Effect of dietary supplementation of *Picralima nitida* seed powder on haemato-serological profile and meat quality of broiler chickens

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Abstract

The residual effects and microbial resistance associated with the use of synthetic drugs in animal bodies necessitate the use of phytoadditives as organic-based medications in poultry diets. An organic alternative is *Picralima nitida* with promising antimicrobial, hypoglycemic, and hypolipidemic activities that could possibly improve poultry health. This study, therefore, evaluated the response of broiler chickens to *Picralima nitida* Seed Powder (PnSP) using 300 day-old Arbor Acre (AA) broiler chicks. They were allotted to five dietary treatments with 6 replicates each and were fed 0, 0.05, 0.1, 0.15, and 0.2% PnSP-based starter (21 days) and finisher (28 days) diets in a Completely Randomised Design (CRD). Cooking Loss (CL), Crude Protein (CP), Ether Extract (EE), and sensory attributes of the meat were determined. For blood profile, Glycemic Index (GI), globulin, glucose, creatinine, Alkaline Phosphatase (ALP), Packed Cell Volume (PCV), and Red Blood Cell (RBC) were determined. Data collected were subjected to One-way Analysis of Variance (ANOVA) at $p < 0.05\%$. No significant ($p = 0.47$) effect on GI; however, the values reduced with an increase in PnSP. CL ($p < 0.001$), CP ($p < 0.001$), and EE ($p = 0.04$) were significantly influenced in a non-definite pattern, and the sensory attributes of the boiled meat were ($p > 0.05$) influenced by PnSP. Globulin ($p = 0.01$), glucose ($p = 0.01$), and ALT ($p < 0.001$) increased with the use of PnSP, while creatinine ($p = 0.03$) decreased with an increase in PnSP. However, ALP was ($p < 0.001$) influenced in a non-definite pattern. In conclusion, 0.1% PnSP improved globulin, glucose, PCV, RBC, and reduced the creatinine level of broiler chickens.

Keywords: *Picralima nitida*, glycemic, cooking loss, serology, haematology.

Efeito da suplementação dietética com pó de sementes de Picralima nitida sobre o perfil hemato-serológico e a qualidade da carne de frangos de corte

Resumo

O efeito residual e a resistência microbiana associadas ao uso de fármacos sintéticos em organismos animais têm impulsionado o uso de fitoativos como alternativas orgânicas nas dietas de aves. Uma dessas alternativas promissoras é a Picralima nitida, planta com reconhecidas atividades antimicrobianas, hipoglicemiantes e hipolipemiantes, que pode contribuir para a melhoria da saúde avícola. Este estudo avaliou a resposta de frangos de corte à suplementação com pó de sementes de *Picralima nitida* (PnSP). Foram utilizados 300 pintos de um dia da linhagem Arbor Acres, distribuídos em cinco tratamentos dietéticos (0, 0,05, 0,1, 0,15 e 0,2% de PnSP), com 6 repetições cada, em delineamento inteiramente casualizado. As dietas foram formuladas para as fases inicial (21 dias) e final (28 dias). Avaliaram-se perda por cocção (CL), proteína bruta (PB), extrato etéreo (EE) e atributos sensoriais da carne. Para o perfil sanguíneo, foram determinados o índice glicêmico (IG), globulina, glicose, creatinina, fosfatase alcalina (ALP), volume globular (VG) e hemácias (eritrócitos). Os dados foram submetidos à análise de variância (ANOVA) a 5% de significância. Não houve efeito significativo sobre o IG ($p = 0{,}47$), embora os valores tenham reduzido com o aumento do PnSP. A CL ($p < 0{,}001$), PB ($p < 0{,}001$) e EE ($p = 0{,}04$) foram significativamente influenciadas, porém sem padrão definido, enquanto os atributos sensoriais da carne cozida não foram significativamente alterados ($p > 0{,}05$). Houve aumento dos níveis de globulina ($p = 0{,}01$), glicose ($p = 0{,}01$) e ALT ($p < 0{,}001$), e redução da creatinina ($p = 0{,}03$) com o uso crescente de PnSP. A

ALP foi significativamente afetada (*p* < 0,001), porém sem padrão definido. Conclui-se que a inclusão de 0,1% de PnSP na dieta melhora os níveis de globulina, glicose, VG, eritrócitos e reduz a creatinina em frangos de corte.

Palavras-chave: *Picralima nitida*, índice glicêmico, perda por cocção, sorologia, hematologia.

1. Introduction

Blood profile data could help in the improvement of broiler chickens' health (Livingston *et al*., 2020; Ogbuewu *et al*., 2023). It could help in diagnosing specific poultry pathogens and might serve as basic knowledge for studies in immunology and comparative avian pathology (Bonadiman *et al*., 2009). Generally, haematological and serological analyses are usually used to assess the health status of animals since they are good indicators of the physiological appearance of animals and their changes are important in assessing the response of such animals to various physiological situations as well as stress (Afolabi et al., 2010; Sharifian et al., 2019; Piray et al., 2022;) which may be attributed to environmental, nutritional and/or pathological factors.

One of the health-promoting effects of phytochemicals from plants arises from their protective effects of counteracting reactive oxygen species, as well as their antimicrobial action. Several studies affirmed that plants that are rich in antioxidants, antimicrobials, hypolipidemic, and anti-inflammation play a protective role against health-related issues (Haruna; Odunsi 2018c). The potential of these medicinal plants may be related to the concentration of phenolic substances (flavonoids, hydrolyzable tannins, proanthocyanidins, phenolic acids, phenolic terpenes) and alkaloids, as well as some vitamins (A, C, and E) (Tungmunnithum et al., 2018).

The use of phytoadditives such as herbs and spices in poultry production has been reported (Morakinyo et al., 2017) to improve the productive performance and health status of birds and thereby enhance the flavour and palatability of their products (Windisch et al., 2008). Today, herbs and spices are extensively studied because of their potent properties and use as alternative non-antibiotic growth promoters and health stabilizers (Lee et al., 2013). The use of *Picralima nitida* (K. Schum) Hallier, an underutilized herb, is of concern in this study due to the extensive and indiscriminate use of antibiotics in Nigerian poultry production.

This unexploited plant is of substantial medicinal value that has been linked to its therapeutic properties such as: antioxidant, anti-inflammatory, hypoglycemic, anthelminthic, anti-microbial, aphrodisiac, and analgesic values (Ajayi; Ojelere, 2013; Olufunmilayo et al., 2015; Akinsola, 2016) which could be attributed to the presence of phytochemicals like tannins, alkaloids, steroids, saponins, and phenols (Nkere; Iroegbu, 2005). The nutritional, mineral, and phytochemical contents of *P. nitida* have been described to make it a potential herb for adoption in the livestock industry (Ajayi; Ojelere, 2013; Haruna; Odunsi, 2022).

This study was therefore carried out to evaluate the effects of *Picralima nitida* on haematological and serological profiles as well as the meat quality of broiler chickens.

2. Materials and Methods

2.1 Description of experimental site

The study was carried out at the Broiler Unit, Teaching and Research Farm, Ladoke Akintola University of Technology, Ogbomoso. Ogbomoso is located in the derived savannah that lies on longitude 4º 10^1 East of the Greenwich meridian and Latitude 8º 10^1 North of the equator. The altitude ranges from 300 m to 600 m above sea level, while the mean temperature and annual rainfall are 27 °C and 1247 mm, respectively (Google Earth, 2018).

2.2 Procurement and processing of Picralima nitida seed

Picralima nitida pods were sourced from Ago Owu Farm Settlement, Ikoyi, Osun State, Nigeria. The pod and leaves of the plant were taken to Forestry Research Institute of Nigeria (FRIN) for identification and authentication in the herbarium, taxonomy section, and a herbarium number FHI-113021 was obtained. The pods were broken to remove the seeds, processed to powder form as described (Haruna; Odunsi, 2022) in the Animal Biosciences Unit of the Department of Animal Nutrition and Biotechnology, LAUTECH, Ogbomoso. The seeds were cleaned with distilled water, de-hulled, and diced into small pieces with a stainless knife to facilitate air-drying a room temperature for 4 days, when constant weights were obtained. The dried seeds were screened to remove undesirable materials such as stones and other extraneous matter and thereafter, were milled with Super Master

(SMB-2977) electric blender into powder form termed *Picralima nitida* Seed Powder (PnSP) and stored in an air-tight container and kept in a cool place until needed for chemical analysis and animal trial.

2.3 Experimental birds, diets, and management

Three hundred (300) day-old broiler chicks (Arbor Acre) from a reputable hatchery in Nigeria were used for the experiment. On arrival, the birds were randomly allotted to five dietary treatments of 6 replicates each after the initial weight had been taken using a Camry (Emperors) digital weighing scale. The model number of the scale is El-02HS with a weighing capacity of 3000 g and to the nearest 0.5 g. 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, medication and vaccination at appropriate ages in the course of the experiment following the general instructions of institutional rules for the care and use of laboratory animals, particularly the chickens were treated humanely following the Ethics approved by Departmental ethical committee (LAUTECH-APH20-30) of the Faculty of Agricultural Sciences (Animal welfare board). The birds were offered feed and drinkable water *ad libitum* daily throughout the experiment, which lasted for seven (7) weeks. Broiler starter diets were offered from 0-3 weeks, while broiler finisher diets were offered from 4-7 weeks. Five iso-nitrogeneous and iso-caloric broiler starter and finisher diets were formulated such that PnSP was included at five levels (0, 0.05, 0.1, 0.15 and 0.2%) to diets, A, B, C, D and E respectively, at starter and finisher phases and their control diets are presented in Table 1.

2.4 Data collection

2.4.1 Determination of haematological and serological parameters

At the 49th day of the study, 5 ml of blood was collected from three (3) birds per replicate, making 18 per treatment via the jugular vein. An initial 2.5 ml blood was collected into labelled sterile universal bottles containing Ethylene-Diamine-Tetra-Acetic acid (EDTA) as anticoagulant used to determine the haematological components Packed Cell Volume (PCV), Red Blood Cell (RBC), Haemoglobin concentration (Hb), White Blood Cell (WBC), and Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), and their differential counts were calculated within an hour of sample collection following standard procedures described by Dacie and Lewis (1991).

Another 2.5 ml of blood was collected into labelled sterile sample bottles without anticoagulant and used to determine the biochemical components (Total protein, total cholesterol, glucose, albumin, globulin, urea, Aspartate Transaminase (AST), Alanine Transaminase (ALT) and Alkaline Phosphatase (ALP) following standard procedures described by Mitruka and Rawnsley (1977).

2.5 Meat quality analysis

2.5.1 Cooking for weight loss

At the end of the experiment, day 49 of the study, three (3) birds per replicate were slaughtered and meat samples were collected from the breast of the birds on a replicate basis, weighed using a Camry (Emperors) digital weighing scale. The model number of the scale is El-02HS with a weighing capacity of 3000 g and to the nearest 0.5 g. The weighed samples were placed in separate sealed polythene bag according to each treatment and cooked in a water bath for 20 min at 70 °C. After cooking, the residual moisture was removed from each of the meat samples by pouring away the water in the polythene. The boiled meat samples were allowed to cool to room temperature, and the differences in weight were recorded as weight loss (Allen et al., 1998).

Cooking loss (g) = Raw weight – Cooked weight

$$\% \text{ Cooking loss} = \frac{\text{Cooking loss} * 100}{\text{Raw weight}}$$

Table 1. Gross and analysed composition of starter (0-3 weeks) and finisher (4-7 weeks) phases (DM %).

Ingredients (%)	Starter	Finisher
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% CP)	3.00	2.50
Di-calcium phosphate	3.00	3.00
Lime stone	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
Picralima nitida seed powder	-	-
Total	100	100
Analysed composition (%)		
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

Note: *100 kilogram of diet contained the following vitamins and minerals**:** Vitamin A = 12IU, Vitamin D_3 = 2500IU, Vitamin E = 30 mg, Vitamin K = 2 mg, Vitamin B_1 = 2.25 mg, Vitamin B_2 = 6 mg, Vitamin B_{12} = 0.015 mg, Niacin = 40 mg, Pantothenic Acid = 15 mg, Folic Acid = 0.05 mg, Biotin = 300 mg, Chloride = 80 mg, Manganese = 50 mg, Zinc = 20 mg, Iron = 5 mg, Copper = 5 mg, Iodine = 1 mg, Selenium = 0.2 mg, Cobalt = 0.5 mg and Antioxidant = 125(IU). ** Nitrogen Free Extract, *** Calculated from ingredient analysis table. Source: Authors, 2025.

2.6 Sensory evaluation

Samples from the breast muscles were also collected on a replicate basis, washed individually in clean water, packed in a transparent double-layer polythene bag, and tagged for identification. Thereafter, they were boiled in a water bath at 70 °C for 20 min and allowed to cool to room temperature before being served to panellists. Ten semi-experienced panellists were used for the sensory evaluation of the boiled meat samples of the breast muscles. Each panellist was required to masticate one sample per treatment with ranked preference in the following categories: colour, juiciness, flavour, tenderness, and general acceptability. A nine-point hedonic scale was used, 1 referring to extremely dislike and 9 as extremely like (Cross et al., 1978).

2.7 Proximate analysis

The proximate composition of starter and finisher diets and meat samples was determined by using the A.O.A.C. (2007) methods.

2.8 Statistical analysis

The data collected were subjected to one-way analysis of variance (ANOVA) using the procedure of SAS (2003).

Significant mean differences were determined using *Duncan's* Multiple Range Test of the same package at 5% probability level.

Model for one way: $Y_{ij} = \mu + \alpha_i + e_{ij}$

Where:

Y_{ij} = jt:h observation of the ith treatment

μ = Population mean

α_i = Effect of ith PnSP (i=0, 0.05, 0.1, 0.15 and 0.2)

e_{ij} = Experimental Error

3. Results

The serological indices of broilers fed diets supplemented with varying levels of PnSP are presented in (Table 2). All the parameters measured were significantly ($p < 0.05$) influenced, except for TP, ALT, and cholesterol. The highest ($p < 0.001$ and < 0.001) values for glucose (173.40 mg/dL), AST (3.10 μ/dL), and ALP (35.50 μ/dL) were observed in treatment E (0.2% PnSP), and the lowest in the control.

Table 2. Effect of PnSP on serological indices of broiler chickens.

Parameters	A (Control)	B (0.05_{PnSP})	C (0.10_{PnSP})	D (0.15_{PnSP})	E (0.20_{PnSP})	SEM	P. Value
Total protein (mg/dL)	3.75	5.10	4.75	5.10	5.45	0.22	0.14
Albumin (mg/dL)	2.45	2.75	2.65	2.85	3.25	0.13	0.38
Globulin (mg/dL)	1.30^{b}	2.35^{a}	2.10^{a}	2.25^{a}	2.20^{a}	0.12	0.01
Glucose (mg/dL)	111.55^{c}	152.25^{ab}	136.05^{bc}	138.70^{bc}	173.40^{a}	6.40	0.01
Creatinine (mg/dL)	1.55^{ab}	2.65^{a}	0.75^{b}	0.95^{b}	1.45^{b}	0.22	0.03
Urea (mg/dL)	6.50^{a}	4.10^{b}	6.45^{a}	6.50^{a}	4.70^{ab}	0.35	0.04
Cholesterol (mg/dL)	76.94	67.23	61.34	63.62	59.50	0.57	0.44
Aspartate transaminase (μ/dL)	62.50^{b}	61.50^{b}	85.50^{a}	69.00^{b}	85.00^{a}	3.10	<0.001
Alanine transaminase (μ/dL)	26.00	22.50	29.00	28.00	26.00	1.10	0.48
Alkaline phosphatase (μ/dL)	34.50^{a}	27.00^{c}	29.50^{bc}	32.50^{ab}	35.50^{a}	0.96	<0.001

Note: ^{abc} Treatment values on the same row with different superscripts are significantly different ($p < 0.05$). PnSP = *Picralima nitida* Seed Powder. Source: Authors, 2025.

The haematological parameters of broilers fed diets supplemented with varying levels of PnSP (Table 3) revealed that all parameters measured were significantly ($p < 0.05$) influenced by PnSP-supplementation, except for eosinophils and basophils that showed ($p = 0.27$) similarity across the treatments. Birds on 0.2% PnSP had the highest ($p < 0.05$) PCV; Hb, RBC, WBC, lymphocyte, MCH, and MCHC, and the lowest values did not follow a definite pattern. The WBC decreased at the inclusion level of 0.05% PnSP but later increased in other supplementation levels. The lymphocyte count was ($p = 0.01$) depressed at treatment C (0.10% PnSP) and D (0.15% PnSP); however, there were no significant differences among treatments A (control), B (0.05% PnSP), and E (0.20% PnSP). MCV and MCH values were significantly ($p < 0.001$) reduced at 0.1% PnSP, with MCHC having the lowest ($p < 0.001$) value at 0% PnSP.

Table 3. Effect of PnSP on haematological parameters of broiler chickens.

Parameters	A (Control)	B (0.05_{PnSP})	C (0.10_{PnSP})	D (0.15_{PnSP})	E (0.20_{PnSP})	SEM	P. Value
PCV (%)	26.50^{b}	33.00^{a}	33.50^{a}	31.00^{a}	34.00^{a}	0.82	<0.001
Hb (g/dl)	8.40^{c}	11.00^{b}	10.90^{ab}	10.30^{ab}	11.35^{a}	0.30	<0.001
RBC ($\times10^9$/dL)	2.20^{d}	2.75^{bc}	3.05^{a}	2.55^{c}	2.80^{b}	0.80	<0.001
WBC ($\times10^3$/mL)	11.40^{b}	9.25^{c}	10.45^{bc}	11.10^{b}	13.15^{a}	0.37	<0.001
Heterophils (%)	29.00^{bc}	30.50^{bc}	34.00^{ab}	38.00^{a}	26.00^{c}	1.32	0.01
Lymphocyte (%)	69.50^{ab}	68.00^{ab}	65.00^{bc}	62.00^{c}	73.00^{a}	1.19	0.01
Eosinophils (%)	0.00	0.00	0.00	0.00	0.50	0.00	0.27
Basophils (%)	0.00	1.00	0.00	0.00	0.00	0.11	-
Monocytes (%)	1.50^{a}	0.00^{b}	1.00^{ab}	0.00^{b}	0.50^{ab}	0.12	0.03
MCV (FI)	120.45^{a}	119.95^{a}	109.85^{b}	121.55^{a}	121.45^{a}	1.37	<0.001
MCH (%)	38.15^{b}	40.00^{a}	35.70^{c}	40.40^{a}	40.50^{a}	0.51	<0.001
MCHC (Pg)	31.75^{c}	33.30^{a}	32.50^{b}	33.20^{a}	33.35^{a}	0.81	<0.001

Note: ^{abc}: Treatment values on the same row with different superscripts are significantly different (p<0.05). Hb = Haemoglobin, MCV = mean corpuscular volume, MCH= Mean corpuscular haemoglobin, MCHC= mean corpuscular haemoglobin concentration, PnSP= *Picralima nitida* Seed Powder, WBC = White blood cell, WBC = Red blood cell, PCV = Packed cell volume

The blood glycemic index and meat quality (water loss and proximate composition) of broiler chickens fed diets supplemented with varying levels of PnSP are presented in (Table 4). The fasting blood sugar test had no significant (p = 0.47) effect, but the values reduced with the inclusion of PnSP, and the lowest value was observed in treatment C (0.1% PnSP). Water loss of the boiled chickens was significantly ($p < 0.001$) influenced by treatment B (0.05% PnSP), having the highest. The crude protein (CP) and ether extract (EE) values significantly ($p < 0.001$ and p = 0.04) increased with the increase in the inclusion of PnSP but drastically decreased at 0.2% PnSP when compared with the control. Values for DM were not significantly (p = 0.29) influenced by dietary treatments.

Table 4. Effect of PnSP on glycemic and meat quality of broiler chickens.

Parameters	A (Control)	B (0.05_{PnSP})	C (0.10_{PnSP})	D (0.15_{PnSP})	E (0.20_{PnSP})	SEM	P. Value
Glycemic (mg/dL)	160.33	163.33	142.00	145.33	149.33	4.20	0.47
Cooking loss (g)	45.80^{c}	57.10^{a}	45.00^{d}	36.40^{e}	50.40^{b}	1.80	<0.001
			Meat composition				
CP (%)	23.24^{b}	23.60^{b}	24.40^{b}	26.31^{a}	18.69^{c}	1.38	<0.001
EE (%)	8.42^{bc}	8.33^{bc}	8.89^{ab}	9.68^{a}	7.50^{c}	0.44	0.04
DM (%)	42.45	41.88	42.81	43.84	43.13	0.58	0.29

Note: ^{abc} Treatment values on the same row with different superscripts are significantly different ($p < 0.05$). CP = crude protein, EE = ether extract, DM = dry matter, PnSP = *Picralima nitida* Seed Powder. Source: Authors, 2025.

The sensory attributes of boiled meat from broiler chickens fed diets supplemented with varying levels of PnSP (Table 5) revealed no ($p > 0.05$) influence of PnSP.

Table 5. Effect of PnSP on sensory attributes of broiler chickens' breast muscle.

Parameters	A (Control)	B (0.05_{PnSP})	C (0.10_{PnSP})	D (0.15_{PnSP})	E (0.20_{PnSP})	SEM	P. Value
Colour	5.67	5.67	6.17	6.17	6.83	0.33	0.82
Flavour	5.83	5.33	4.33	4.67	5.83	0.35	0.60
Juiciness	5.83	5.17	4.83	5.50	5.00	0.28	0.84
EF	5.67	6.00	5.50	6.17	6.67	0.25	0.64
AA	5.67	5.33	5.17	5.50	5.67	0.33	0.98
RAC	3.67	4.50	4.33	5.67	5.83	0.37	0.32
OA	6.33	5.67	4.83	5.33	6.00	0.37	0.76

Note: ^{ab} Treatment values on the same row with different superscripts are significantly different ($p < 0.05$). PnSP = *Picralima nitida* Seed Powder, EF = Ease of fragmentation, AA = Apparent adhesion, RAC = Residue after chewing, OA = Overall acceptability

4. Discussion

The values obtained for TP, albumin, globulin, and glucose in birds fed 0% PnSP were lower than normal values recommended by Mitruka & Rawnsley (1977). The insignificant values observed in TP and albumin values were in support of the values observed by Ojediran et al. (2017) and Rafiu et al. (2025), while the increasing values with an increase in PnSP levels were within the recommendation of Mitruka & Rawnsley (1977). The values agreed with the reports of Mahejabin et al. (2015), Morakinyo et al. (2017), and Haruna & Odunsi (2018b) that neem, turmeric, pawpaw leaf, and pawpaw latex supported the production of blood and blood protein. Though the studied plant sources were different but the results in this study were in concurrence.

The increase in the values of TP and globulin as PnSP levels increased in the diets of the birds could be attributed to the anti-microbial effect of PnSP which assisted in the utilization of nutrients, indicating that the birds are well nurtured since the protein in blood serve as building blocks for many organs, hormones and enzymes. Serum protein is essential for overall health issues such as digestion, blood clotting, and energy production (Stacy-Sampson, 2019). The inconsistency in the trend of AST and ALT could not support Olufunmilayo et al. (2015), who stated that prolonged use of high doses of PnSP may be hepatotoxic and harmful to the body.

The assertion that PnSP helps in blood formation could be attributed to the availability of adequate nutrients, minerals, and phytochemical compounds for the birds, since their feed intake numerically increased with the inclusion of PnSP in their diets. The increase in the values of PCV with the use of PnSP indicates that absorption of nutrients and transportation of oxygen increased with the use of PnSP, also indicating a hematopoietic effect of PnSP, thus, increased primary and secondary polycythemia (Isaac et al., 2013) and strongly suggests that PnSP could be useful in the management of anaemia (Olufunmilayo et al., 2015). A high level of PCV indicated either an increase in the number of RBCs or a reduction in circulating plasma volume (Chineke et al., 2006); this is confirmed by the current result. Peters et al. (2011) posited that PCV, Hb, and MCH are major indices for evaluating circulatory erythrocytes, diagnosis of anaemia, and also serve as useful indices of the bone marrow capacity to produce red blood cells. Also, MCH and MCHC indicate blood level conditions, of which a low level is an indication of anaemia (Aster, 2004).

The current result is in concurrence with the report of Olufunmilayo et al. (2015) that ethanolic seed extract of *P. nitida* elevated RBC, PCV, and HB values of alloxan-induced diabetic male albino rats. The highest values of WBC and lymphocytes observed at 0.2% PnSP are an indication that the birds gained immunity against infections, indicating that PnSP was able to support the transportation of antibodies, as indicated by Soetan et al. (2013). Haruna & Odunsi (2018b), Lala et al. (2018), and Adedeji et al. (2019) also reported that phytoadditives (dried pawpaw latex, *Morinda lucida* leaf meal, and *Lawsonia innermis* leaf meal), respectively, improved the physiological and health status of broiler chickens.

The positive effect of PnSP on the meat quality of the birds could be attributed to the antioxidant activity of *P. nitida* as reported by Adeneye et al. (2011). This is an indication that PnSP could maintain water loss in processed meat (as observed in 0.05 and 0.2% PnSP) and could thereby increase the shelf life of the processed meat, as water is an agent of deterioration that enables microbial growth and activity.

The low rate of cooking loss was observed at 0%. 0.1% and 0.15% have some merit in meat production since they ensure a better tenderness, juiciness, and give meat more flavour than those with high cooking loss. The result corroborates the findings of Omojola & Adesehinwa (2007), Haruna & Odunsi (2018b), and Olusola et al. (2018) that 0.2 and 0.5% exogenous enzymes, 0.1% crude pawpaw latex, and 100 g kg^{-1} onion skin extract, respectively, in broiler chicken diets significantly increased water loss of breast and thigh muscles.

Meats are usually taken for their high protein contents, which help to build and repair the body tissue of the consumer. The increment in CP values, 23.60% (0.05%) – 26.31% (0.15%) PnSP, could be justified by the albumin and globulin values that improved with the increase in PnSP level. Current result supported the reports of Puvaca et al. (2014), Puvaa et al. (2015), and Morakinyo et al. (2017) that garlic, black pepper, and turmeric powder significantly increased the CP of breast and thigh meat of broiler chickens. The result disagreed with Haruna & Odunsi (2018a), who observed a significant decrease in the CP content with an increase in inclusion levels of crude pawpaw latex; likewise, Faleye (2018) reported that fluoroquinolones did not have a significant influence on DM, CP, and EE of broiler chickens' breast meat. The variations could be attributed to the composition of the experimental diets

5. Conclusions

In conclusion, the use of PnSP helps in the stability of health as it induces positive actions on blood haemato-biochemical parameters, such as adequate production of serum protein, globulin, serum enzymes, RBC, and reduces the creatinine level. Crude protein and ether extract of the breast meat increased with an increase in PnSP level up to 0.15% and the panellist gave no preference in terms of sensory attributes.

6. Authors' Contributions

Moshood Abiola Haruna: collected the samples, carried out the field work, and wrote the manuscript. *Adeyinka Adeniyi Odunsi*: supervised the overall research and revised the draft and final script approved by both authors.

7. Conflicts of Interest

The authors declare that they have no conflict of interest.

8. Ethics Approval

Yes applicable. Approval for the research was obtained from the Departmental ethical committee (LAUTECH-APH20-30) of the Faculty of Agricultural Sciences (Animal Welfare Board).

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