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Growth Performance, Shank Pigmentation and Blood Profile of Broiler Chickens Fed Neem Leaf Meal-Based Diets

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***Abstract*—** *The many benefits of all parts of neem (Azadirachta indica) tree are well documented. Thus, this study was done to ascertain the effects of sundried neem leaf meal (NLM) on growth performance, shank pigmentation and blood profile of broiler chickens. One hundred and forty four day-old chicks were randomly distributed after 1 week pre-experimental period to four experimental diets which comprised NLM at 0% (control), 5% (5NLM), 10% (10NLM) and 15% (15NLM). A completely randomized design was adopted with 12 birds per replicate and 3 replicates per treatment. Feed and water were given ad-libitum and other management practices were carried out. Initial weight of chicks and final weights at the end of the starter and finisher phases were taken. Feed intake was measured weekly and feed conversion ratio (FCR) calculated. Shank pigmentation was assessed from 3 birds/ replicate at the end of the trial. Blood samples were collected from 3 birds/ replicate at the end of the starter and finisher phases. For the starter phase, final weight, total weight gain and FCR were significantly influenced by NLM inclusion. Chicks fed control and 5NLM diets had similar higher values than others. Blood parameters were not significant except basophil values. At the finisher phase, total weight gain and FCR were not significantly different although feed intake significantly reduced with inclusion of NLM in the diets. Blood parameters were not significant except lymphocyte values. There was a non-significant increase in shank pigmentation with increase in NLM inclusion. It is concluded that NLM inclusion in broiler diets at both phases should not exceed 5% based on growth performance. Neem leaf meal increased yellow colouration of shank and was not harmful to broiler blood parameters.*

***Keywords*—Neem leaves, Natural colourants, Broiler production, Poultry feed.**

I. INTRODUCTION

The poultry industry has great potentials that could aid the improvement of the health status of people through the provision of animal protein (Adeniji, 2005) and also help alleviate poverty (Bloom and Canning, 2000). Broiler chickens in particular are good converters of feed to meat hence their fast growth and they have wide acceptability by people all over the world.

One main constraint to poultry production mostly in developing countries is the high cost of production of which the cost of finished feed contributes significantly. According to Adebayo and Adeola (2005), high cost and shortage of feed ingredients needed by chickens is a major obstruction to the expansion of poultry production. Thus, research on the use of alternative feed ingredients which would limit the inclusion of expensive ones, which are also in stiff competition with man, is essential. High cost of finished feed would translate to high total cost of production and finally to high cost of sales of broiler chicken/ meat.

Neem leaf meal has been tested as an alternative feed ingredient in poultry production. The neem tree is abundant in Nigeria because it is used to prevent deforestation (Onyimonyi *et al.*, 2009) due to its ability to tolerate drought. Neem leaves contain about 22.37% crude protein, 14.30% crude fibre and 7.10% ash. The results reported by the various authors regarding the optimum level of neem leaf meal inclusion in broiler-chicken diets are not consistent. Onyimonyi *et al.* (2009), Obikaonu (2012) and Obun*et al.* (2013) reported 0.5, 5 and 15% respectively for broiler finishers. Thus, thisstudy was carried out to determine the optimum inclusion level of neem leaf meal in broiler-chicken diets using growth performance, shank pigmentation and blood profile as response criteria.

II. MATERIALS AND METHODS

2.1 Study site

The study was conducted at Poultry Unit of the Teaching and Research Farm and Animal Production and Health Department laboratories of the Federal University of Technology, Akure, Ondo State, Nigeria.

2.2 Test ingredient and experimental birds

Neem leaves were harvested fresh from Akoko, Ondo State and sun dried for about 3 days when it became crispy. The dried leaves were then milled and stored properly prior to diet formulation. One hundred and forty four day-old broiler chicks (Marshallbreed) were purchased from a reliable hatchery and placed on experimental diets after a one-week pre-experimental period during which they were fed commercial starter diet. Four diets were formulated to contain neem leaf meal at varying levels at both starter and finisher phases. Control diet was without neem leaf meal (0%); 5NLM, 10NLM and 15NLM contained neem leaf meal at 5, 10 and 15%, respectively. Composition of starter and finisher diets are shown in Table 1. The birds were randomly distributed to the diet groups in a completely randomized design. There were three replicates per treatment and twelve birds per replicate. The feeding trial lasted 7 weeks during which birds were managed intensively.Feed and potable water were provided *ad-libitum*.

2.3 Data collection and analysis

Initial weight was taken at the start of the experiment and final weight for each phase was taken at the end of the respective phase. Feed intake was measured weekly and feed conversion ratio calculated as ratio of feed intake to weight gain. Shank pigmentation was assessed from three birds per replicate at the end of the finisher phase by a 10-member panel using the following keys:

5- Extremely pigmented
4- Highly pigmented
3- Moderately pigmented
2- Slightly pigmented
1- Not pigmented

Blood samples were also collected from three birds per replicate at the end of starter and finisher phases respectively. Samples wereanalyzed for packed cell volume, red blood cell count, haemoglobin concentration, erythrocyte sedimentation rate, heterophil, basophil and eosinophil according to Lamb(1981). Mean cell haemoglobin concentration, mean cell haemoglobin and mean cell volume were calculated appropriately from packed cell volume, red blood cell count and haemoglobin concentration values. Data collected were subjected to one way analysis of variance using the Minitab statistical package (v 17) and means were separated using Tukey test of the same package.

III. RESULTS

3.1 Growth performance

The growth performance of broiler chicks fed neem leaf meal based diets is shown in Table 2. Final live weight (g/bird) of the chicks was significantly ($P<0.05$) different. Birds on control diet had the highest value which did not differ significantly ($P>0.05$) from that of birds fed 5NLM. Total weight gain followed same trend as final weight. Birds fed 10NLM and 15NLM had weight gain which differed significantly ($P<0.05$) from birds fed control and 5NLM diets. A progressive decrease was observed in weight gain with increasing inclusion of NLM in the diets. No significant ($P>0.05$) difference was found in total feed intake (g/bird) of the broiler chicks at all levels of inclusion. Values calculated as the feed conversion ratio were significantly ($P<0.05$) different across dietary treatments. Broiler chicks on control had the lowest feed conversion ratio (1.86) while those on 15NLM had the highest value (3.51).

As shown in Table 3, the initial live weight of the broiler-chicken finishers was a reflection of the effect of NLM at the starter phase. Final live weights of the birds (kg/bird) was significant ($P<0.05$), birds on control diet had the highest final weight, values decreased with increasing level of NLM. Birds that were fed 10NLM and 15NLM had same final weight.Total weight gain, although numerically lower in NLM diets was not significantly ($P>0.05$) different. Total feed intake was significantly ($P<0.05$) influenced by dietary NLM inclusion. Birds on control diet ate more, although the values had slight reductions. Feed conversion ratio was statistically similar ($P>0.05$) across dietary treatments.

3.2 Shank pigmentation

Shank pigmentation of the broiler-chicken finishers fed neem leaf meal based diets is presented in Table 4.The values show a non-significant ($P>0.05$) increase in pigmentation as level of NLM increased in the diets. Values increased from 1.67 in control chickens to 3.07 in those fed 15NLM diet.

3.3 Blood profile

All parameters recorded for blood profile of broiler chicks fed diets containing neem leaf meal (Table 5) viz; packed cell volume (PCV), red blood cell count (RBC), haemoglobin concentration (Hb), erythrocyte sedimentation rate (ESR), mean cell haemoglobin concentration (MCHC), mean cell haemoglobin (MCH), mean cell volume (MCV), lymphocyte, heterophil, and eosinophil were not significantly ($P>0.05$)different except basophil, whose values did not follow any particular trend in relation to dietary treatments.

The blood profile of broiler-chicken finishers fed NLM as presented in Table 6 shows that PCV, RBC, Hb, ESR, MCHC, MCH, MCV, heterophil, basophil and eosinophil were not significantly($P>0.05$)influenced by NLM inclusion. The lymphocyte was however significantly ($P<0.05$) different, control had the lowest value.

IV. DISCUSSION

The decreasing trend observed in total weight gain of broiler chicks in this study is in agreement with Obikaonu

(2012) who reported this trend in weight gain by broiler chickens. The non-significance in feed intake is contrary to the report of Obikaonu (2012) in which a significant increase was found in feed intake of broilers as levels of NLM increased. Although feed intake was not significant in this study, chicks fed NLM diets had higher values than control and the value for chicks fed 15NLM dropped compared to other NLM groups. This decrease at 15% may be attributed to the bitter taste (Onyimonyi *et al*., 2009) of NLM or the possible reduction in aesthetic value of the diet to the birds due to its darker colour caused by the quantity of NLM included.Onyimonyi *et al*. (2009) also reported lower feed intake with the highest level of NLM used although their level of inclusion was lower than levels used in this study. Feed conversion ratio of broiler chicks increased with increasing level of NLM, this depicts that efficient utilization of feed is reduced with higher NLM inclusion. This might be due to possible interference between phytochemicals such as tannin and nutrient availability (Nworgu *et al*., 2014; Liaqat*et al*., 2016) which is characteristic to some leaf meals.

For the finisher chickens, the non-significance observed in weight gain is contrary to Obikaonu (2012) who reported a significant decrease in weight gain of broiler finishers. Although, the non-significant weight gain here was highest for control. In line with this same author, significant difference was observed in feed intake but decrease with NLM inclusion was recorded in this study as opposed to increase in feed intake with NLM inclusion there. The decrease in feed intake recorded in this study could be as deduced earlier for broiler chicks. It could also suggest that older birds have a higher perception of bitter taste. It appears that more feed was needed per kg weight gain at the starter phase than finisher phase. And it was more pronounced for birds on the control diet.

According to Blair (2008), there are variations in consumers' choice of broiler skin colour. While some like broilers to be yellow skinned, others prefer it as white. Sirri*et al*. (2010) suggested that evaluation of broiler pigmentation or yellowness could be ascertained on any part of the chicken's body, which means colour of broiler skin could be deduced from results of shank pigmentation. Onibi *et al*. (2008) reported that shanks better depicts intensity of pigmentation in broiler chickens. In this study, there was an increase in shank pigmentation with increase in NLM inclusion although it was not significant. Joseph (2016) also observed an increase in yellowish colour of cockerel shanks when NLM was included in their diets. Olabode (2015) also observed a deeper egg yolk colour with increase in NLM inclusion. So, NLM may be used as a natural colourant for chicken products.

According to Obikaonu *et al*. (2011), there were significant differences in haemoglobin (Hb), erythrocyte sedimentation rate (ESR) and packed cell volume (PCV), although the values reported did not follow any particular trend but were rather undulating with NLM inclusion. These authors also reported that eosinophils and basophils were not detected in their experiment. However, values obtained in this study for the main anaemia pointers; Hb and PCV (Turksonand Ganyo, 2015) fell within the acceptable range (Mitruka and Rownsley, 1977; Ross *et al*., 1978). At the finisher phase, there was no significance in the blood parameters except lymphocytes and it appeared that PCV, RBC and Hbhad slightly higher values with increase in NLM addition.Esonu*et al*. (2016) reported a significant increase in PCV values of laying chickens fed NLM up to 10%but Obun*et al*. (2013) reported a significant decrease in PCV values of broiler finishers and other blood parameters were not significant. Lymphocyte values, although significant fell within normal range. According to Etim*et al*. (2014), factors such as age, breed, sex and management practices could affect blood parameters of animals and thus may have caused the variability in results from these studies.

V. CONCLUSION

Based on growth performance, neem leaf meal inclusion in broiler-chicken starter and finisher diets should not exceed 5%. Neem leaf meal increased the yellow pigmentation of shanks and was not deleterious on their blood parameters.

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Table.1: Composition of experimental diets

Ingredients (kg)	**Starter Phase**				**Finisher Phase**			
	Control	**5%**	**10%**	**15%**	**Control**	**5%**	**10%**	**15%**
Maize	53.00	50.00	46.00	42.10	52.50	51.30	48.20	44.50
NLM	0.00	5.00	10.00	15.00	0.00	5.00	10.00	15.00
Wheat offal	8.80	6.80	6.80	6.80	13.00	8.00	6.50	6.00
Soyabean meal	16.00	16.00	15.00	15.00	15.00	15.00	14.60	14.10
Groundnut cake	16.00	16.00	16.00	14.90	13.90	15.10	15.10	14.80
Fish meal (72%)	3.00	3.00	3.00	3.00	0.00	0.00	0.00	0.00
Vegetable oil	0.00	0.00	0.00	0.00	2.00	2.00	2.00	2.00
Bone meal	2.10	2.10	2.10	2.10	2.40	2.40	2.40	2.40
Limestone	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total	100	100	100	100	100	100	100	100
Calculated analysis								

Metabolizable energy (Kcal/Kg)	2923.72	2970.48	2993.33	3017.56	2989.62	3073.74	3115.62	3144.99
Crude protein (%)	22.57	23.08	23.42	23.69	19.79	20.48	20.89	21.24
Crude fibre (%)	3.68	4.16	4.73	5.32	3.83	4.15	4.65	5.20
Ether extract (%)	4.08	4.15	4.21	4.24	4.11	4.22	4.28	4.33
Calcium (%)	1.11	1.16	1.20	1.25	1.03	1.08	1.13	1.18
Phosphorus (%)	0.54	0.61	0.68	0.75	0.50	0.57	0.63	0.70

NLM= Neem Leaf Meal

Table.2: Growth performance of broiler chicks fed diets containing neem leaf meal

Diets	**Level of inclusion (%)**	**Initial weight (g/bird)**	**Final weight (g/bird)**	**Total weight gain (g/bird)**	**Total feed intake (g/bird)**	**Feed conversion ratio**
Control	0	131.94	843.40^{a}	711.40^{a}	1318.50	1.86^{a}
5NLM	5	137.50	783.40^{a}	645.90^{a}	1479.90	2.29^{ab}
10NLM	10	137.50	655.30^{b}	517.80^{b}	1425.10	2.75^{b}
15NLM	15	136.11	526.30^{c}	390.20^{c}	1354.20	3.51^{c}
Pooled standard deviation		5.77	42.24	44.45	62.78	0.23

^{abc}Means with different superscripts along the same column are significantly different (P<0.05)
NLM- Neem leaf meal

Table.3: Growth performance of broiler-chicken finishers fed diets containing neem leaf meal

Diets	**Level of inclusion (%)**	**Initial weight (kg/bird)**	**Final weight (kg/bird)**	**Total weight gain (kg/bird)**	**Total feed intake (kg/bird)**	**Feed conversion ratio**
Control	0	1.04^{a}	2.36^{a}	1.32	3.68^{a}	2.79
5NLM	5	0.93^{ab}	2.10^{ab}	1.16	3.22^{ab}	2.79
10NLM	10	0.75^{bc}	1.70^{b}	0.95	3.13^{b}	3.33
15NLM	15	0.60^{c}	1.70^{b}	1.11	3.15^{b}	3.03
Pooled standard deviation		0.08	0.21	0.23	0.20	0.42

^{abc}Means with different superscripts along the same column are significantly different (P<0.05)
NLM- Neem leaf meal

Table.4: Shank pigmentation of broiler-chicken finishers fed neem leaf meal

Diets	**Level of inclusion**	**Shank pigmentation**
Control	0	1.67
5NLM	5	2.20
10NLM	10	2.67
15NLM	15	3.07
Pooled standard deviation		0.99

NLM- Neem leaf meal

Table.5: Blood profile of broiler chicks fed diets containing neem leaf meal

Diets	Level of inclusion (%)	PCV (%)	RBC (10^6mm^3)	Hb(g/100ml)	ESR (mm/hr)	MCHC (%)	MCH (pg)	MCV (μ^3)	Lymphocyte (%)	Heterophil (%)	Basophil (%)	Eosinophil (%)
Control	0	29.63	2.72	9.89	3.50	33.37	36.61	109.70	62.00	20.75	2.38^{ab}	1.38
5NLM	5	29.22	2.67	9.72	3.67	33.27	36.73	110.39	61.44	23.11	2.00^{b}	1.78
10NLM	10	27.63	2.42	9.21	4.63	33.35	38.13	114.33	61.75	21.75	2.75^{a}	1.50
15NLM	15	28.44	2.54	9.48	4.33	33.32	37.48	112.48	62.00	21.44	2.56^{a}	1.33
Pooled standard deviation		2.32	0.35	0.77	1.91	0.09	1.82	5.41	2.28	2.03	0.51	0.50

^{ab}Means with different superscripts along the same column are significantly different (P<0.05)

PCV- Packed cell volume; RBC- Red blood cell count;Hb- Haemoglobin concentration; ESR- Erythrocyte sedimentation rate; MCHC- Mean cell haemoglobin concentration; MCH- Mean cell haemoglobin; MCV- Mean cell volume; NLM- Neem leaf meal

Table.6: Blood profile of broiler-chicken finishers fed diets containing neem leaf meal

Diets	Level of inclusion (%)	PCV (%)	RBC (10^6mm^3)	Hb(g/100ml)	ESR (mm/hr)	MCHC (%)	MCH (pg)	MCV (μ^3)	Lymphocyte (%)	Heterophil (%)	Basophil (%)	Eosinophil (%)
Control	0	27.13	2.24	9.05	5.00	33.36	41.65	124.82	59.38^{b}	23.13	2.63	1.25
5NLM	5	28.44	2.41	9.48	3.00	33.32	39.83	119.54	62.11^{ab}	21.89	2.44	1.56
10NLM	10	28.63	2.45	9.53	2.88	33.27	39.27	118.03	62.75^{a}	21.63	2.25	1.38
15NLM	15	29.22	2.56	9.73	3.22	33.31	38.91	116.82	61.89^{ab}	22.78	2.67	1.56
Pooled standard deviation		2.57	0.47	0.86	1.74	0.10	4.51	13.56	2.27	2.18	0.50	0.63

^{ab}Means with different superscripts along the same column are significantly different (P<0.05)

PCV- Packed cell volume; RBC- Red blood cell count; Hb- Haemoglobin concentration; ESR- Erythrocyte sedimentation rate; MCHC- Mean cell haemoglobin concentration; MCH- Mean cell haemoglobin; MCV- Mean cell volume; NLM- Neem leaf meal