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Performance of laying birds fed diets containing forage meal of *Tithonia diversifolia* (Hemsl A. Gray) and antibiotics

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Abstract

A study was conducted to evaluate the effects of dietary inclusion of the forage meal of Tithonia diversifolia with or without antibiotic on the laying performance and egg quality of birds for a period of eleven weeks. T. diversifolia is also known as wild sunflower. Wild sunflower leaf meal (WSFLM) was incorporated in the diets at 75g/kg (basal diet). Streptomycin and penicillin were added to basal diet at 100 ppm each. Mixture of penicillin and streptomycin, each at 100 ppm was added to the fourth diet. Control diet neither contained WSFLM nor antibiotic. The results of weekly performance at first week of the study, showed that there were significant ($P < 0.01$) increases for egg production, hen day production and feed efficiency for birds fed diets containing WSFLM, while egg weight and feed intake were not affected. Haugh Unit ($P \leq 0.05$) and egg breadth ($P \leq 0.01$) at 8th week, whereas food consumption at second ($P \leq 0.05$), fourth and fifth weeks ($P \leq 0.01$) were all significantly influenced by the dietary treatments. Yellow pigmentation of egg yolks was significantly ($P < 0.01$) enhanced by WSFLM throughout 77 days. The summary of the data at the end of the study indicated that WSFLM significantly ($P < 0.01$) enhanced egg weight, egg production, egg yolk and hen day production ($P < 0.05$). Control birds and those fed basal diets with antibiotic significantly ($P < 0.05$) retained protein and ether extract than those fed basal diet. Supplementation of basal diet with either penicillin or streptomycin positively affected the egg production and egg weight at 77th day, whereas the mixture of the two antibiotics adversely affected the performance of the birds. It is therefore advisable that WSFLM at 75 g kg^{-1} in combination with either penicillin or streptomycin at 100 ppm may be included in the diet of laying birds.

Key words: Wild sunflower leaf meal, antibiotics, laying performance of birds.

Introduction

Feed accounts for 70 to 80 percent of the total cost of broiler production in Nigeria (Akinwumi *et al.*, 1979). The replacement of expensive conventional feed ingredients with cheap and available substitutes in feed formulation represents a suitable strategy in reducing the total feed cost of poultry production in Nigeria. Dietary addition of foliage meals has been recently encouraged as a cheap source of protein and colouring agent in broiler and layer diets (Odunsi *et al.*, 1996, 1999).

Wild sunflower (*Tithonia diversifolia*, Hemsl. A. Gray) of the family Asteraceae is also known as Mexican sunflower or tree marigold which was formerly identified as *T. rotundifolia* or *T. tagetiflora* (Dutta *et al.*, 1986). In Nigeria, the plant occurs along the roadsides and farmland and as a weed of field crops in most ecological zones especially the forest – savanna transition zone. It grows as an annual, a biennial or a perennial plant depending on the habitat (Akinola *et al.*, 2000). The leaves from *T. diversifolia* may be processed to form a meal which could be a valuable feed ingredient for laying hens. The proximate composition of the leaf meal as reported by one author, showed that the meal contained 15% crude protein CP, 9.94% crude fibre CF, 8.87% ash, 2.19% ether extract EE, and 55.31% nitrogen free extracts NFE (Kuti 1991). Furthermore, Odunsi *et al.* (1996) reported that wild sunflower leaf meal WSFLM contained 16.61% CP, 12.00% CF, 5.00% EE, 14.00% ash and 52.39% NFE. The relative content of the protein and crude fibre in the meal from the reports of these authors suggests that it could be a precious feed ingredient. However, Odunsi *et al.* (1996) reported that there were significant reductions in food consumption and hen day production of birds fed more than 5% WSFLM. They suggested that high fibre, low energy content and anti-nutrient component in the meal may account for reduced performance of the birds. In order to maximize the utilization of WSFLM by birds at a higher inclusion rate of more than 5%, dietary supplementation of the leaf meal with antibiotics may offer a solution. Antibiotics have been reported as a growth promoter for animals (Onifade and Babatunde, 1996). However, investigations on the effect of antibiotics in combination with WSFLM on the performance of laying birds have not been reported. Hence, this study was carried out to assess the impact of dietary inclusion of penicillin, streptomycin and WSFLM on the performance and egg quality of laying birds in the tropics.

Materials and Methods

The leaves used for this study were harvested from the matured plants of *T. diversifolia* at the Teaching and Research Farm of Ladoke Akintola University of Technology, Ogbomoso. The thorny branches were removed from the bunch of leaves. The leaves were dried for 72 hours and thereafter manually ground into a meal, which was then bagged until used.

Experimental design and diets

Forty Shaver Brown layers of twenty-four weeks old were used for the study and they were randomly alloted on similar weights basis into five treatments of two replicates each, such that there were eight birds per treatment. Completely randomized design was adopted for this study. The birds were housed individually in a battery cage. The experimental diets were maize-groundnut cake based. Fishmeal, palm kernel cake and blood meal were added to supplement protein and energy from the two major feed ingredients. Other fixed ingredients were added to meet the needs of layer birds for amino acids and minerals. Wild sunflower leaf meal (WSFLM) was incorporated into basal diet (treatment '1') at 75 gkg^{-1} replacing part of maize and groundnut cake in the control diet. Control diet was not supplemented with the test ingredients. Streptomycin and penicillin were separately added to basal diet at 100 ppm (treatments '2' and '3' respectively). Mixture of the two antibiotics, each at 100 ppm was added to the last diet (treatment '4'). The experimental diets were fairly iso-energetic and iso-nitrogenous (2705.36 ± 24.51Kcal kg^{-1} and 17.54 ± 0.54 % crude protein, respectively). Feed and water were supplied *ad libitum*. A three-week adaptation period to the experimental diets was observed before data collection. Daily egg production was monitored. Data on laying performance of birds were collected weekly while those on egg quality were obtained five weeks to the end of the study. Birds were weighed at the beginning and the end of the study. Feed efficiency was calculated as a ratio of weights of feed consumed and dozen of eggs laid.

Measurement of internal egg quality and shell thickness

Four eggs per treatment were randomly selected from the total eggs collected per week for measurement of internal quality of eggs and shell thickness. Albumen height was determined by using spherometer. The measurement is taken at albumen widest expanse, and midway between the yolk edge and the external edge of the thick albumen. The colour of egg yolk was measured using Roche Yolk Colour Fan. Haugh Unit (HU) was determined by the formular below

$$HU=100 \log (H + 7.57 - 1.7 W^{0.75})$$

Where H = height of albumen in mm

W = weight of eggs in gram

Immediately the inner content of eggs was evacuated from shell, the thin membrane was carefully removed. The empty shell was air dried for a few minutes, and shell thickness was obtained using micrometer screw gauge. It was taken at three points, the broad, equatorial and narrow ends, the average was recorded as shell thickness. Egg breadth and length were measured by using thread and a ruler. All other measurements such as weights of eggs and egg shell were determined with the help of weighing balance. Yolk index is a ratio of yolk height and yolk length.

Nutrient retention trial

At the end of the 11^{th} week of the experiment, four birds per treatment were separated for a metabolic trial using total collection method. A daily allowance of 90g feed was supplied to each bird.

Proximate Composition

The chemical analyses of the experimental diets and faecal samples were carried out according to AOAC (2000).

Statistical Analysis

All data collected on laying performance and egg quality were analyzed by one way analysis of variance and significant differences between the means were separated using Duncan Multiple Range Test as outlined by Steel and Torrie (1980).

Table 1: *Gross composition of experimental diets (%).*

	Treatments				
Ingredients	Control	1	2	3	4
Maize	57.75	52.79	52.79	52.79	52.79
Groundnut cake	22.00	19.46	19.46	19.46	19.46
Fish meal	2.00	2.00	2.00	2.00	2.00
Wild sunflower leaf meal	-	7.50	7.50	7.50	7.50
Palm kernel meal	5.00	5.00	5.00	5.00	5.00
Blood meal	1.00	1.00	1.00	1.00	1.00
Oyster shell	7.00	7.00	7.00	7.00	7.00
Bone meal	4.00	4.00	4.00	4.00	4.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25
Sodium chloride	0.50	0.50	0.50	0.50	0.50
Streptomycin	-	-	+	-	+
Penicillin	-	-	-	+	+
Total	100	100	100	100	100
Calculated analysis					
Crude protein	17.4	17.17	17.17	17.17	17.17
Metabolizable energy Kcal kg^{-1++}	2749.20	2694.40	2694.40	2694.40	2694.40
Ether extract %	4.03	4.00	4.00	4.00	4.00
Crude fibre %	2.88	3.75	3.75	3.75	3.75

+ Antibiotics were added to the diets at 100ppm.

* Premix supplied per kg diet. Vit.A10,000 IU; Vit.D_2 2,000 IU; Vit.E. 12 IU, Vit.K_2 8 IU, Thiamine 1.5mg, Riboflavin 1.5mg, Pyridoxine 6mg, Cobalamines 10 mg, Biotin 20mg, Niacin 15g, Pantothenic 5mg, Folic acid 0.6 mg, Manganese 75 mg, Zinc 50 mg, Iron 25 mg, Copper 5 mg, Iodine 4 mg, Selenium 100 mg, Cobalt mg. B.H.T. 125g and Choline chloride 150 mg.

++ Metabolizable energy (ME) of WSFLM is not known, so the values reported were without ME of WSFLM.

Table 2: *Proximate composition of the experimental diets (%)*

Parameters	Control	Treatments			
		1	2	3	4
Crude protein	16.63	17.51	17.94	17.84	17.80
Crude fiber	3.00	2.85	2.50	2.68	2.98
Ether extract	4.20	4.00	4.00	4.10	3.90
Ash	10.00	9.50	9.00	9.45	9.50
Nitrogen free extractive	66.17	66.14	66.56	65.93	65.82
Dry matter	90.50	92.00	91.50	90.00	92.00

Results

Data on the weekly performance and egg quality of laying birds fed WSFLM added diets are presented in Tables 3, 4 and 5. In the first week of the study, birds fed basal diet with streptomycin had outstanding egg production and improved hen day production ($P < 0.01$) than those fed other diets (22.50, 80.36% vs average 17.5, 62.51%), whereas birds fed basal diet had the best ($P<0.01$) feed efficiency (1.75 vs ave. 2.45). Birds fed basal diet with streptomycin maintained this excellent yield till the fourth week. Weekly performance of the experimental birds from 6th to 11th week were not shown because there was no significant effect of the dietary treatments. Birds fed basal diet with penicillin had a numerically higher production than those fed other diets from the fifth week to the tenth week (ave. 23.3, 83.32% v ave. 20.69, 75.65%). The eggs laid by birds fed WSFLM diets were numerically heavier ($P > 0.05$) than eggs laid by control birds (ave. 57.4g vs 50.5g). However, control birds ate more food than those fed other diets especially at second ($P < 0.05$), fourth and fifth weeks ($P < 0.01$).

Physical characteristics of eggs laid by experimental birds revealed that birds fed WSFLM diets laid bigger eggs ($P > 0.05$) than those fed control diet (ave. 3.02, 4.31 cm vs 2.94, 4.27 cm for egg breadth and length respectively). Egg breadth of birds fed WSFLM diets was significantly ($P<0.01$) higher at 8th week (Table 4) than those of control birds. In addition, Haugh Unit ($P < 0.05$) was significantly higher for birds fed WSFLM than those of control birds at 8th week (Table 5). The size of the eggs reflected on the content of the eggs such that the weights of albumen and egg yolk of control birds were lighter ($P > 0.05$) than those fed WSFLM (ave. 33.48g, 13.47g vs 35.42g, 13.92g). The dietary inclusion of the foliage of *T. diversifolia* showed that it was a good colouring agent. Yellow colouration of the egg yolks was significantly ($P<0.01$) enhanced about five times than those fed control diet with 0% WSFLM. The shell thickness of eggs in this study at 11th week was about 0.409 mm.

The summary of all the collected data is shown in Table 6. Generally, the result was a replica of the weekly performance. The WSFLM significantly increased egg weight ($P < 0.01$), egg production ($P < 0.01$) and hen day production ($P< 0.05$), but the dietary inclusion of WSFLM with the mixture of penicillin and streptomycin reduced egg production and hen day production by about 10.09 and 7.13 percent respectively relative to those fed basal diet. Control birds and those on WSFLM experienced heavier loss of weight ($P > 0.05$) than birds given diet containing the mixture of the two antibiotics (ave. 11.19% vs. 4.63%). The former group of birds significantly retained protein and ether extract than birds fed basal diet.

Discussion

The responses of the birds to dietary WSFLM and antibiotics showed that the indices of

Table 3: *Effect of dietary inclusion of T. diversifolia leaf meal supplemented with or without antibiotics on the weekly performance of laying birds.*

[illegible]	Parameters	Control	1	2	3	4	SEM	Level of significance
	Egg weight (g/egg)	55.25	58.79	58.67	58.26	58.78	0.66	NS
	Feed intake(g/bird/day)	136.61	125.90	118.75	122.32	125.722	2.77	NS
	Egg production	18.00^{b}	18.50^{b}	22.50^{a}	19.00^{b}	14.50^{c}	0.84	**
	Hen day production (%)	64.29^{b}	66.10^{b}	80.36^{a}	67.86^{b}	51.79^{c}	3.23	**
	Feed efficiency	2.55^{a}	1.75^{c}	2.17^{b}	2.17^{b}	2.92^{a}	0.13	**
	Egg weight (g/egg)	56.69	58.61	59.37	59.54	56.48	0.56	NS
	Feed intake (g/bird/day)	136.61^{a}	126.79^{ab}	116.07^{bc}	122.32^{b}	115.18^{c}	2.82	*
	Egg production	22.50	22.50	24.50	24.50	21.00	0.58	↑
[illegible]	Hen day production (%)	80.36	80.36	87.50	85.72	75.00	2.20	NS
	Feed efficiency	2.05	1.91	1.61	1.68	1.85	0.06	↓
	Egg weight (g/egg)	55.77	58.22	60.24	58.46	56.22	0.87	
	Feed intake (g/bird/day)	133.93	125.01	120.54	128.57	121.43	1.91	↑
	Egg production	24.00	23.50	25.00	25.00	24.50	0.51	NS
[illegible]	Hen day production (%)	85.72	83.93	89.29	89.29	87.5	1.84	
	Feed efficiency	1.89	1.79	0.81	1.73	1.68	0.04	↓
	Egg weight (g/egg)	54.13	57.41	58.57	54.36	57.08	0.74	NS
	Feed intake (g/bird/day)	139.29^{a}	130.36^{ab}	121.43^{b}	132.15^{ab}	120.54^{b}	2.40	**
	Egg production	24.50	25.00	27.50	27.50	23.00	0.60	↑
[illegible]	Hen day production (%)	87.50	89.29	98.22	96.43	82.15	2.43	NS
	Feed efficiency	1.91	1.75	1.49	1.60	1.79	0.14	↓
	Egg weight (g/egg)	53.84	57.59	58.64	55.83	56.49	0.72	NS
[illegible]	Feed intake (g/bird/day)	125.00^{a}	117.86^{a}	108.21^{b}	119.65^{a}	115.18^{a}	1.92	**
	Egg production	25.50	24.00	24.50	26.00	23.00	0.49	↑
	Hen day production (%)	91.08	89.22	87.50	92.86	82.15	1.66	NS
	Feed efficiency	1.68	1.58	1.49	1.51	1.70	0.03	↓

Table4: *Effect of wild sunflower leafmeal and antibiotics on the outer quality of eggs laid by experimental birds from 7th to 11th week of the study.*

Weeks	Parameters	Control	1	2	3	4	SEM	Level of significance
	Egg breadth (cm)	2.85	2.80	2.97	2.91	2.86	0.02	↑
	Egg length (cm)	4.18	4.32	4.26	4.1[illegible]	4.22	0.05	
7th	Shell weight (g)	6.48	6.20	5.93	6.15	5.60	0.13	NS
	Shell thickness × 10^{-2} (mm)	31.33	29.58	31.15	28.02	27.05	0.86	↓
	Egg breadth (cm)	2.75^b	3.11^a	3.19^a	3.00^a	3.12^a	0.05	**
	Egg length (cm)	4.24	4.47	4.31	4.27	4.35	0.04	↑
8th	Shell weight (g)	5.68	5.88	6.00	5.10	6.10	0.11	
	Shell thickness × 10^{-2} (mm)	38.25	37.28	37.17	34.25	37.58	0.71	NS
	Egg breadth (cm)	3.09	3.00	2.97	3.12	3.15	0.03	↓
	Egg length (cm)	4.45	4.29	4.34	4.36	4.32	0.03	
9th	Shell weight (g)	4.38	5.53	6.18	4.38	5.65	0.15	↑
	Shell thickness × 10^{-2} (mm)	34.67	39.00	40.17	36.00	38.50	0.79	
	Egg breadth (cm)	3.02	3.09	3.07	2.99	2.98	0.02	NS
	Egg length (cm)	4.30	4.41	4.20	4.36	4.21	0.05	↓
10th	Shell weight (g)	5.98	5.88	5.77	5.23	5.78	0.15	
	Shell thickness × 10^{-2} (mm)	41.33	39.08	37.75	36.58	39.93	0.70	↑
	Egg breadth (cm)	2.98	3.02	2.99	3.05	3.00	0.02	
	Egg length (cm)	4.20	4.27	4.33	4.45	4.31	0.05	NS
11th	Shell weight (g)	6.35	6.48	6.90	6.55	6.33	0.12	↓
	Shell thickness × 10^{-2} (mm)	40.83	40.50	42.75	39.67	40.50	0.50	

Means in the same row with different superscripts differ (** $P < 0.01$)significantly. NS – Not significantly different

Table 5: *Effect of antibiotics and T. diversifolia leaf meal on the internal quality of eggs laid by experimental birds from 7^{th} to 11^{th} week of the study.*

ks	Parameters	Control	1	2	3	4	SEM	Level of significance
[illegible]	Yolk weight (g)	12.90	13.78	13.93	12.60	10.20	0.29	NS
	Albumen weight (g)	32.88	34.50	36.10	34.63	34.37	1.67	NS
	Yolk colour	1.00^b	4.75^a	5.75^a	5.25^a	4.67^a	0.41	**
	Haugh unit	59.51^b	63.91^a	65.27^a	62.11^a	64.40^a	0.63	*
	Yolk index	0.41	0.34	0.36	0.40	0.39	0.02	NS
[illegible]	Yolk weight (g)	12.20	13.78	13.83	13.85	13.65	0.27	NS
	Albumen weight (g)	31.83	37.28	39.33	35.05	37.23	1.01	NS
	Yolk colour	1.00^b	5.50^a	5.75^a	6.50^a	5.75^a	0.50	**
	Haugh unit	62.74	61.31	62.25	62.32	62.95	0.47	NS
	Yolk index	0.47	0.45	0.42	0.40	0.42	0.01	NS
[illegible]	Yolk weight (g)	14.68	13.85	14.55	14.45	14.70	0.25	NS
	Albumen weight (g)	36.75	33.60	33.03	38.55	34.78	0.78	NS
	Yolk colour	1.00^b	5.75^a	6.75^a	6.50^a	7.00^a	0.53	**
	Haugh unit	61.82	63.23	62.72	62.70	63.22	0.63	NS
	Yolk index	0.46	0.46	0.49	0.48	0.50	0.01	NS
0^{th}	Yolk weight (g)	13.43	14.93	14.05	14.15	13.78	0.77	NS
	Albumen weight (g)	34.63	36.90	35.90	35.63	33.58	0.82	NS
	Yolk colour	1.00^b	6.50^a	6.50^a	6.25^a	6.75^a	0.52	**
	Haugh unit	61.49	62.78	62.75	61.91	62.43	0.43	NS
	Yolk index	0.47	0.48	0.40	0.47	0.46	0.01	NS
11^{th}	Yolk weight (g)	14.13	14.53	14.3	14.45	15.05	0.18	NS
	Albumen weight (g)	34.58	34.98	34.75	33.95	34.35	0.64	NS
	Yolk colour	1.00^b	6.25^a	6.75^a	6.00^a	6.75^a	0.52	**

Means in the same row with different superscripts differ significantly (** $P < 0.01$)
NS – Not significantly different

Table 6: *Summary of the laying performance of the experimental birds fed WSFLM with or without antibiotics for 77 days and nutrient retention*

Weeks	Control	1	2	3	4	SEM	Level of significance
Feed intake (g/bird/day)	125.00	116.79	116.79	122.14	118.21	3.71	NS
Egg weight (g)	54.76^{c}	57.19^{b}	58.64^{a}	57.64^{ab}	56.76^{b}	0.22	**
Egg production	20.68^{c}	22.90^{b}	22.95^{b}	25.55^{a}	20.59^{c}	0.31	**
Hen day production (%)	73.86^{b}	79.19^{a}	81.96^{a}	82.79^{a}	73.54^{b}	1.08	*
Egg length (cm)	4.28	4.35	4.29	4.29	4.28	0.02	NS
Egg breadth (cm)	2.94	3.00	3.04	3.04	3.03	0.02	NS
Shell thickness $\times 10^{-2}$ (mm)	42.85	37.11	37.45	37.45	37.22	0.05	NS
Yolk colour	1.00^{b}	5.75^{a}	6.25^{a}	6.25^{a}	5.99^{a}	0.27	**
Yolk weight (g)	13.87	14.17	14.14	14.14	13.48	0.12	NS
Yolk index	0.45	0.43	0.43	0.43	0.44	0.01	NS
Haugh Unit	61.51	63.05	63.25	63.25	62.70	0.27	NS
Albumen weight (g)	34.13	34.45	35.82	35.82	33.07	0.37	NS
Initial liveweight (kg)	1.85	1.75	1.85	1.84	1.85	Na	NS
Final liveweight (kg)	1.65	1.67	1.62	1.63	1.77	Na	NS
Weight loss (%)	11.08	9.52	12.24	11.93	4.63	Na	NS
Crude protein (%)	74.58^{a}	69.98^{b}	75.71^{a}	76.71^{a}	71.22^{ab}	3.41	*
Nutrient Retention							
Crude fibre (%)	59.17	55.04	68.33	65.35	62.35	10.60	NS
Ether extract (%)	85.59^{a}	58.79^{b}	78.25^{a}	84.24^{a}	64.38^{ab}	10.17	*
Ash (%)	53.64	49.07	51.00	52.74	50.00	12.90	NS
Nitrogen free extract (%)	48.62^{b}	83.65^{a}	84.00^{a}	85.26^{a}	80.00^{a}	12.35	*
Dry matter (%)	79.39	65.59	70.00	77.57	65.00	2.92	NS

NS – No significant difference; Na – not available

Means in the same row with unlike superscript letters differ significantly (*$P<0.05$, **$P<0.01$)

performance might have been induced by high protein content in WSFLM diets. This was because the responses to dietary treatments were independent of the quantity of food intake. As at 2nd, 4th and 5th weeks, the higher food intake by control birds did not improve the production indices better than birds fed WSFLM diets.

Dietary WSFLM also increased egg breadth and Haugh Units at 8th weeks, whereas the enhancement of yellow colouration of the egg yolks was strongly influenced by WSFLM. The significant improvements for egg weight, egg production and hen day production for birds fed WSFLM diets may due to higher protein content in the WSFLM diets than control diet. Birds fed WSFLM diets with either streptomycin or penicillin performed better ($P > 0.05$) than birds fed WSFLM without antibiotic. This was because the antimicrobial drugs may have reduced the population of intestinal microbes with subsequent reduction in intestinal thickness (Visek, 1978), which led to more efficient feed utilization and improved laying performance. The negative interaction of the activities of the two antibiotics may be responsible for the reduced laying performance of birds fed diet containing the mixture of streptomycin and penicillin. This study revealed that antibiotics did not interfere with the mechanism responsible for the process of egg yolk colouration. This implies that dietary supplementation with WSFLM, penicillin and streptomycin may not compromise with the standard quality of eggs. It also shows that WSFLM is a cheap source of protein and colouring agent for egg production in Nigeria. The judicious use of diets containing antibiotics over control diet especially at first week study supports the finding of Eruvbetine *et al.* (2002) as shown in improved feed efficiency. One study has shown that antibiotics did not influence feed intake of laying birds (Jamroz *et al.* 1998), while other authors reported that there were significant reductions in feed intake of broilers and laying hens given forage meal at 7.5% in the diets (Odunsi *et al.* 1996,Udedibie and Opara 1998). Our observation on feed intake agrees with the reports of these authors. The significantly heavier eggs for birds on the supplements disagree with Jamroz *et al* (1998) that chlortetracycline significantly reduced egg weight. Inclusion of WSFLM in the diets may account for the difference. Birds on WSFLM laid eggs with thicker shell than those reported by Jamroz *et al.* (1998) of 0.331mm. The inconsistent in the responses of the birds may be due to different diet compositions.

There is a growing concern on the dietary use of antibiotics for animal production. This is because of mis-used of antibiotics by farmers (Oyekunle and Owonikoko, 2002), development of bacterial resistant strains (Walton, 1996) and presence of antimicrobial drug residue in animal tissues (Oyekunle and Owonikoko 2002, Dipeolu *et al.*2002). However, in a survey carried out by Oyekunle and Owonikoko (2002) on the use of antimicrobial drugs for poultry production in Ijebu North Local Government Area, Ogun State, Nigeria. They found out that 97.1% of the respondents complied with recommended dosage, 99% achieved satisfactory desired effects with enhanced profit margin for 73.1% of the farmers and about 81% are literate farmers. These suggested that the use of antimicrobial drugs could not be totally discouraged among farmers considering its substantial benefits. It was also reported that dietary supplementation with antibiotics or enzyme for laying birds could increase gain (Eruvbetine *et al.* 2002). Therefore, there is the need to enlighten the farmers through extension services on the use of antibiotics for therapeutic and prophylactic treatments especially in the western part of Nigeria where the level of education among the populace is relatively high compared to other parts of the country.

In addition, it has been reported that antimicrobial residues are relatively rare in food animals of some developed countries and when detected, the concentrations were very low often less than 1 part per million, 1 ppm (Walton, 1996). Findings on the use of antibiotics in animal production in Nigeria have also revealed that the level of antibiotic residues is usually less than 1 ppm. Dipeolu *et al.* (2000) showed that the presence of tetracycline residues in tissues ranged between 0.01 µg/g to 0.20 µg/g for turkey samples and 0.02 µg/g to 0.12 µg/g for egg samples. In another survey study by Dipeolu *et al.*(2002), they found that residues of tetracycline antibiotic occurred at a concentration of 0.008 µg to 0.017 µg and 0.003 µg to 0.008 µg for diets containing only tetracycline (at 200 ppm), tetracycline and enzyme respectively. These data from Dipeolu *et al.* (2000 and 2002) showed that antibiotics residues in food animals were very less than 1 ppm with a range of 0.003 ppm to 0.5 ppm, which might be properly metabolized when such foods are eaten.

The results of this study revealed that WSFLM might be included in layer diet at 75g kg^{-1} with either penicillin or streptomycin at 100ppm for satisfactory performance. However, dietary use of antibiotics should be cautiously applied in animal production to avoid large concentration of antibiotic residue in livestock products.

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