

## SEED OF PROMISE: EXPLORING *PICRALIMA NITIDA* SEED POWDER AND AQUEOUS EXTRACT AS GROWTH PROMOTERS IN BROILER CHICKENS

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### ABSTRACT

The ban on the sub-therapeutic use of antibiotics in animal nutrition for growth promotion due to antimicrobial resistance has necessitated the need to source alternative photobiotic such as *Picralima nitida*. This study thereby evaluated the comparative response of broiler chickens to *Picralima nitida* seed powder (PnSP) and extract (PnSE) in feed or water with or without routine medications. A total of 150 day-old Arbor Acre chicks were randomly allotted to 5 dietary treatments denoted A-E with 3 replicates per treatment. The birds were fed the same basal diet of which control birds were given without PnSP nor PnSE, 0.1% PnSP was added to diets B and C while 25ml/L of PnSE was added to the drinking water of those on treatment D and E with or without medication respectively for 49 days. Average Daily Gain (ADG), Average Daily Feed Intake (ADFI), Feed to Gain Ratio (FGR), blood profile and microbial assay were evaluated. Data collected were subjected to a one-way analysis of variance and treatment means were separated using Duncan Multiple Range Test. Results indicated that Final Live Weight (FLW) and ADG ( $P < 0.001$ ) improved with PnSP/PnSE with or without routine medications at the starter phase; however, those on the control diet had the least values for FGR at the finisher and pooled phases. The microbial load was reduced without any damage to the liver and intestine with the use of *P. nitida*. In conclusion, *Picralima nitida* improved the performance of the birds; however, the combination of PnSP with synthetic medication was more effective.

**Keywords:** carcass, microbial assay, performance, *Picralima nitida*

### INTRODUCTION

In the United States, the first usage of antibiotics dates back to the late 1940s. Pigs and other simple-stomached animal species, such as poultry species, grew well when fermentation products of the bacteria strain *Streptomyces aureofaciens* were added to their diets. However, the overuse of antibiotics has led to clinical and microbiological evidence of antibiotic-resistant bacteria that may be zoonotic (Oleforuh-Okoleh *et al.*, 2015).

The potential role of phytochemicals in animal nutrition as alternative to antibiotic growth promoters has garnered interest. Several leaves have been used as growth promoters for broiler chickens, including lemon grass, *Moringa oleifera*, pawpaw leaf, banana leaf, turmeric root meal, *Eupatorium odourata* and *Ocimum gratissimum*, *Morinda lucida* and crude pawpaw latex.

Due to their wide range of antimicrobial, antioxidant, gut microflora manipulation, appetite and digestion stimulating,

Immune enhancing, increase production of digestive enzymes, and improved consumption of digestive products by improving liver function properties, these plants have been reported to be effective growth promoters.

Broiler chickens fed diets enriched with *Morinda lucida* (Brimstone) leaf meal were assessed for performance, intestinal health, and tissue microbial count by Lala *et al.* (2017) with or without standard treatment (antibiotics and anti-coccidiostat).

The researchers found that adding *Morinda lucida* to feed at a rate of 2 g/kg increased performance and decreased harmful microorganisms. Oleforuh-Okoleh *et al.* (2015) evaluated the impact of banana leaf infusion and powder (50 ml/L of drinking water and 50 g/kg of feed, respectively) on the blood profile and performance of broiler chickens and reported favourable growth responses.

Therefore, by utilizing *Picralima nitida* (K. Schum) Hallier powder and aqueous extract in the feed and water of broiler chickens, respectively, this study adapted the work of Lala *et al.* (2017) and Oleforuh-Okoleh *et al.* (2015).

## MATERIALS AND METHODS

### LOCATION OF THE STUDY

The study was carried out at the Broiler Unit, Teaching and Research Farm, Ladoko Akintola University of Technology, Ogbomosho. Ogbomosho is located in the derived savannah that lies on longitude 4° 101 East of Greenwich meridian and Latitude 8° 101 North of the equator. The altitude ranges from 300 m to 600 m above sea level while the mean temperature and annual rainfalls are 270 °C and 1247 mm, respectively (Google Earth, 2018).

### PROCUREMENT, PREPARATION AND PROCESSING OF *Picralima nitida* SEEDS

The *Picralima nitida* pods originated from the Ago Owu Farm Settlement in Ikoyi, Osun State, Nigeria. The preparation followed the guidelines provided by Haruna & Odunsi (2022), and the aqueous extraction was completed by macerating the seed powder following the instructions provided by Modu *et al.* (2017) and Haruna & Odunsi (2022). 800 ml of distilled water and 200g of powdered *Picralima nitida* seed were macerated for 72 hours before the mixture was filtered through a muslin cloth. When it came time for the animal trial, the filtrate (water extract) was added to the birds' drinking water after being stored at 4°C.

### EXPERIMENTAL BIRDS, TREATMENTS, MANAGEMENT AND STUDY LAYOUT

One hundred and fifty (150) day-old broiler chicks (Arbor Acre) from a reputable hatchery in Ibadan, Nigeria were used for the experiment. The birds were randomly allotted five dietary treatments (A-E) of 3 replicates each with 10 birds per replicate after the initial weight has been taken using Century digital scale produced in China and the scale could weigh up to 3kg to the nearest 0.1g. On arrival, the birds were offered diets and water mixed with vitamins and glucose to minimise transportation stress. The birds were subjected to standard poultry routine practices such as brooding, vaccination and with or without medication throughout the experimental period.

The birds were offered feed and drinkable water ad-libitum on daily basis throughout the experiment which lasted for seven (7) weeks. Broiler starter diets were offered from day 1-3 weeks while broiler finisher diets were offered from 4-7 weeks. Five (5) Iso-nitrogenous and iso-caloric broiler starter and finisher diets were formulated.

The birds were all fed the same basal diets and the layout of the experiment is presented in Table 1. Zero point one (0.1) % PnSP was included in the diet of a group while the 25 ml bitter leaf extract/litre of water recommended by Rafiu *et al.* (2019) was adopted for inclusion of the PnSE in the other group. Both PnSP and PnSE replaced the administration of antibiotics on days 2-6, anti-coccidiosis on days 15-25, tylosin on days 30-34 and finally anti-coccidiosis on days 37-38 as shown in Table II.

**TABLE I: LAYOUT OF EXPERIMENT**

A	B	C	D	E
-	0.1% PnSP in feed		25ml PnSE / litre of water	
+ M	+ M	- M	+ M	- M

M = Normal routine medication

**TABLE II: GROSS COMPOSITION OF STARTER AND FINISHER DIETS (DM %)**

Ingredients (%)	(Starter) day 1-3 weeks	(Finisher) 4-7 weeks
Maize	52.10	57.00
Soya bean meal	27.00	23.00
Groundnut cake	8.00	4.00
Wheat offal	5.00	8.60
Fish meal (72%)	3.00	2.50
Di-calcium Phosphate	3.00	3.00
Oyster shell	1.00	1.00
Lysine	0.20	0.20
Methionine	0.25	0.25
Broiler Premix*	0.25	0.25
Salt	0.20	0.20
<b>Total</b>	<b>100</b>	<b>100</b>
<b>Calculated composition (%)</b>		
Crude Protein	21.6	18.8
Ether Extract	2.97	3.05
Crude Fibre	4.40	4.44
Metabolizable Energy (kcal/Kg)***	2707.9	2709.4
<b>Analysed composition (%)</b>		
Crude Protein	23.05	19.91
Ether Extract	5.05	4.66
Crude Fibre	4.31	5.09
Ash	7.10	6.90
Dry Matter	93.11	93.55
NFE**	53.60	56.99
Metabolizable Energy (kcal/Kg)***	2875.67	2903.66

\*100 kilogram of diet contained the following vitamins and minerals: Vitamin A = 12IU, Vitamin D<sub>3</sub> = 2500IU, Vitamin E = 30mg, Vitamin K = 2mg, Vitamin B<sub>1</sub> = 2.25mg, Vitamin B<sub>2</sub> = 6mg, Vitamin B<sub>12</sub> = 0.015mg, Niacin = 40mg, Pantothenic Acid = 15mg, Folic Acid = 0.05mg, Biotin = 300mg, Chloride = 80mg, Manganese = 50mg, Zinc = 20mg, Iron = 5mg, Copper = 5mg, Iodine = 1mg, Selenium = 0.2mg, Cobalt = 0.5mg and Antioxidant = 125(IU); \*\* Nitrogen Free Extract, \*\*\* Calculated from ingredient analysis table

**TABLE III: MEDICATION AND VACCINATION SCHEDULES**

Days	Medication and vaccination		Route of administration
	Birds with medication	Birds without medication	
1	Vitamins and glucose D	Vitamins and glucose D	Oral
2-6	Anti-biotic	PnSP/PnSE	Oral
7	1 <sup>st</sup> Lasota	1 <sup>st</sup> Lasota	Oral
8-13	Vitamins	Vitamins	Oral
14	1 <sup>st</sup> Gumboro	1 <sup>st</sup> Gumboro	Oral
15-17	Vitamins	Vitamins	Oral
18	2 <sup>nd</sup> Lasota	2 <sup>nd</sup> Lasota	Oral
19-25	Anti coccidiosis	PnSP/PnSE	Oral
26	2 <sup>nd</sup> Gumboro	2 <sup>nd</sup> Gumboro	Oral
27-29	Vitamins	Vitamins	Oral
30-34	Tylosin	PnSP/PnSE	Oral
37-38	Anti coccidiosis	PnSP/PnSE	Oral
39-49	Vitamins	Vitamins	Oral

## RESULTS

The effects of *P. nitida* seed powder (PnSP) / *P. nitida* seed extract (PnSE) on growth performance during the starter phase (1-21 d) are presented in Table 4. The FLW and ADG were positively and significantly ( $p < 0.001$ ) influenced by PnSP and PnSE while there were no significant ( $p = 0.15$ ,  $p = 0.62$  and  $0.45$ ) differences for FI, Feed: Gain and % Survivability. The effects of PnSP / PnSE with or without medication on growth performance during the finisher phase (22-49 d) are presented in Table 4. Positive ( $p = 0.05$ ,  $0.04$  and  $< 0.001$ ) values were recorded with the use of PnSP and PnSE with or without medication on ADG, ADFI and FGR; however, no significant effect was observed on FLW ( $p = 0.13$ ) and percentage survivability ( $p = 0.45$ ) of the birds. Following the same trend with the finisher phase, Table 4 showed that PnSP and PnSE with or without medication improved  $p = 0.01$  ADFI and FGR when pooled together. Numerically, the FLW ranged between 2955.93 g (PnSE+M) to 3358.33 g (PnSP+M) and survivability ranges 93.33% (PnSE+M) to 100.00% (PnSP-M and PnSE-M).

Though the general performance was impressive, however, the FGR was poorer with the inclusion of PnSP and PnSE in feed and water with or without medication when compared with the control. Glycemic index value elicited a significant ( $p = 0.05$ ) difference in fasting blood sugar as presented in Table 5, the sugar was reduced significantly with the inclusion of PnSP and PnSE in the diets and water of the birds. The reduction was more prominent in birds without routine medications.

The serum biochemical analysis presented in Table 6 indicated that all parameters were significantly ( $p < 0.05$ ) influenced except for globulin, alanine transaminase and alkaline phosphatase. The significant values of total protein ( $P = 0.01$ ), albumin ( $P = 0.03$ ), aspartate transaminase ( $P = 0.04$ ), urea ( $P = 0.01$ ) and cholesterol ( $P = 0.05$ ) were inconsistent.

However, for the majority of the parameters, the highest values were observed in birds fed a diet containing PnSP without medication.

The haematological parameters of broiler chickens fed diets containing PnSP/PnSE indicated that *P. nitida* had ( $p < 0.05$ ) significant and positively influence all parameters except haemoglobin ( $P = 0.12$ ), eosinophils ( $p = 0.35$ ), basophils ( $p = 0.45$ ) and MCV ( $P = 0.22$ ) (Table 7).

Broilers on D (PnSE+M) had the highest values for packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC) and heterophils. Treatment E (PnSP-M) had the highest value of monocytes ( $p = 0.01$ ), MCH ( $0.001$ ) and MCHC ( $p = 0.03$ ). Total bacteria count (TBC) and total fungi count (TFC) of the jejunum are presented in Table 8. Birds on the control diet had a higher microbial count (bacteria ( $2.7 \times 10^6$  CFU/ml) and fungi ( $1.3 \times 10^6$  CFU/ml)) compared with those on the treated diets with *P. nitida* (with or without medication).

The seven bacterial species isolated were *Escherichia coli*, *Streptococcus species*, *Micrococcus species*, *Bacillus subtilis* (non-pathogenic), *Pseudomonas aeruginosa*, *Enterobacter cloaca* and *Klebsiella oxytoca* (pathogenic), however, only *Escherichia coli* spp were found in all the treatments. *Aspergillus flavus*, *Fusarium oxysporum*, *Penicillium notatum*, *Aspergillus niger* and *Fusarium solani* are the five fungal spp observed in the jejunum, the treated birds did not have *Aspergillus flavus* when compared with the control birds.

**TABLE IV: GROWTH PERFORMANCE OF BROILER CHICKENS SUBJECTED TO PnSP AND PnSE WITH OR WITHOUT ROUTINE MEDICATIONS AT STARTER**

Parameters (g)	A Control	B PnSP+M	C PnSP-M	D PnSE+M	E PnSE-M	SEM	P. Value
<b>Starter</b>							
Initial live weight (g)	40.84	40.99	39.76	40.81	41.01	0.23	0.46
Final live weight (g)	872.59 <sup>b</sup>	951.67 <sup>a</sup>	925.00 <sup>a</sup>	955.19 <sup>a</sup>	923.33 <sup>a</sup>	8.89	<0.001
Average daily gain (g)	39.61 <sup>b</sup>	43.37 <sup>a</sup>	42.15 <sup>a</sup>	43.54 <sup>a</sup>	42.02 <sup>a</sup>	0.42	<0.001
Average daily feed intake (g)	56.01	66.43	65.35	64.75	61.67	1.48	0.15
Feed : Gain	1.41	1.53	1.55	1.49	1.47	0.03	0.62
%Survivability	96.67	100.00	100.00	100.00	100.00	0.67	0.45
<b>Finisher</b>							
Initial live weight (g)	872.59	951.67	925.00	955.19	923.33	8.89	<0.001
Final live weight (g)	3298.81	3358.33	3141.11	2955.93	3123.33	54.60	0.13
Average daily gain (g)	86.65 <sup>a</sup>	85.95 <sup>a</sup>	79.15 <sup>ab</sup>	71.46 <sup>b</sup>	78.57 <sup>ab</sup>	1.99	0.04
Average daily feed intake (g)	149.80 <sup>b</sup>	173.45 <sup>a</sup>	162.89 <sup>ab</sup>	173.80 <sup>a</sup>	161.01 <sup>ab</sup>	3.04	0.04
Feed : Gain	1.73 <sup>c</sup>	2.02 <sup>a</sup>	2.06 <sup>b</sup>	2.45 <sup>a</sup>	2.05 <sup>bc</sup>	0.07	<0.001
%Survivability	100.00	96.67	100.00	96.67	100.00	0.91	0.58
<b>Pooled</b>							
Initial live weight (g)	40.84	40.99	39.76	40.81	41.01	0.23	0.44
Final live weight (g)	3298.81	3358.33	3141.11	2955.93	3123.33	54.60	0.13
Average daily gain (g)	66.49	67.70	63.29	59.49	62.90	1.11	0.13
Average daily feed intake (g)	109.6 <sup>b</sup>	127.58 <sup>a</sup>	121.09 <sup>ab</sup>	127.06 <sup>a</sup>	118.44 <sup>ab</sup>	2.07	0.01
Feed : Gain	1.65 <sup>c</sup>	1.89 <sup>b</sup>	1.91 <sup>b</sup>	2.15 <sup>a</sup>	1.89 <sup>b</sup>	0.05	0.01
%Survivability	96.67	96.67	100.00	93.33	100.00	1.18	0.38

phase (day 1-21)

<sup>a, b</sup>: Treatment values on the same row with different superscripts are significantly different (p<0.05).SEM = Standard Error Mean PnSP+M= *Picralima nitida* Seed Powder + Medication;PnSP-M = *Picralima nitida* Seed Powder – Medication; PnSE+M = *Picralima nitida* Seed Extract +Medication;PnSE-M = *Picralima nitida* Seed Extract – Medication**TABLE V: GLYCEMIC INDEX OF BROILER CHICKENS SUBJECTED TO PnSP AND PnSE WITH OR WITHOUT ROUTINE MEDICATIONS**

Parameters	A Control	B PnSP+M	C PnSP-M	D PnSE+M	E PnSE-M	SEM	P. Value
Glycemic index	227.00 <sup>a</sup>	205.33 <sup>ab</sup>	178.00 <sup>b</sup>	211.67 <sup>ab</sup>	183.33 <sup>b</sup>	6.34	0.05

<sup>a, b</sup>: Treatment values on the same row with different superscripts are significantly different (p<0.05).PnSP + M= *Picralima nitida* Seed Powder + Medication; PnSP-M = *Picralima nitida* Seed Powder – Medication; PnSE + M =*Picralima nitida* Seed Extract +Medication; PnSE - M = *Picralima nitida* Seed Extract – Medication

**TABLE VII: HAEMATOLOGICAL INDICES OF BROILER CHICKENS SUBJECTED TO PnSP AND PnSE WITH OR WITHOUT ROUTINE MEDICATIONS**

Parameters	A Control	B PnSP+M	C PnSP-M	D PnSE+M	E PnSE-M	SEM	P. Value
Packed cell volume (%)	36.50 <sup>ab</sup>	35.00 <sup>b</sup>	35.00 <sup>b</sup>	39.50 <sup>a</sup>	37.50 <sup>ab</sup>	0.59	0.05
Haemoglobin (g/dl)	12.15	11.70	11.85	13.10	12.75	0.20	0.12
Red blood cell ( $\times 10^9$ /dl)	3.05 <sup>ab</sup>	2.95 <sup>b</sup>	2.90 <sup>b</sup>	3.30 <sup>a</sup>	3.15 <sup>ab</sup>	0.05	0.05
White blood cell ( $\times 10^3$ /ml)	15.55 <sup>a</sup>	11.65 <sup>b</sup>	12.00 <sup>b</sup>	16.00 <sup>a</sup>	11.40 <sup>b</sup>	0.64	0.01
Heterophils (%)	28.00 <sup>b</sup>	34.00 <sup>a</sup>	34.00 <sup>a</sup>	34.00 <sup>a</sup>	25.00 <sup>b</sup>	1.09	<0.001
Lymphocyte (%)	67.00 <sup>a</sup>	63.50 <sup>b</sup>	62.00 <sup>b</sup>	62.50 <sup>b</sup>	69.50 <sup>a</sup>	0.90	<0.001
Eosinophils (%)	1.00	0.50	1.00	1.00	1.50	0.15	0.35
Basophils (%)	1.50	0.50	1.50	1.50	1.00	0.20	0.45
Monocytes (%)	2.00 <sup>b</sup>	1.50 <sup>b</sup>	1.50 <sup>b</sup>	1.00 <sup>b</sup>	3.00 <sup>a</sup>	0.22	0.01
MCV (fL)	119.80	118.65	120.70	119.70	119.10	0.29	0.22
MCH (%)	39.85 <sup>b</sup>	39.65 <sup>b</sup>	40.85 <sup>a</sup>	39.70 <sup>b</sup>	40.45 <sup>a</sup>	0.14	<0.001
MCHC (Pg)	33.25 <sup>bc</sup>	33.40 <sup>abc</sup>	33.85 <sup>ab</sup>	33.15 <sup>c</sup>	34.00 <sup>a</sup>	0.11	0.03

<sup>abc</sup>: Treatment values on the same row with different superscripts are significantly different ( $p < 0.05$ ).

MCV = Mean corpuscular volume; MCH = Mean corpuscular haemoglobin; MCHC = Mean corpuscular haemoglobin concentration; PnSP + M = *Picralima nitida* Seed Powder + Medication; PnSP-M = *Picralima nitida* Seed Powder – Medication; PnSE + M = *Picralima nitida* Seed Extract + Medication; PnSE-M = *Picralima nitida* Seed Extract – Medication

**TABLE VIII: MICROBIOLOGICAL ASSAY OF THE GUT OF BROILER CHICKENS SUBJECTED TO PnSP AND PnSE WITH OR WITHOUT ROUTINE MEDICATIONS**

Treatment	Total Bacteria Count (TBC)							Total Fungi Count (TFC)						
	TAC ( $\times 10^6$ CFU/ml)	1	2	3	4	5	6	7	TAC ( $\times 10^6$ CFU/ml)	1	2	3	4	5
Control	2.7	+	+	+	+	+	-	-	1.3	+	-	+	-	+
PnSP+M	2.1	+	+	+	+	-	-	-	1.0	+	+	+	-	-
PnSP-M	2.0	+	+	-	-	-	+	+	0.8	+	+	-	+	-
PnSE+M	1.7	+	-	-	-	+	-	-	0.7	-	+	+	+	-
PnSE-M	1.2	+	-	-	-	-	+	+	0.4	+	+	-	+	-

KEY for TBC: <sup>1</sup>= Non-pathogenic, <sup>2</sup>= Pathogenic and TAC = Total aerobic count

1 = *Escherichia coli*<sup>1</sup>, 2 = *Klebsiella oxytoca*<sup>2</sup>, 3 = *Bacillus subtilis*<sup>1</sup>, 4 = *Streptococcus species*<sup>1</sup>, 5 = *Pseudomonas aeruginosa*<sup>2</sup>, 6 = *Enterobacter cloaca*<sup>2</sup>, 7 = *Micrococcus species*<sup>1</sup>

KEY for TFC: 1 = *Fusarium oxysporum*, 2 = *Penicillium notatum*, 3 = *Aspergillus niger*, 4 = *Fusarium solani*, 5 = *Aspergillus flavus*

PnSP+M = *Picralima nitida* Seed Powder + Medication; PnSP-M = *Picralima nitida* Seed Powder – Medication; PnSE+M = *Picralima nitida* Seed Extract + Medication; PnSE-M = *Picralima nitida* Seed Extract – Medication

## DISCUSSION

During the starter phase, an increase in live weight and weight gain were observed with the use of PnSP and PnSE with or without medication, thereby showing *P. nitida* as a growth stimulant either with or without routine medication. The increase in ADG with the use of PnSP with medication could be attributed to the synergetic effect of PnSP and synthetic drugs. These findings corroborate reports by Lala et al. (2017) with *Morinda lucida*; Mondal et al. (2015) and Choudhury, (2017) with turmeric powder; Goodarzi et al. (2013) and An et al. (2015) with onion bulb powder and extract showed that performance of broiler chickens was improved at starter phase with the use of those phytochemicals. Yaghobfar et al. (2011) and Goodarzi & Nanekarami

(2014) showed that aqueous onion extract and turmeric powder, respectively, did not have a significant influence on broiler chicken's growth performance at the starter phase. Bera et al. (2013) investigated the possible toxic effects of the petroleum ether, ethyl acetate and methanol extracts of *Musa paradisiaca* leaf in adult Swiss albino mice and did not observe any change in the final body weight and feed intake of mice administered with the various extracts. They concluded that the extracts may be safe in Swiss albino mice. It was revealed at the finisher phase that birds on PnSP+M had a comparable weight gain with the control birds; however, the birds on the control diet had the best FGR. The depression in ADG and poorest FGR despite the highest value of ADFI with the combination of PnSE and medication could be that they (PnSE and synthetic antibiotics and anticoccidiosis) have an anti-synergy effect or overdose due to high alkaloid in PnSE. Sekhar et al. (2012) and Perviz et al.

(2016) reported that toxicity of phyto-additive could be attributed to dosage, exposure time, and sensitivity, site of action and developmental stage of the animal involved. The anti-microbial activity of PnSP could enhance food digestion and assimilation consequently, improving the ADG of the birds as observed in the present study implying that PnSP with or without medication and PnSE-M can be used as a phyto-additive in broiler chickens.

The result supported the report of Oleforuh-Okoleh *et al.* (2015) that birds fed banana leaf powder performed better than those administered banana leaf infusion. Lala *et al.* (2017) also reported that *Morinda lucida* powder should be used with medication and anti-coccidiosis to have a better performance but disagreed with Olusola *et al.* (2018) who reported that birds administered onion skin extract performed better than those fed diets containing onion skin powder. Bitter leaf aqueous extract (Goodarzi & Nanekarami, 2014) and dietary onion (*Allium cepa*) extract (Aditya *et al.*, 2017) had also been reported to have a positive influence on the performance of broiler chickens. Phytoadditives contain active substances that improve digestion, metabolism and possess antibacterial and immunostimulant activities (Ghazalah & Ali, 2008).

The reduction in the glycemic index values with the inclusion of *P. nitida* in the diet of the birds could be attributed to the presence of erinidine (alkaloids) in *P. nitida* as reported by Adeneye & Cooks (2015). The result corroborates the reports of Adeneye *et al.* (2013) that PnSP attenuates an increase in post-absorptive blood glucose concentrations after 3g/kg glucose loaded in the rats and Olufunmilayo *et al.* (2015) also reported that PnSP has a hypoglycemic effect and may also reduce oxidative stress in albino rats.

Adeneye & Cooks (2015) and Olufunmilayo *et al.* (2015) also reported that *H. umbellata* reduces fasting blood glucose levels in alloxan-induced diabetic rats. The increase in the values of serum total protein (TP) with the use of *P. nitida* with or without medication in association with reduction in the creatinine suggested good health status of the birds. The inclusion of the PnSP and PnSE with or without medication could neither impair renal function nor expose the birds to potential kidney damage, specifically by renal filtration mechanism (Wasan *et al.*, 2001). The liver and kidney play a major role in metabolic processes, while the liver detoxifies substances that are harmful to the body; the kidney helps in the maintenance of homeostasis by reabsorbing vital substances and excretion of waste products (Greaves, 2007). The positive effect of PnSP on serum metabolites could be accorded to the appreciable amount of alkaloids (Olufunmilayo *et al.*, 2015).

The significant increase observed in albumin of the birds fed PnSP without medication resulted in a significant positive influence in TP in the birds, thereby supporting the report of Mousa *et al.* (2017) that the addition of *Moringa oleifera* and *Cichorium intybus* in diets of broiler chickens had a positive influence on TP and albumin. Albumin and globulin are the major proteins found in the blood and their concentration in the blood can drop in cases of malnutrition and infection. Globulin proteins consist of antibodies, enzymes and other types of proteins that help in fighting infections and

enhancing the blood clotting process and serve as hormone carriers, and transport the hormones to different parts of the body (Oleforuh-Okoleh *et al.*, 2015).

Uric acid is the first acute renal marker of renal injury while creatinine is the most reliable renal indicator and it increases only when the majority of renal functions are lost (Borges *et al.*, 2005). Creatinine levels decreased with the use of PnSP and PnSE with or without medication. The reduction was more significant with the use of routine medications plus PnSP and PnSE indicating that the use of *P. nitida* maintained the liver, most especially when combined with routine medications. The current study supports the findings of Ghazalah & Ali (2008) and Oleforuh-Okoleh *et al.* (2015) that Rosemary and banana leaves significantly reduced the creatinine level in the blood.

Aspartate aminotransferase (AST) and alanine transaminase (ALT) are the two main liver functional blood serum tests. AST and ALT are found primarily in the liver as well as in the heart, kidney, pancreas, muscles and red blood cells. They are normally elevated in cases of tissue damage, especially in the heart and liver. The magnitude of elevation of the values varies, depending on the cause of the hepatocellular injury. A very high ALT level suggests viral or severe drug-induced hepatitis or other hepatic diseases with extensive death of liver cells. The AST level fluctuates depending on the extent of cell death. Serum biochemical parameters related to hepatic functions in the present study indicated that there was no significant influence on AST concentration in the control, PnSP+M, PnSE+M and PnSE-M when compared with PnSP-M which was significantly higher. However, the mean values obtained were within the normal range reported by Fraser (1986) and An *et al.* (2015). Thus, the values obtained on AST and ALT levels imply that both the powder and extract with or without medication could not cause toxic effects on the heart tissue (Crook, 2006).

Haematological results showed significant influence on all parameters except for haemoglobin, RBC, eosinophils, basophils and MCV which were not influenced significantly. Haematological parameters are indicators of the physiological status of poultry birds and animals at large (Esonu *et al.*, 2006). The powder and extract did not adversely affect the treated birds as evident in the comparable values for the control and treated groups at the end of the experimental period. However, the values of PCV, Hb, RBC and WBC fell within the normal ranges for broilers as reported by Mitruka & Rawnsley (1981). The stability in the haematological constituents observed in the present study is an indication that the inclusion of *P. nitida* (powder and extract) did not have any pathological effect on the birds, thus, did not cause any haematological disorder.

The seven bacterial species isolated in the jejunum of the birds were *Klebsiella oxytoca*, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Streptococcus specie*, *Micrococcus specie* and *Enterobacter cloaca*. *Escherichia coli* was the only specie found in all the treatments. Four of the organisms are non-pathogenic (*Escherichia coli*, *Bacillus subtilis*, *Streptococcus specie*, *Micrococcus specie*) while three were pathogenic (*Klebsiella oxytoca*, *Pseudomonas aeruginosa*, *Enterobacter cloaca*). *Aspergillus flavus*,

*Fusarium oxysporum*, *Penicillium notatum*, *Aspergillus niger* and *Fusarium solani* were the five spp. of fungi observed in the jejunum.

The birds on PnSP or PnSE did not have *Aspergillus flavus*. The antimicrobial activities of plants and essential oils have been well documented while its toxicological effects are seen only at very high doses. The active constituents in *P. nitida* which are erinidine, allicin in garlic and piperine in black pepper are solely responsible for the reduction of total bacterial load and *E. coli* count (Gopi et al., 2014 and Olufunmilayo et al., 2015). Bacteria and fungi count generally and specifically, pathogenic organisms were drastically reduced with the use of *P. nitida* with /or without medication and this could be attributed to the presence of erinidin and other alkaloids. Previous findings on garlic (Fayed et al., 2011), oregano and garlic oil (Kirkpinar et al., 2011) and composites of cinnamon, timur, organum and tulsi (Bishnu et al., 2009) showed a significant reduction in the microbial population of the GIT and inhibit the activity of *Staphylococcus Aureus*, *Bacillus subtilis*, *Bacillus cereus* and *Bacillus thuringiensis*. The inhibition of *Klebsiella sp*, *Pseudomonas aeruginosa*, *Bacillus subtilis* and *Streptococcus* spp. with the use of *P. nitida* is similar to the result obtained with *Morinda lucida* (Lala et al., 2017).

## CONCLUSION

Based on the results obtained from this study, it could be concluded that the use of *P. nitida* with or without medication in broiler chicken's diet improved ADG of broiler chickens at the starter phase; moreover, at the finisher phase, control birds and those supplemented with PnSP+M gained higher weight when compared across the treatments, however, those on control had the best FGR. There was stability in the serum and haematological indices observed in the study which were within normal physiological range of avian. This is an indication that the inclusion of *P. nitida* (powder and extract) did not in any way cause any pathological effect on the birds, thus farmers are encouraged to use it as growth promoter in broiler production. *Picalima nitida* seed powder and the extract with or without medication also reduced the blood sugar level and abdominal fat.

## RECOMMENDATION

The use of 0.1% PnSP and 25 ml PnSE / litre of water with or without routine medication could be adopted in broiler rearing; however, further research should investigate the protein-sparing effect of PnSP in sub-optimal protein broiler diets.

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