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PERFORMANCE CHARACTERISTICS AND NUTRIENT DIGESTIBILITY OF BROILERS FED VARYING LEVELS OF SOLDIER FLY LARVAE MEAL

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Target audience: Animal Nutritionists, Livestock Farmer and Research Scientists.

ABSTRACT

A nine week study was carried out with Avian 3F06 broilers to examine the performance and nutrient digestibility of the birds fed varying levels of soldier fly larvae meal (SFLM). Birds were fed seven experimental diets using fish meal as the reference protein source in control diet A while Diets B, C, D, E, F and G contained 5, 10, 15, 20, 25 and 30% levels of SFLM respectively.

At the starter phase, there was no significant difference (P > 0.05) in the final liveweight of the birds except for the birds on Diet E (20% SFLM). Similarly birds on Diet F (25% SFLM) had a significantly lower (P < 0.05) final liveweight than those on the other diets at the finisher phase. The overall weight gain showed that birds on Diet D (15% SFLM) had the highest daily weight gain (DWG) of 33.50g while birds on Diet F (25% SFLM) had the lowest DWG of (28.84g).

The daily feed intake (DF1) increased with increase in the levels of SFLM in the diets at the starter phase while no significant difference was observed at the finisher phase. Over the study period, birds on diet D had the best feed conversion efficiency (FCE). The protein efficiency ration (PER) was significantly reduced beyond 15% SFLM inclusion at both starter and finisher phases. The results of nutrient digestibility at the finisher phase, showed no significant differences in the dry matter, crude fat and nitrogen free extract digestibility of the birds. The crude protein digestibility showed that birds on Diet G had the highest value while birds on diet C had the lowest. Significant differences were also observed in the crude fibre and ash digestibility. The study showed that broilers will tolerate up to 15% SFLM in both starter and finisher diets without adverse effects on their performance and nutrient digestibility.

Key words: Performance, Soldier fly larvae meal, nutrient digestibility, broiler.

DESCRIPTION OF PROBLEM

The poultry industry shows the greatest potential of rapidly improving the animal protein intake of Nigerians. The cost of conventional feed ingredients continues to increase without checks. The imported products, which used to help in meeting the short-falls and keep the prices of local material low have either been banned or cannot be afforded by farmers due to high foreign exchange. These have necessitated the use of alternative feed ingredients in livestock rations.

The use of agro-industrial by-products including poultry and livestock wastes in livestock production are geared towards the production of animal protein at reduced cost without compromising optimum growth and performance. The protein sources of animal origin include abattoir waste, fish waste, and poultry by products, maggot and animal dung. The possible use of maggot meal as a source of protein in poultry ration has been tested by a number of workers:- Teotia and Miller (1) Atteh and Ologbenla (2), Adejinmi and Adeleye (3) and Akpodiete *et al.*. (4) and has been found to be beneficial. Adejinmi and Adeleye (3) also enumerated the value of soldier fly larvae meal in broiler diet as well as its differences from the common maggot of housefly.

In view of the importance of insect larvae as an alternative protein source in livestock ration, an investigation was carried out to examine the performance and nutrient digestibility of broilers fed varying levels of soldier fly larvae meal (SFLM) and its tolerance limit in broiler rations.

MATERIALS AND METHODS

The solder fly larvae used in this study were collected from the shavings-free droppings under caged layers. They were harvested, washed, dried and ground into a meal before incorporating them into the ration.

Experimental Diets

Starter diets

Seven experimental diets were formulated using fishmeal as the reference protein source in the control diet A. Diets B, C, D, E, F and G contained 5, 10, 15, 20, 25 and 30% levels of SFLM respectively in the experimental ration as shown in Table 1. Adjustments were made in the soyabean meal and maize to balance the protein and energy requirements. The groundnut cake in Diet G was reduced to 8.00% in order to accommodate the 30% SFLM incorporated into the diet.

Finisher diets

Seven experimental diets were also formulated as in the starter phase with diet A as the control Diets B, C, D, E, F and G contained 5, 10, 15, 20, 25 and 30% levels of inclusion of SFLM (Table 2). Groundnut Cake was excluded in the finisher ration because of the lower percentage of protein required at this stage. Diets were analysed for their chemical composition according to AOAC methods (5).

Table 1: Ingredient composition (%) of broiler starter rations

Ingredients	A(0%)	B(5%)	C(10%)	D(15%)	E(20%)	F(25%)	G(30%)
Maize	41.35	38.15	38.50	38.87	40.00	39.50	36.50
Soyabean meal	19.15	21.35	16.00	10.63	4.50	-	-
Wheat offal	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Palm kernel cake	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Groundnut cake	10.00	10.00	10.00	10.00	10.00	10.00	8.00
Fishmeal	4.00	-	-	-	-	-	-
SFLM	-	5.00	10.00	15.00	20.00	25.00	30.00
Oyster shell	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Vitamin mineral premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100
Calculated Values							
ME (Kcal/g)	2.78	2.77	2.83	2.90	2.83	3.04	3.08
Crude protein (%)	23.06	23.14	23.29	23.44	23.35	23.77	24.93
Calorie: protein	120.55	119.7	121.51	123.72	121.37	127.89	123.54

Determined chemical composition on DM basis (%)

Parameters (%)							
Dry matter	91.84	92.34	91.86	92.52	93.33	92.68	93.43
Other components on DM basis:							
Crude protein	22.07	22.41	22.43	22.55	22.56	22.67	22.96
Crude fibre	10.11	9.82	9.43	9.95	9.98	8.87	8.10
Crude fat	3.88	4.44	5.27	5.32	5.22	5.37	5.41
Ash	9.81	10.35	10.63	11.04	12.98	13.02	12.65
Nitrogen free extract	54.13	52.98	47.76	51.14	49.26	50.07	50.88

Vitamin – premix supplied per kg of diet

Vit. A. 10.000IU: Vit. D 1000IU: Vit. E 10mg: Vit. B 1.5mg: Vit. B_2 3.2mg: Vit. B_6 2.4mg: vit. B_{12} 8mg: Folic acid 0.6mg: Panthothenic acid. 14.4mg: Choline chloride 80mg: Mg. 0.25mg: Mn 120mg: Fe 48mg: I_2 1100mg: Se. 100mg.

Table 2: Ingredient composition (%) of broiler finisher rations

Ingredients	A(0%)	B(5%)	C(10%)	D(15%)	E(20%)	F(25%)	G(30%)
Maize	49.16	46.80	46.68	45.28	47.25	49.50	44.50
Soyabean meal	20.84	22.20	17.32	13.72	7.25	-	-
Wheat offal	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Palm kernel cake	10.00	10.00	10.00	10.00	10.00	10.00	10.00
SFLM	-	5.00	10.00	15.00	20.00	25.00	30.00
Fishmeal	4.00	-	-	-	-	-	-
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Palm oil	2.00	2.00	2.00	2.00	1.50	1.50	1.50
Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100	100	100
Calculated values							
(ME (Kcal/g)	2.77	2.81	2.88	2.94	3.03	3.12	3.15
Crude protein (%)	20.22	20.04	20.34	20.05	20.90	20.44	22.31
Calorie: protein	136.98	140.43	141.66	139.63	145.23	152.64	141.28

Determined chemical composition on DM basis (%)

Parameters (%)							
Dry matter	91.68	91.91	92.56	91.44	92.46	92.46	91.64
Other components on DM basis:							
Crude protein	19.18	21.16	18.88	20.38	19.52	19.11	20.30
Crude fibre	9.56	10.96	10.53	10.54	9.48	8.85	8.82
Crude fat	4.41	5.14	6.36	7.51	6.04	6.64	6.65
Ash	8.66	10.86	9.51	9.52	6.59	8.94	10.10
Nitrogen free extract	58.19	51.88	54.72	52.05	58.37	56.46	54.13

Vitamin – premix supplied per kg of diet
Vit. A. 10.000IU; Vit. D 1000IU; Vit. E 10mg; Vit. B 1.5mg; Vit. B_2 3.2mg; Vit. B_6 2.4mg; Vit. B_{12} 8mg; Folic acid 0.6mg; Panthothenic acid. 14.4mg; Choline chloride 80mg; Mg. 0.25mg; Mn 120mg; Fe 48mg; I, 1100mg; Se, 100mg.

Experimental birds and treatments

One hundred and forty unsexed day-old broiler chicks (Avian 3F06) were used for this study. There were seven treatments, each with two replicates of 10 birds. The study followed a completely randomised design. The experimental diets and clean water were supplied *ad libitum*. The birds were fed on starter diets from day-old to 5 weeks of age and finisher diets from the fifth week to nineth week. The initial weights of birds were taken at the commencement of the experiment. Daily feed intake and weekly body weights were also recorded.

At the seventh week of the experiment, nutrient digestibility trial was carried out using 4 birds randomly selected from each treatment. The birds were offered weighed quantities of feed daily and excreta were collected quantitatively for 3 days, oven dried at 60^0C and ground prior to chemical analysis. The feed samples and excreta were analysed using standard methods (5). All data were subjected to analysis of variance according to Steel and Torrie (6) and means were separated by Duncan's Multiple Range Test (7).

RESULTS AND DISCUSSION

Performance Characteristics

The summary of results on performance characteristics is presented in Table 3.

At the starter phase, birds fed diet E had significantly ($P < 0.05$) lower final liveweight compared with the birds on other treatments. Similarly birds on Diet F (25% SFLM) had significantly lower ($P < 0.05$) liveweight at the finisher phase. However, there were no significant differences ($P > 0.05$) in the final liveweight of the birds fed on other treatments. The daily weight gain followed the same trend as observed for the final live weight. The overall weight gain showed that birds on Diet D (15% SFLM) had the highest daily weight gain (33.50g), while birds on diet F had the lowest (28.84g). Comparatively, these were not significantly different ($P > 0.05$) from the daily weight gains of the birds on the control diet A. This shows that SFLM could replace all the fish meal and to some extent the soyabean meal in broiler diets without compromising performance. The daily feed intake generally increased with an increase in the level of inclusion of SFLM at the starter phase, while no significant differences ($P > 0.05$) were observed at the finisher phase.

The increase in feed intake with increase addition of SFLM in the diet at the starter phase, could be due to an increase in energy content of the diets with increase in inclusion of SFLM in the diets. This agrees with the reports of Patrick and Schaible (8) who showed feed intake of poultry is determined only by energy concentration provided the diet is adequate in essential amino acids and bulkiness does not limit intake. This observation also agrees with the findings of Dale and Fuller (9) who observed that chicks increased their bio-available energy as dietary energy concentration increases and as energy from fat replaces that of carbohydrate. The increase in bioavailable energy intake associated with high fat diets may be partly due to a reduction in specific dynamic action as suggested by Dale and Fuller (9). At the starter phase birds on diet B had the best FCE (1.88) while those on Diet E had the poorest (2.36). At the finisher phase, birds on Diet D had the best FCE (2.32) while those on Diet F had the poorest FCE (3.08). Over the experimental period, birds on diet D had the best FCE (2.18) while birds on Diet F had the poorest FCE (2.60). This shows that birds fed

Table 3: Performance of broilers fed varying levels of soldier fly larvae meal

	Dietary treatments							
Parameters	A	B	C	D	E	F	G	SEM
Initial live weight (g)	39.98	40.00	39.90	39.95	40.00	40.00	39.99	7
No. of birds	20	20	20	20	20	20	20	
Final liveweight (g)								
(1 – 35 days)	050[a]	058[a]	1060[a]	1077[a]	910[b]	1025[a]	1075[a]	15.78
1 63 days	2088[ab]	2063[ab]	2007[ab]	2150[a]	1870[ab]	1857[b]	2023[ab]	35.45
Weight gain (g/bird/day)								
1 – 35 days	28.86[a]	29.08[a]	29.14[a]	29.62[a]	24.86[b]	28.11[a]	29.57[a]	0.45
35 – 63 days	7.06	5.90	33.82	38.33	34.29	29.73	33.88	1.27
1 – 63 days	2.50[ab]	2.11[ab]	31.22[ab]	33.50[a]	29.05[ab]	28.84[b]	31.48[ab]	0.56
Feed Conversion efficiency (FCE)								
1 – 35 days	2.06[bc]	1.88[c]	1.89[c]	1.92[c]	2.36[a]	2.15[ab]	2.17[ab]	0.05
35 – 63 days	2.47[bc]	2.55[b]	2.66[ab]	2.32[c]	2.70[a]	3.08[a]	2.55[b]	0.08
1 – 63 days	2.29[b]	2.22[b]	2.28[b]	2.18[b]	2.56[a]	2.60[a]	2.41[ab]	0.05
Protein efficiency ratio (PER)								
1 – 35 days	2.10[a]	2.32[a]	2.31[a]	2.27[a]	1.84[b]	1.98[b]	1.89[b]	0.02
35 – 63 days	2.11[a]	1.86[b]	2.01[ab]	2.12[a]	1.89[b]	1.70[c]	1.94[b]	0.03
1 – 63 days	2.11[a]	2.09[a]	2.16[a]	2.20[a]	1.89[b]	1.84[b]	1.92[b]	0.02
Mortality (%)								
1 – 35 days	-	-	-	5.00	-	-	-	-
35 – 63 days	-	-	-	5.00	-	-	-	-
1 – 63 days	-	-	-	10.00	-	-	-	-

Means on the same row with different superscripts are significantly different (P < 0.05).

on diets containing 15% SFLM and below had better FCE than those fed diets containing more than 15% SFLM.

The efficiency of dietary protein conversion to body weight was significantly (P < 0.05) reduced beyond 15% SFLM inclusion at both starter and finisher phases. This confirms the earlier observation on Feed Conversion efficiency that SFLM is more efficiently utilized in broiler ration at 15% inclusion level and below.

Nutrient digestibility

The results of nutrient digestibility are presented in Table 4. The results showed no significant differences in dry matter, crude fat and nitrogen free extract digestibility. The values obtained for crude fat digestibility increased numerically with an increase in SFLM level in the diets. This could be attributed to the increasing level of crude fat in the diets with increasing level of SFLM. The crude protein digestibility showed no significant differences among the birds on Diets A to Diet F (0 – 25%). Birds on Diet G had a significantly higher ($P < 0.05$) crude protein digestibility while birds on diet C had the lowest. This could be attributed to the higher crude protein content of Diet G when compared with Diet C at the finisher phase. Osinaike (10) observed that nutrient utilization depends on nutrient digestibility and dietary nutrient density. The ash digestibility was however inconsistent. The lower crude fibre digestibility values obtained in Diets F and G shows that the crude fibre were poorly digested at these levels compared with the other diets.

Table 4: Nutrient digestibility of broilers fed varying levels of soldier fly larvae meal at the finisher phase

	Dietary treatments							
Parameters	A	B	C	D	E	F	G	SEM
Dry matter	84.44	83.06	82.61	83.40	85.10	82.90	80.02	0.93
Crude protein	73.69^{ab}	78.70^{ab}	70.70^{b}	81.83^{ab}	82.90^{ab}	78.79^{ab}	84.94^{a}	7.37
Crude fibre	73.20^{a}	58.88^{c}	73.41^{a}	73.06^{a}	75.48^{a}	68.51^{b}	59.68^{c}	10.42
Crude fat	90.15	90.05	91.66	91.27	92.20	94.44	95.12	2.91
Ash	64.82^{ab}	69.58^{a}	64.15^{ab}	66.86^{ab}	57.72^{c}	60.22^{bc}	44.22^{d}	13.64
Nitrogen-free extract	92.19	88.28	90.64	87.99	89.75	88.78	96.51	5.38

Means on the same row with different superscripts are significantly different ($P < 0.05$).

CONCLUSION AND APPLICATION

The study showed that SFLM could be incorporated into broiler diets at both starter and finisher phases. SFLM could replace all the fishmeal and to some extent the soyabean meal in broilers without compromising performance. SFLM in broiler diets should not exceed 15% since higher inclusion level results in a reduced feed conversion efficiency and efficiency of dietary protein conversion to body weight.

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