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Performance of Spring Chicken Fed Different Inclusion Levels of Black Soldier Fly Larvae Meal

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Abstract

This study was proposed to infer on the growth parameter in spring chicken fed black soldier fly larvae meal (BSFLM) then examine meat characteristics using four levels of diet 0% control, 5%, 7.5% and 10% inclusion, with 96 day-old Cobb chicks (CP 747). Larvae was propagated at the University Putra Malaysia poultry farm (Ladang II) using coconut Waste as substrate, within one month period. The chicks were fed for 26 days, where Growth performances; carcass and meat quality parameters were assessed. The data were analyzed using statistical analytical tool SAS 9.4 version, 2014 window. Means comparison was carried out through Duncan multiple range test. The performance results showed that body weight gain showed similarities (P<0.05), except control (0%) 112.32g, whilst 5%, 7.5% and 10% levels were 207.69 g, 228.40 g & 251.64 g, respectively. Feed intake with 5% (253.48 g) as the least after control 0% (146.85 g), and 463.68 g for 10% as the highest (P<0.05). Final body weight differ significantly (P<0.05) and feed conversion ratio also recorded (P<0.05) where 5% level has dramatically secured outstanding result of 1.24, then 1.31 (0%), 1.78 & 1.86 for (7.5% & 10%) accordingly. However, carcass analysis revealed that only thigh and liver have significantly varied (P<0.05) amongst the treatments level, but the remaining cuts (carcass weight, dressing percentage, breast weight, drum stick, wings and gizzard) were statistically similar (P>0.05). Equally, meat quality parameters indicated no significant difference (P>0.05) except pH. Finally the outcome of the study suggested overall performance was encouraging at lower inclusion levels having the least and feed conversion ratio 5% 1.24 vs. control 0%, 7.5% & 10%, respectively, this recommends that soldier fly larvae meal most economically good and effective performance at 5% inclusion. Therefore, black soldier fly larvae meal shows positive effect on weight gain and can be used successfully without fear of side effect in both the spring chicken and broiler performance, especially at starter level.

Keywords: BSFLM; Inclusion levels; Growth performance; Spring chicken

Introduction

There are still much more unexhausted research work on the potentials and suitability of dipteran, particularly the black soldier fly larvae, on rearing chicks and broiler chicken [1-5]. Several literature showed variably larvae meal replaced either soy meal or fish meal at different level of inclusion, ranging from 0.23% to 100% [6]. However, the majority of these publications like [3] fed larvae meal on broiler chicken production, [7] juvenile turbot, and Rainbow trout by [8]. Therefore, replacing soy meal and fishmeal with black soldier fly larvae meal has become a cosmopolitan practice in poultry and other fields of livestock production. The current research focused on the most appropriately and economic level of inclusion of BSFLM in spring chicken nutrition through feeding trial carried out using broilers cobb 747. Spring Chicken – Are young chicken having tender meat or is a young chicken, especially broiler or fryer Gallus gallus chicken - a domestic fowl bred for meat or eggs; believed to have been developed from jungle fowl [9]. Spring chicken usually qualifies with a word Poussin, occasionally called coquelet, which is referring to a young chicken of less than 28 days old at slaughter and regularly weighs 400–450 g but not more than 750 g or weighing 750–850 g. A Poussin must have a carcass weight not exceeding 750 g or not be more than 28 days old at slaughter. Information concerning spring chicken is yet primitive and very scarce especially production literature, however, scanty information may be obtained from catering aspect, foods and recipe menus. Consequences to lected works on the continuous population upsurge and subsequently the demand pressure on protein sources of food will extend up to 70% or more feed, in forth coming 25-35 years, as anticipated by United Nations/Food and Agriculture Organization (UN & FAO), especially in developing countries [10]. By these, it means that there would be additional stress on cropping lands, animal protein and fish products due to the need and increased income in conjunction with human preference [11,12]. This has tallied compatibly with recent revolution for larvae farming operation in different parts of the world, few examples include "Ynsect" near Paris, another in Cape Town, South Africa "Agriprotein" and "Enterra Feed Corporation" Vancouver, southwestern British Colombia and Ohio US, called "Enviro Flight" which at the current situation are capable of daily larvae production of about 380 kg to 20 tons and projected production of black soldier fly larvae coupled with mealworms, lastly" Protix Biosystems" a Dutch-based maggot meal production firm also planned for extension of SFL farming and larvae fat extraction for animal/pets' food industries [12].

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Material and Methods

Experimental Animals and the Diets

A day old unsexed ninety six (96) Cobb broiler chicks were randomly assigned with four levels of treatment diets using a completely randomized design. The treatment diets were formulated such that T1 T2 T3 and T4 diet, T1 stands as the control, while T2, T3 and T4 contained 5%, 7.5% and 10%, respectively, of bsflm as illustrated in Table 1. The Experimental chicks were grouped into four replications of six chicks per group. The experimental diets and water were provided ad libitum for the whole experimental session and then terminates at 26d. In this study, single combined vaccination was administered at 100first week (New Castle Disease Vaccine and bronchitis vaccine). All other routine managerial practices were duly observed throughout the experimental period. This arrangement and procedure was closely alike to that reported by [13].

Ingredients	10% (T4)	7.5% (T3)	5% (T2)	0% (T1)
Corn	55	55	53.7	56
Soybean meal	23.5	25	31	32.4
Wheat bran	4	3.2	1.5	3.5
Bsf larvae	10	7.5	5	0
Palm oil	4	5	4.5	4
DiCalcium phosphate	1	1	1.3	1.2
Limestone	0.5	0.5	1	1.3
Vitamin premix[1]	0.3	0.3	0.3	0.3
Mineral premix[2]	0.3	0.3	0.3	0.3
Lysine	0.5	1.3	0.5	0.3
Methionine	0.5	0.5	0.5	0.3
Salt	0.4	0.4	0.4	0.4
TOTAL	100	100	100	100
Chemical Composition				
Moisture content (%)	18.53	20.5	20.04	17.18
Dry matter (%)	81.47	79. 50	79.96	82.82
Organic matter (%)	91.24	91.22	92.59	91.82
Crude protein (%)	21.87	21.64	21.58	21.67
Crude fat (%)	46.67	45	35	35
Ash (%)	8.76	8.78	7.41	8.18
Energy Kcal/kg	3200	3200	3200	3200

[1]Supplied per kg of diet: Vitamin A 1500 IU; Cholecalciferol 200 IU; Vitamin E 10 IU; Riboflavin 3.5 mg; Pantothenic acid 10 mg; Niacin 30 mg; Cobalamin 10 µg; Choline chloride 1000 mg; Biotin 0.15 mg; Folic acid ½ mg; Thiamine 1.5 mg; Pyridoxine 3 mg

[2]Supplied /kg of the diet: Cu 8 mg; Fe 80 mg; I 0.18 mg; Mn 60 mg; Se 0.15 mg; Zn 40 mg.

Table 1: Proximate composition of formulated and fed BSFLM diets.

Growth performance indicators recorded include feed intake (FI), Body Weight Gain (BWG) and feed conversion efficiency/ ratio (FCR). Before the take-off of the experiment, bird's initial weights were recorded as their Initial Body Weight (IBW) then after every week their weekly body weights. Lastly, final weight gain (FW or FWG) were recorded at the poultry farm before conveyed to slaughter house at the department of animal science, University Putra Malaysia.

Carcass Analysis

At the termination of the feeding trial a pair of chicken in each individual replicate were randomly picked, after fasted a night before, then slaughtered by severing the oesophagus, trachea (wind pipe) and the two jugular veins. The birds were skinned without scalding due to tenderness of the birds, dressed carcasses, major cuts were weighed. While the visceral Organs; liver, gizzard etc., were pain stakingly detached and weighed. The weights were expressed in gram including dressed carcass weight. Economic analysis of live weight gain of broiler chicks was calculated by deducting net expenditure cost of chick from the gross income of the live weight gain.

Data analysis

Data analysis was done using ANOVA with Completely Randomized Design model and means were compared by Duncan's Multiple Range Test through SAS 9.4 version, 2014 for all statistical outputs.

Results and Discussion

The results for growth performance of spring chicken in Table 2 shows that body weight gain (BWG) in 5% (207.69 g), 7.5% (228.40 g) and 10% (251.64 g) inclusion was highly Significant (P<0.05).

Treatments						
Parameters	**0%**	**5%**	**7.50%**	**10%**	**SEM**	**P-value**
Body weight (g)	446.7	514.8	500.5	528.7	66.89	0.98
Initial body weight/b (g)	51.64	53.23	52	53.09	0.39	0.43
Final body weight /b (g)	671.84^b	755.21^b	716.88^b	852.53^a	21.73	0.007
Body weight gain (g)	112.33^b	207.69^a	228.40^a	251.64^a	3.29	0.0001
Daily weight gain/b (g)	30.82	33.31	31.58	32.98	2.42	0.29
Feed intake (g)	146.85^d	253.48^c	401.36^b	463.68^a	32.72	0.0001
FCR	1.31^b	1.24^b	1.78^a	1.86^a	0.08	0.002
Mortality (%)	4.16	4.16	4.16	0	-	-

a b c d Means bearing same superscript in the same row are not significantly different (P>0.05)

Table 2: Growth Performance of Spring chicken fed black soldier fly larvae meal (BSLM).

Similarly, Final Body Weight (FBW) was also statistically different (P<0.05) for each treatment in relation to another. Feed Intake (FI) appreciably varied higher (P<0.05) among the treatments, which is closely related to their Feed Conversion Ratio (FCR) with statistical differences across the entire experimental birds (P<0.05). But daily weight gain (DWG) was not significantly different (P>0.05) in all levels of inclusion. Likewise there were no significance variation in Body Weight (BW) and Initial Body Weight (IBW) among treatment diets, while a few percentage mortality of single bird each in treatment (T1, T2 and T3) were observed.

[14,15] reported that 10% worm meal did not have significance effect (P>0.05) on body weight gain (BWG) at starter phase; however, these findings were In agreement with our current investigation. At the same time when fed 5% and 15% body weight gain was statistically high (P<0.05), which was consistent with our results at 5%.

Similarly, [3,14,16] have reported negative and insignificant (P>0.05) body weight gain performances at 25%-100% inclusions.

The decreased performances across diets were connected to reduced tastiness as a result of increased quantity of maggot. Nevertheless, the species of larvae used in these experiments haven't been stated. But significant response was experienced in 100% level.

The sensory evaluation test revealed a significant difference in both color and tenderness (Table 3). In treatment groups with 5% and 10% BSFLM inclusion levels having the best color appearance acceptability remark, whereas tenderness was shown too illuminated in 5% level (P<0.05) only. While both odour and taste in all levels were not significantly different (P>0.05). pH values indicated in the present work were statistically significant (P<0.05). Contrary to colour co-ordinates, where no changes was recorded (P>0.05).

Parameters								
Sensory Parameters				Meat Colour				
Levels	Colour	Odour	Taste	Tenderness	L*	a*	b*	pH
0%	6.29^{ab}	5.43	5.71	5.57^{b}	47.11	11.97	19.13	6.25^{a}
5%	6.71^{a}	5.86	6.14	7.29^{a}	49.93	9.64	20.89	5.82^{b}
7.50%	6.14^{b}	6	6.43	6.86^{ab}	49.79	10.36	20.44	5.81^{b}
10%	7.29^{a}	6.43	6.57	6.57^{ab}	48.65	11.38	21.19	6.07^{ab}
SEM	0.7	0.98	0.69	0.79	0.72	0.57	0.4	0.07
P-value	0.06	0.9	0.85	0.26	0.54	0.53	0.31	0.04

$^{a\ b}$ means with the same superscript in the same column are not significantly different (p<0.05). L* a* b* means lightness redness and yellowness of the meat respectively. S/force - shear force and CL - cooking loss.

Table 3: The sensory evaluation and meat quality parameters of spring chicken fed larvae meal diets.

Carcass quality parameters of spring chicken meat were not significantly different (P>0.05) except thighs and liver, which exhibited significant variations (P<0.05) and highly significant (P<0.05) respectively (Table 4). This capability of BSFLM may not have been remarkable without its sound amino acid profile which is higher than that of soybean meal principally methionine or methionine+cysteine and lysine [6,10,15,17-21]. However, when fed house fly pupae meal and yellow mealworm, perhaps arginine could be a limiting amino acid, since these are customarily the greatest restrictive essential amino acids for growing monogastrics animals such as broiler chicken, as indicated by [21,22]. In addition, it was extensively viewed severally in literatures that, black soldier fly among other insects is a promising insect for food and feed security, and passionately with high feed conversion efficiency. This result was in agreement with [23] when fed varying levels of silkworm meal to rabbits without significance (P>0.05) in carcass characteristics.

Treatments						
Parameters	0%	5%	7.50%	10%	SEM	P-value
Carcass wt. (g)	475.38	440.63	429.75	435.75	6.02	0.77
Dressing %	62.22	58.87	59.88	57.03	0.98	0.31
Breast (g)	48.74	39.73	32.64	32.49	4.44	0.5 4
Thighs (g)	28.04^{a}	23.27^{b}	28.45^{a}	27.34^{a}	0.59	0.002
Drum stick (g)	21.57	19.57	22.34	21.95	0.47	0.15
Wings (g)	19.1	16.83	16.57	16.26	0.6	0.34
Gizzard	28.5	26.92	24.69	24.21	0.9	0.31
Liver	17.75^{b}	20.74^{b}	17.75^{b}	27.13^{a}	1.07	0.001

$^{a\ b}$ means with similar superscript within a column are significantly the same (p<0.05). BSFLM – Black Soldier Fly Larvae Meal, SEM- Standard Error Means, TBP-Total Blood Protein

Table 4: Carcass quality and heamatological parameters of broiler chicken (spring chicken) fed BSFLM at different inclusion levels.

Makkar et al. [15] recommended that palatability (tastiness) of meat from chicken fed BSFLM was commendable and good, as such it could replace between the ranges of 25% and 100% soymeal or fishmeal. Nonetheless, this may be subject to the type of animal. While in the current research, it was obtained that even at 5% inclusion can comfortably encourage good growth without putting much quantity and give significance equal to 10% better than control 0% level.

Conclusion

This results of present study confirmed that the most appropriate and economically suitable level of inclusion was 5% among the experimental diets, since, there were no significant difference among the treatments (P>0.05). Therefore, for cost-effectiveness in terms of feed cost, least inclusion level of 5% is recommended against 7.5% and 10% levels, respectively. Secondly, BSFLM can suggestively replace soybean meal with little quantity to achieve optimum performance in spring chicken feeding and poultry diets at large. Furthermore, it does not necessarily need fortification of some key amino acids (lysine, methionine) for enhanced growth, it also causes no adverse effect to chick's feeding habit while the meat receives good acceptability by consumer.

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