

Dietary Supplementation of Poultry Herbs® on Growth performance, Immune Response and Haemato-Biochemical Parameters of Hubbard Broiler Chicken

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Received date: August 18, 2025; **Accepted date:** October 20, 2025; **Published date:** October 30, 2025

Citation: Eimoga A.A, Mubarak Olalekan Badmus and Alagbe, J.O, (2025), Dietary supplementation of Poultry Herbs® on Growth performance, Immune response and Haemato-Biochemical Parameters of Hubbard Broiler Chicken, *J Clinical Research and Reports*, 21(3); DOI:10.31579/2690-1919/571

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Abstract

A 42 days study was carried out to examine the effect of dietary supplementation of Poultry herbs® on growth performance, immune response and haemato-biochemical parameters of Hubbard broiler chicken. 600 1-day- old broiler chicks (Hubbard) of mixed sex were randomly distributed into 5 treatment groups and each treatment had 5 replicates (20 birds per replicate). Experimental diet meets the requirement provided by the Nutritional Research Council. Neomycin was supplemented at 10 g/kg diet for birds in group A while poultry herbs (PH) was supplemented at 5 g, 10 g, 15 g, 20 g and 25 g/kg diet for birds in group B, C, D, E and F respectively using a completely randomized design. Clean water was also offered *ad libitum*. Analysis of phyto-constituents in PH showed that terpenoids (1091 mg/g), phenol (1000.3 mg/g) and flavonoids (977.4 mg/g) are the most prominent compound followed by alkaloids (500.9 mg/g), tannins (411.6 mg/g), steroids (208.5 mg/g), saponins (100.6 mg/g) and glycosides (86.55 mg/g) respectively. Average daily weight, average daily feed consumption and feed conversion ratio improved in birds fed PH in group: B, C, D, E and F compared to group A ($p < 0.05$). Higher mortality was recorded among birds in group A (2.20 %) and lower in group B (1.00 %) while none was recorded in the other groups. Population of microbes in the caecum, *Escherichia coli*, *Staphylococcus spp*, *Salmonella spp*, *Streptococcus spp*, *Pseudomonas spp*, *Proteus spp* were higher among birds in group A compared to other groups fed with PH whereas *Lactobacillus spp* were higher among birds in group B, C, D, E and F than in group A ($p < 0.05$). Haematocrit, total erythrocytes, hemoglobin, total leucocytes, lymphocytes, total protein, glucose, cholesterol, immunoglobulin (A, G and M) values were influenced ($p < 0.05$) except for basophil count ($p > 0.05$). It was concluded that PH is rich in phyto-constituents that are non-toxic and could be supplemented up to 25 g/kg in the diet of broilers without their growth performance and health status.

Kew Words: antimicrobials; broilers; growth; plants; performance; phyto-constituents

Introduction

PH an acronym for poultry herbs is a blend of different medicinal plants consisting of dried garlic, ginger, turmeric, neem seeds, papaya seeds and *Capsicum annuum*. These plants have been explored in traditional medicine for the treatment of various ailments such as, skin infections, gastrointestinal disorder, snake bite, eye problem, sexually transmitted disease, kidney and liver diseases amongst others (Shanmugapriya et al., 2012; Klavina et al., 2015). Medicinal plants are rich in phyto-constituents (flavonoids, phenols, terpenoids, saponins, alkaloids, tannins, steroids etc.) which confers them the ability to perform multiple pharmacological roles such as, anti-inflammatory, antifungal, antiviral, immune-stimulatory, anti-helminthic, anti-tumor, antioxidant, cytotoxic,

antidiarrheal, antimicrobial, cardio-protective, gastro-protective, antibacterial, anti-diabetic and antiviral (Karthika and Paulsamy, 2014; Mamza et al., 2012; Nurdiani et al., 2012).

The concentration of these phyto-constituents can be influenced by age of plant, specie, location and processing methods (Ojediran et al., 2024b; Alagbe, 2024). Furthermore, extracts from medicinal plants have been suggested to inhibit the activities of some pathogenic organisms such as, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, *Staphylococcus epidermidis*, *Klebsiella pneumonia*, *Salmonella spp* and *Candida albicans* (Manilal et al., 2011; Davendran and Balasubramanian, 2011; Prabhu and Guruvayoorappan, 2012).

Medicinal plants have also been reported to be toxic free, eco-friendly, effective and has no withdrawal period (Alagbe, 2024).

Previous studies have revealed that supplementation of medicinal plants in the diet of birds have beneficial effects on the secretion of endogenous enzymes (Lewis et al., 2003; Muritala et al., 2022), palatability and absorption of digested nutrients (Adewale et al., 2021), growth, efficient protection against pathogenic organisms through its immune system (Musa et al., 2020; Shittu et al., 2023) and modulation of fatty acid in meat samples (Lee et al., 2003). Mazharul et al. (2024) reported that Moringa powder dietary supplementation at 0.4 % had positive influence on the growth performance of birds. Mitsch et al. (2004) also confirmed that supplementation of essential oil at 200 mg/kg diet influenced carcass characteristics of broiler chickens.

In view of the abundant potential in PH and the urgent need to address the increasing cases of antimicrobial resistance, this study was designed to investigate the influence of dietary supplementation of Poultry herbs on growth performance, immune response and heamato-biochemical indices of Hubbard broilers.

Materials and methods

Experimental site and purchase of Poultry herbs

The Poultry section at Sumitra Research Institute, Gujarat India was used for the study (7°25' N and 5°19' E). The experiment was carried out in accordance to the research ethics and guidelines of Animal management department of the Institute with reference number (SDM/02025) and the duration of the research was 42 days.

Poultry herbs (PH) was purchased from a Veterinary store in Kurama Street, Gbagyi Villa, Kaduna State, Nigeria. 50 g of the sample was placed in an airtight polythene bag and sent to biochemistry laboratory at Sumitra Research Institute, Gujarat, India for further analysis. Concentrations of phyto-constituents in PH were assayed as previously described by Alagbe (2024).

Management of birds, design and experimental diet

Healthy 600 1-day- old broiler chicks (Hubbard) of mixed sex were randomly distributed into 5 treatment groups and each treatment had 5 replicates (20 birds per replicate) and transferred to an already disinfected battery cage. Upon arrival, birds were unboxed and their average initial body weight was taken using a digital sensitive scale (Xenum model T608, China). Birds were fed starter diet (week one to three) and finisher

(week four to six). Experimental diet meets the requirement provided by the Nutritional Research Council in 1994 as presented in Table 1. Neomycin was supplemented at 10 g/kg diet for birds in group A while poultry herbs (PH) was supplemented at 5 g, 10 g, 15 g, 20 g and 25 g/kg diet for birds in group B, C, D, E and F respectively. A completely randomized design was used for the experiment while birds had unrestricted access to clean water. Parameters determined includes, final live weight, total feed consumption and feed conversion ratio from day 1 to 42.

Evaluation of blood parameters

On the 42nd day of the experiment three birds were randomly selected per replicate for haematological and serum biochemical indices. Blood samples (4 mL each per bird) was collected from the wing vein into labeled sample bottles. Bottles for haematology contains anti-coagulant (EDTA) while those for serum parameters was without anticoagulant. Haematological parameters were determined using COF[®] automatic dual blood analyzer (Model DF09C, China) while serum samples were analyzed using Syntex biochemical analyzer (Model BBOX/667, China). Each kit was operated adhering strictly to their manufacturer instructions and recommendations.

Intestinal microbial population and immune estimation

For intestinal microbial estimation, two birds were randomly selected per replicates. 5g of intestinal content was collected into a labeled sample bottle followed by the addition of few drops of 1% peptone reagent before it was taken to the laboratory for further analysis. Enumeration of intestinal microbes was done using Dulox[®] microbial analyzer (Model BN/009C/025, Korea).

Immunoglobulin A, G and M count was done on the last day of the experiment by randomly selecting three birds per replicate (from same birds used for blood analysis). Analysis was carried out using Gluex[®] Auto-Immunex (Model FV/009V/ER04, China).

Data analysis

Data obtained were analyzed using General Linear Model procedures of Statistical Analysis System (SAS, version 9.1.3 of 2010). Differences in mean were computed using Duncan's Multiple Range Test for multiple comparisons. Significance was determined at $p < 0.05$.

Experimental Results

Components	Starter (1-21d)	Finisher (22-42d)
Corn	50.00	57.5
Soy bean meal (47.0 percent)	35.75	32.4
Fish meal (70.0 percent)	7.20	3.00
Oyster shell	4.00	4.00
Bone meal	2.00	2.00
Lysine	0.25	0.25
Methionine	0.25	0.25
Premix (0.25 %)	0.25	0.25
Sodium chloride	0.30	0.35
Total	100.0	100.0
Determined values (%)		
Crude protein (g/kg)	234.5	210.7
Crude fibre (g/kg)	34.88	37.90
Ether extract (g/kg)	42.16	38.57
Lysine (g/kg)	12.17	11.06
Methionine (g/kg)	4.95	4.81
Methionine + Cysteine (g/kg)	8.74	7.39
Energy (ME/Kcal/kg)	2996.5	3170.9

Vitamin and Mineral premix Each 2.5 kg consists of: Vit A 18,000, 000 IU; Vit D3, 4000, 000 IU; Vit. E. 20g; Vit k3 6 g; Vit B1, 2500 mg ; Vit B2, 100g ; Vit B6, 300 g; Vit B12, 50 mg; Pantothenic acid, 100 g; Niacin, 85 g , Folic acid , 1900 mg ; Biotin, 100 g; Choline Chloride, 660 mg, Fe, 60 g; Mn, 120 g; Cu, 3.7 g; Co, 250 mg; Si, 180 mg and Zn , 96 g

Table 1: Nutrient composition of experimental diet (Starter and finisher mash)

Components	Concentrations (mg/g)
Terpenoids	1091.2
Tannins	411.6
Alkaloids	500.9
Flavonoids	977.4
Phenols	1000.3
Saponins	100.6
Glycosides	86.55
Steroids	208.5

Table 2: Phyto-components in P-Herbs used for the experiment

Parameters	A	B	C	D	E	F	SEM
Starter phase (1 to 21 days)							
Experimental period (days)	42.00	42.00	42.00	42.00	42.00	42.00	-
Initial body weight (g/bird)	50.09	50.02	50.01	49.99	49.97	49.86	0.01
Final body weight (g/bird)	600.1 ^c	750.3 ^b	755.2 ^b	766.4 ^b	900.9 ^a	910.1 ^a	56.31
***Average daily weight gain (g/bird)	28.57 ^c	35.72 ^b	35.96 ^b	36.49 ^b	42.90 ^a	43.33 ^a	20.78
Feed consumption (g/bird)	1500.6 ^c	1744.8 ^b	1750.1 ^b	1751.6 ^b	1818.3 ^a	1822.9 ^a	110.2
Average daily feed consumption (g/bird)	71.45 ^c	83.02 ^b	83.33 ^b	83.40 ^b	86.58 ^a	86.80 ^a	0.05
feed conversion ratio	2.50 ^a	2.32 ^b	2.32 ^b	2.28 ^b	2.01 ^c	2.00 ^c	0.001
Mortality (%)	1.20 ^a	0.00	0.00	0.00	0.00	0.00	0.01
Finisher phase (22-42 days)							
Average body weight gain (g/bird)	1154.1 ^c	1390.6 ^b	1394.7 ^b	1577.2 ^a	1580.8 ^a	1590.2 ^a	97.22
Average daily body weight gain (g/bird)	54.95 ^c	66.21 ^b	66.41 ^b	75.10 ^a	75.27 ^a	75.72 ^a	0.06
Feed consumption (g/bird)	3000.2	3001.3	3005.7	3110.5	3115.4	3118.2	160.9
Average daily feed consumption (g/bird)	142.8	142.9	143.1	148.1	148.3	148.4	0.09
feed conversion ratio	2.59 ^a	2.15 ^b	2.15 ^b	2.00 ^c	2.00 ^c	2.00 ^c	0.01
Mortality (%)	1.00 ^a	1.00 ^b	0.00	0.00	0.00	0.00	0.01
Overall production (1-42 days)							
Total weight gain	1754.21 ^c	2140.9 ^b	2149.9 ^b	2343.6 ^a	2481.7 ^a	2500.3 ^a	100.3
*Average daily weight gain (g/bird)	41.76 ^c	50.97 ^b	54.18 ^b	55.80 ^b	59.08 ^a	59.53 ^a	0.03
Total feed consumption (g/bird)	4500.8 ^b	4746.1 ^a	4755.8 ^a	4862.1 ^a	4933.7 ^a	4941.1 ^a	171.9
**Average daily feed consumption (g/bird)	107.1 ^b	116.0 ^a	116.2 ^a	116.8 ^a	117.4 ^a	117.6 ^a	0.07
Feed conversion ratio	2.56 ^a	2.21 ^b	2.21 ^b	2.07 ^b	2.00 ^c	2.00 ^c	0.02
Mortality (%)	2.20 ^a	1.00 ^b	0.00	0.00	0.00	0.00	0.01

Values followed by different letters were significantly different ($p < 0.05$); Group A: Experimental diet with Neomycin at 10 g/kg diet; Group B, C, D, E and F: Experimental diet supplemented with Poultry herbs (PH) at 5 g, 10g, 15 g, 20 g and 25 g/kg respectively. SEM: standard error of mean; *total weight gain/42 d; ** total feed consumption/42d; ***final body weight - initial body weight

Table 3: Impact of P-herbs supplementation on the growth performance of Hubbard broiler chickens

Components	A	B	C	D	E	F	SEM
Hematocrit (%)	28.66 ^b	29.41 ^b	33.89 ^a	33.97 ^a	33.91 ^a	34.05 ^a	6.21
Total erythrocytes ($\times 10^{12}/L$)	1.98 ^c	2.45 ^b	3.00 ^a	3.01 ^a	3.05 ^a	3.13 ^a	0.05
Haemoglobin (g/L)	89.44 ^c	100.0 ^b	119.7 ^a	120.1 ^a	121.5 ^a	124.6 ^a	10.40
Total leucocytes ($\times 10^9/L$)	16.73 ^b	18.55 ^b	23.08 ^a	23.16 ^a	23.25 ^a	23.33 ^a	0.44
Basophils (%)	1.43	1.48	1.75	1.78	1.88	1.94	0.02
Heterophils (%)	31.95 ^a	30.51 ^a	26.90 ^b	26.94 ^b	25.88 ^b	25.80 ^b	4.91
Lymphocytes (%)	60.52 ^b	69.04 ^b	75.08 ^a	75.11 ^a	76.02 ^a	76.09 ^a	7.06

Values followed by different letters were significantly different ($p < 0.05$); Group A: Experimental diet with Neomycin at 10 g/kg diet; Group B, C, D, E and F: Experimental diet supplemented with Poultry herbs (PH) at 5 g, 10g, 15 g, 20 g and 25 g/kg respectively. SEM: standard error of mean

Table 3: Impact of dietary supplementation of P-herbs on the haematological parameters of Hubbard broilers

Components	A	B	C	D	E	F	SEM
Total protein (g/dL)	3.13 ^c	4.11 ^b	4.40 ^a	4.50 ^a	4.62 ^a	4.73 ^a	0.13
Albumin (g/dL)	1.46 ^c	2.11 ^b	2.38 ^b	2.42 ^a	2.50 ^a	2.58 ^a	0.04
Globulin (g/dL)	1.57 ^c	2.00 ^b	2.02 ^b	2.08 ^b	2.12 ^a	2.15 ^a	0.03
Glucose (mg/dL)	128.6 ^a	112.3 ^b	110.9 ^b	95.61 ^c	92.30 ^c	91.47 ^c	9.55
Cholesterol (mg/dL)	102.8 ^a	92.51 ^b	90.55 ^b	80.43 ^c	80.21 ^c	80.20 ^c	8.02

Values followed by different letters were significantly different ($p < 0.05$); Group A: Experimental diet with Neomycin at 10 g/kg diet; Group B, C, D, E and F: Experimental diet supplemented with Poultry herbs (PH) at 5 g, 10g, 15 g, 20 g and 25 g/kg respectively. SEM: standard error of mean

Table 4: Impact of dietary supplementation of P-herbs on the serum biochemical parameters of Hubbard broilers

Variables	A	B	C	D	E	F	SEM
IgA (mg/dL)	1.79 ^b	2.30 ^a	2.37 ^a	2.46 ^a	2.80 ^a	2.95 ^a	0.03
IgG (mg/dL)	0.88 ^b	1.62 ^a	1.71 ^a	1.73 ^a	1.80 ^a	1.85 ^a	0.02
IgM (mg/dL)	0.93 ^b	1.76 ^a	1.81 ^a	1.82 ^a	1.87 ^a	1.96 ^a	0.02

Values followed by different letters were significantly different ($p < 0.05$); Group A: Experimental diet with Neomycin at 10 g/kg diet; Group B, C, D, E and F: Experimental diet supplemented with Poultry herbs (PH) at 5 g, 10g, 15 g, 20 g and 25 g/kg respectively. SEM: standard error of mean

Table 5: Influence of P-herbs supplementation on the Immune parameters of Hubbard broilers

Variables (Log 10 CFU)	A	B	C	D	E	F	SEM
<i>Escherichia coli</i>	3.05 ^a	2.83 ^b	2.57 ^b	2.52 ^b	2.51 ^b	2.51 ^b	0.03
<i>Staphylococcus spp</i>	3.77 ^a	2.91 ^b	2.33 ^b	2.21 ^b	2.16 ^b	2.16 ^b	0.03
<i>Streptococcus spp</i>	2.78 ^a	1.92 ^b	1.01 ^b	0.92 ^b	0.91 ^b	0.90 ^b	0.04
<i>Lactobacillus spp</i>	3.63 ^c	4.61 ^b	5.06 ^a	5.11 ^a	5.16 ^a	5.29 ^a	0.12

Values followed by different letters were significantly different ($p < 0.05$); Group A: Experimental diet with Neomycin at 10 g/kg diet; Group B, C, D, E and F: Experimental diet supplemented with Poultry herbs (PH) at 5 g, 10g, 15 g, 20 g and 25 g/kg respectively. SEM: standard error of mean

Table 6: Influence of P-herbs supplementation on the Intestinal microflora of Hubbard broilers

Phyto-components in P-Herbs used for the experiment revealed that terpenoids had the highest concentration of 1091.2 mg/g than phenol (1000.3 mg/g), flavonoids (977.4 mg/g), alkaloids (500.9 mg/g), tannins (411.6 mg/g), steroids (208.5 mg/g), saponins (100.6 mg/g) and glycosides (86.55 mg/g) as presented in Table 2.

Impact of P-herbs supplementation on the growth performance of Hubbard broiler chickens is presented in Table 3. In the starter phase, average daily weight gain and average daily feed consumption follow similar trend, birds fed diet B (5 g PH per kg diet), C (10 g PH per kg diet) and D (15 g PH per kg) were similar ($p > 0.05$). Those which received diet E and F (20 g and 25 g PH per kg diet) were also similar ($p > 0.05$) but significantly higher than birds fed diet A (basal diet with 10 g Neomycin® per kg diet). Feed conversion ratio and percentage mortality values which

varied from 2.00 - 2.50 and 1.00 - 1.20 % were significantly affected ($p < 0.05$) by the treatment. In the finisher phase, average daily weight gain (54.95 - 75.72 g/bird) were higher among birds which received diet D, E and F, intermediate in diet B and C, lowest in diet A ($p < 0.05$). Average daily feed consumption values (142.8 - 148.4 g/bird) were not influenced ($p < 0.05$). Conversely, feed conversion ratio was higher among birds which received diet A, intermediate in diet B and C, lowest among bird given diet D, E and F ($p < 0.05$). In the overall production cycle (1-42d), average daily weight gain values which varied from 41.76 to 59.53 g/bird were higher among birds in diet E (59.08 g) and F (59.93 g), intermediate in diet B (53.97 g), C (54.18 g), D (55.80 g) and lower in diet A (41.76 g) ($p < 0.05$). Average daily feed consumption were higher among birds fed diet supplemented with PH relative to those given diet A ($p < 0.05$). Feed

conversion ratio decreases as the level of PH supplementation increased in the diet of birds ($p < 0.05$).

Impact of dietary supplementation of P-herbs on the haematological parameters of Hubbard broilers is presented in Table 3. Total erythrocytes values varied from 1.98 to 3.13 ($\times 10^{12}/L$), haemoglobin (89.44 - 124.6 g/L), haematocrit (28.66 - 34.05 %), total leucocytes [(16.73 - 23.33 ($\times 10^9/L$)), heterophils (25.80 - 31.95 %) lymphocytes (60.52 - 76.09 %) were all influenced ($p < 0.05$) by the treatments except for basophils count (1.43 - 1.94 %) ($p > 0.05$).

Impact of dietary supplementation of P-herbs on the serum biochemical parameters of Hubbard broilers is presented in Table 4. Total protein, albumin and globulin values among birds fed diet D, E was similar to F ($p > 0.05$) but significantly higher than those that received diet A and B ($p < 0.05$). Cholesterol and glucose values follows similar trend, as their concentrations were higher ($p < 0.05$) in among birds given diet A [(102.8 mg/dL; 128.6 mg/dL)] than in diet B [(92.51 mg/dL; 112.3 mg/dL)], C [(90.55 mg/dL; 110.9 mg/dL)]; D [(80.43 mg/dL; 95.61 mg/dL)], E [(80.21 mg/dL; 92.30 mg/dL)] and F [(80.20 mg/dL; 91.47 mg/dL)] respectively.

Influence of P-herbs supplementation on the Immune parameters of Hubbard broilers (Table 5). Immunoglobulin A, G and M concentrations were lower ($p < 0.05$) among birds that received diet A [(1.79; 0.88; 0.93 (mg/dL)] than diet B [2.30; 1.62; 1.76 (mg/dL)], C [(2.37; 1.71; 1.81 (mg/dL)], D [(2.46; 1.73; 1.82 (mg/dL)], E [(2.80; 1.80; 1.87 (mg/dL)] and diet F [(2.95; 1.85; 1.96 (mg/dL)] in that order.

Influence of P-herbs supplementation on the Intestinal microflora of Hubbard broilers is presented in Table 6. Intestinal count of *Escherichia coli*, *Staphylococcus spp* and *Streptococcus spp* were higher ($p < 0.05$) among birds fed diet A [(3.05; 3.77; 2.78 (Log 10 CFU)] than B [(2.83; 2.91; 1.92 (Log 10 CFU)], C [(2.57; 2.33; 1.01 (Log 10 CFU)], diet D [(2.52; 2.21; 0.92 (Log 10 CFU)], E [(2.51; 2.16; 0.91 (Log 10 CFU)] and F [(2.51; 2.16; 0.90 (Log 10 CFU)]. Conversely, *Lactobacillus spp* count were higher ($p < 0.05$) among birds that received diet F [(5.29 (Log 10 CFU)], E [(5.16 (Log 10 CFU)], D [(5.11 (Log 10 CFU)], C [(5.06 (Log 10 CFU)], B [(4.61 (Log 10 CFU)] and A [(3.63 (Log 10 CFU)].

Discussion

Phytochemicals or phyto-constituents are natural non-toxic, ecofriendly and effective compounds with abundant medicinal and pharmacological properties such as anti-inflammatory, anti-cancer, anti-helminthic, immune-modulatory, anti-malarial, cytotoxic, antidiarrheal, antioxidant, anti-tumor, antifungal, antimicrobial, anti-hypertensive, antibacterial, cardio-protective amongst others (Ojediran et al., 2024b; Singh et al., 2022). Phyto-constituents are also regarded as the power house of medicinal plants (Alagbe, 2025). The most prominent compounds (terpenoids, phenols and flavonoids) in poultry herbs (PH) observed in this study indicates that it has antimicrobial, anti-inflammatory, immunostimulatory and antibacterial activities (Ojediran et al., 2024a; Oluwafemi et al., 2021). They also have the capacity to prevent the activities of free radicals and prevents pathogens from attaching itself to the intestinal walls of birds, thus preventing infections (Musa et al., 2020). The synergy of these compounds with tannins, alkaloids, saponins, glycosides and steroids ensures a healthy gut and strong immune system to maintain good health and performance among birds (Omokore and Alagbe, 2019). Results on the overall performance revealed that as the level of dietary supplementation of PH increased across the group led to a significant improvement in average daily weight gain of birds. Though birds diet D (15 g PH per kg), diet E and F (20 g and 25 g PH per kg diet) had a higher body weight gain compared to those which received diet A and B while birds given diet A had the lowest weight gain. This suggests that supplementation of PH encourages birds endogenous enzyme secretion thus resulting in improved nutrient digestibility and growth (Oluwafemi et al., 2021; Agubosi et al., 2021). The activities these phyto-constituents also produce a gastro-protective and hepato-protective results in birds

(Alagbe, 2024). This outcome is in consonance with the reports of (John, 2024b) when phytoconstituents was supplemented in the diet of broiler chickens. Similarly, average daily feed consumption was higher among birds fed with PH compared to those which received solely antibiotics (group A). This result suggests that the supplementation of PH in the diet makes it more palatable. Feed palatability is a combination of flavour, taste, and mouth feel, as well as physiological responses following digestion that determine feed consumption (Ruben, 2023; John, 2024c). Result obtained is in agreement with the reports of Daniel et al. (2023) when pawpaw essential oil is supplemented in the diet of broilers. PH have also shown to possess strong antimicrobial affinity for undesirable pathogens in the gut of birds compared to those given antibiotics (Aliyu et al., 2024). It is important to note that PH does not deposit toxic substances in animal products or cause multi-drug resistance (John, 2024a). Alagbe (2025) reported that supplementation of medicinal plants in the diet of birds have inhibited pathogens like *Escherichia coli*, *Staphylococcus spp*, *Salmonella spp*, *Streptococcus spp*, *Pseudomonas spp*, *Proteus spp* amongst others in the gut thereby reducing inflammation and prevents them from attachment to the intestinal wall (Omokore and Alagbe, 2019; John, 2024e). They also allow the proliferation of beneficial bacteria like *Lactobacillus spp*, thus providing a balanced intestinal flora (Musa et al., 2020; Adewale et al., 2021). This is similar to the mode of action of PH recorded in this experiment. By supplementing PH in the diet of birds creates a positive impact in the gut and also mitigate against health challenges.

The presence of phyto-constituents in PH can also boost immune defense by promoting or stimulating birds' antibody production to neutralize free radicals and reducing oxidative stress in the gut (Alagbe et al., 2025; Shittu et al., 2024). This result suggests that PH possess antioxidant properties possibly due to the presence of terpenoids, flavonoids and phenolic compound (Singh et al., 2022). Result obtained in this study agrees with the reports of Muritala et al. (2022) when *Polyalthia longifolia* leaf extracts was given to broiler chickens in the place of conventional antibiotics.

The haematocrit, haemoglobin and total erythrocyte values were within the normal ranges (25.00 to 35.00 %), (70.00 to 130.00 g/L) and (1.50 to 3.50 $\times 10^{12}/L$) reported by Abdi-Hachesoo et al. (2011) and Kalita et al. (2018). Higher levels haematocrit, haemoglobin and total erythrocyte reported especially among birds that received PH suggests an improvement in oxygen-carrying capacity of the cells, thus resulting in sufficient nutrients in the tissue of birds (John, 2024d; Ladokun et al., 2008). The result obtained in this study also suggests the absence of bone marrow disorder and vitamin deficiency especially folate in the blood (Alagbe et al., 2022; Islam et al., 2004). Total leucocytes, heterophils, basophils and lymphocytes were within the normal baseline ranges 10.00 - 25.00 ($\times 10^9/L$), 20.00 - 40.00 %, 1.00 - 2.50 % and 45.00 - 85.00 % reported by Talebi et al. (2005); Dalai et al. (2015). Total leucocytes and their differentials (basophils, heterophils and lymphocytes) are involved in the protection of the body against infections (Campbell, 2012).

Impact of dietary supplementation of P-herbs on the serum biochemical parameters of Hubbard broilers revealed that total protein, albumin and globulin values were within the range of 3.00 - 5.50 g/dL, 1.85 - 2.92 g/dL and 1.50 - 2.50 g/dL reported by Simaraks et al. (2004). Abdi-Hachesoo et al. (2013) also confirmed that total protein values for broilers varied from 2.60 - 6.50 g/dL. The result obtained indicates the absence of hepatic dysfunction and also a sign that the birds were well nourished (Keçeci and Çöl, 2011). The birds fed PH had values of cholesterol which were lower than the normal range (100.0–150.0 mg/dL) reported by Campbell (2012). However, the values were within the normal range (110 to 250 mg/dL) as cited by Keçeci and Çöl, 2011). Result obtained suggests that supplementation of PH in the diet could lower serum cholesterol, thus performing cardio-protective properties (Café et al., 2012; Wati et al., 2015). Concentrations of glucose in this experiment 91.47 - 128.6 mg/dL was lower than the baseline values of 190 - 510 mg/dl cited by Thrall

(2007). Elevation in glucose concentrations can be as a result environmental stress or poor animal management (Adewale et al., 2021).

Conclusion

Result obtained suggests that PH had positive effect on the growth performance of birds especially when supplemented up to 20 g/kg diet. PH are toxic free and can hinder the activities of *Escherichia coli*, *Staphylococcus spp*, *Salmonella spp*, *Streptococcus spp*, *Pseudomonas spp*, *Proteus spp* and increase the proliferation of *Lactobacillus spp* thus creating a balanced gut. Blood parameters examined were within the established range for birds suggesting that broilers were healthy.

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DOI:[10.31579/2690-1919/571](https://doi.org/10.31579/2690-1919/571)

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