ewald *et al.*, 2020). The BSFL as an alternative ingredient into feeds for broiler chickens is to obtain proper nutritional value of the chickens which will aid in the enhancement of their carcass weight, proper feed intake and overall health benefits (Ewald *et al.*, 2020). Hence this study focuses on the carcass and organ characteristics of Ross 308 broiler chickens fed black soldier fly larvae meal.

MATERIALS AND METHODS

Study Area

This study was conducted at the poultry unit of the Teaching and Research farm of the Faculty of Agriculture and Agricultural Technology, Benson Idahosa University, Benin City, Edo State. The region is situated in the southern geopolitical zone of Nigeria, with longitudes 5° 04' and 6° 43' east and latitudes 5° 44' north and 7° 34' north of the Greenwich Meridian. (NAA, 2014).

Preparation of Diets

All feed ingredients were obtained from local reputable animal feed dealers. However, black soldier fly larvae were reared at Benson Idahosa University using fecal matter as the feed substrate. The larvae were harvested and sundried for 14 days. The dried larvae were then ground into powder. The powder was then mixed with other raw materials to formulate five isonitrogenous diets (22% CP) and isocaloric (3000 Kcal/kg metabolizable energy) such that BSFLM substituted SBM at 0% (T1) – control; 25% (T2); 50% (T3); 75% (T4); and 100% (T5) on crude protein basis (Table 1).

Table 1. Gross Composition of Finishers' Diet

INGREDIENTS	T1 0% (Control)	T2 (25%BSFL)	T3 (50%BSFL)	T4 (75%BSFL)	T5 (100%BSFL)
Maize	50.60	50.60	50.60	50.60	50.60
Soybean meal	25.00	18.75	12.50	6.25	1.00
BSFL	0.00	6.25	12.50	18.75	25.00
Fishmeal	6.00	6.00	6.00	6.00	6.00
Wheat Offal	10.00	10.00	10.00	10.00	10.00
Soya Oil	3.00	3.00	3.00	3.00	1.00
DCP	0.20	0.20	0.20	0.20	0.20
Bone Meal	4.00	4.00	4.00	4.00	5.00
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.20	0.20	0.20	0.20	0.20
TiO ₂	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients					
ME(Kcal/kg)	3002.09	3050.90	3099.72	3148.53	3050.14
CP (%)	21.37	21.56	21.75	21.94	22.56
CF	4.05	4.05	4.11	4.13	4.23
Ash	3.69	4.83	5.97	7.11	8.31
Ether Extract	3.98	3.98	6.58	7.88	9.22

Composition of vitamin premix per kg of diet: vitamin A, 12500 I.U; vitamin E, 40mg; vitamin K3, 2mg; calcium pantothenate, 11.5mg; vitamin B6, 5mg; vitamin B12, 0.025mg; SBM:Soyabean mmeal, BSFLM: lack soldier fly meal, DCP:Dicalcium phosphate; BSFLM-Black soldier fly larvae meal; DC-Dicalcium Phoshate.

Management of Experimental Birds and Design

A total of one hundred and twenty (120), day- old ROSS 308 birds were used for the experiment. They were randomly sub-divided into five (5) dietary treatments of three replicates, with 8 birds each in a completely randomized design. Feed and water were given to the birds' *ad-libitum*. Lighting source was provided using electricity bulbs during the night. The birds were administered anti-stress and vitamin/mineral premix orally at the recommended dosage after randomization before the commencement of the experiment. The birds were reared on deep litter in an open-sided wire mesh constructed poultry house to allow for adequate ventilation. Medications, vaccinations and other routine management practices were strictly followed.

Evaluation of Carcass Quality

At the end of the 8 weeks feeding trial, 2 birds per replicate were randomly selected with their live weight taken before carcass evaluation after fasting them for 16 hours. The birds were slaughtered and their internal organs were neatly and carefully removed and weighed, also followed by the cutting of the carcass into retail parts and weighed as well. Dressed weight were also recorded after evisceration. The weights were expressed as percentages of dressed weight.

RESULTS AND DISCUSSION

Carcass Characteristics

The live weight varied but not significantly ($P>0.05$) across the dietary treatment groups, except for dressing percentage, which was significantly ($P>0.05$) reduced in T5. Cut parts weight that differs significantly ($P<0.05$) among the treatment groups were breast, drumstick, thigh, and back weights. The wing weights were significantly ($P<0.05$) higher in T2 and T4 when compared with the 100% inclusion level, whereas the shank and neck weights were not significantly different ($P>0.05$) within all the treatment means. The large intestine was significantly ($P<0.05$) influenced when birds were fed diets with T2 and T4. The weight of the gizzard was similar across all treatments except for T5. It was observed that birds fed BSFLM diets elicited better cut part weights.

Table 2. Carcass Characteristics of Broiler Finisher Fed Black Soldier Fly Meal based Diets

Parameters	T1 0%(Control)	T2 (25%BSFL)	T3 (50%BSFL)	T4 (75%BSFL)	T5 (100%BSFL)	SEM
Live wt. (g/bird)	1038.00	1300.00	1015.00	1079.00	1267.00	133.80
Dressed wt. (%)	80.15 ^b	71.82 ^{ab}	82.54 ^b	82.83 ^b	52.08 ^c	8.36
Cut Parts (G)						
Breast	248.30 ^b	248.00 ^b	255.70 ^b	259.30 ^b	143.00 ^a	18.72
Drumstick	127.30 ^b	136.00 ^b	108.70 ^b	131.00 ^b	80.30 ^a	8.39
Thigh	121.70 ^b	127.70 ^b	121.00 ^b	134.70 ^b	84.30 ^a	7.31
Wing	112.00 ^b	108.70 ^b	99.30 ^{ab}	108.30 ^b	76.70 ^a	8.15
Shank	53.00 ^{abc}	59.00 ^{bc}	48.33 ^{ab}	61.33 ^c	42.00 ^a	3.63
Organ Weights (G)						
Small intestine	68.00	97.67	93.00	87.00	83.67	9.71
Large intestine	44.33 ^b	42.33 ^b	36.33 ^{ab}	43.00 ^b	29.67 ^a	2.92
Gizzard	31.00 ^{ab}	32.67 ^{ab}	32.67 ^{ab}	34.33 ^b	26.33 ^a	2.31

BSFLM: Black Soldier Fly Larvae Meal, Live wt.: Live weight, Dressed wt.: Dressed weight

Carcass traits in chickens are influenced by genetic selection for growth rate and meat production (Kanlisi *et al.*, 2024). The study demonstrated a positive correlation between the concentration of Black Soldier Fly Larvae Meal (BSFLM) in the diet and an increase in organ weight. This could be attributed to the increased work performed by these organs, leading to hypertrophy, is likely due to the inclusion levels of BSFLM-based diets (Abd El-Hack *et al.*, 2020). It is almost worth



nothing that the lower dressed weight observed were in birds fed diet 5 (T5). This could be related to several factors like the random selection of birds for slaughter might have resulted in the selection of individual birds with lower body weights which contributed to the lower dressed weight recorded (Sumbule *et al.*, 2021). Additionally, metabolic differences and variations within the same strain could also explain the discrepancy, as reported in previous studies by (Sumbule *et al.*, 2021). An increase in organ weight with increasing levels of BSFLM, in the diets was observed. The increase in gizzard may be due to the bulkiness of the diets containing BSFLM, hence the bigger volume of the gizzard (Oluokun, 2000). The results are consistent with (Fathalla *et al.*, 2015) who reported an increase in gizzard and heart weight. This is attributed to an increased amount of work performed by these organs as a result of increased fiber digestion leading to organ hypertrophy (Molist *et al.*, 2009). According to Fernandes *et al.* (2013), the improvement in carcass characteristics of broiler breeds in recent decades has been pronounced, resulting in substantial genetic gains. Particularly of importance is the yield of the breast and shank, since they are the most expensive cuts as they are well paid for in the market (Fernandes *et al.*, 2013). The dressed weight was highest in birds fed treatments 1-4 which substantiate the findings of (Heita *et al.*, 2023) where they observed that the dress-out percentage was highest in birds fed BSFLM diets.

CONCLUSION AND RECOMMENDATION

The study demonstrated that replacing soybean meal (SBM) with black soldier fly larvae meal (BSFLM) in broiler finisher diets significantly improved carcass yield parameters such as breast, drumstick, thigh, and back weights without adverse effects on organ characteristics. Inclusion levels up to 75% produced the best performance in carcass and organ traits, indicating that BSFLM is a viable and sustainable alternative protein source for broiler production. It is therefore recommended that BSFLM can safely replace up to 75% of soybean meal protein in broiler finisher diets to enhance carcass quality and overall production efficiency. Further studies should, however, investigate its economic implications, nutrient digestibility, and impact on meat quality and consumer acceptability. However, more research is needed on the optimal inclusion levels.

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