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Nutritional and growth performance of feeding polylathia longifolia leaf meal as partial replacement of wheat offal in the diet of broiler chicks

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Abstract
A total of two hundred and fifty (250) one day old (Ross 308) broiler chicks of mixed sex were used to determine the nutritional and growth performance of feeding *Polyalthia longifolia* leaf meal (PLM) as partial replacement of wheat offal in the diet of broiler chicks. Birds were divided to five treatments with five replicates of ten (10) birds in a completely randomized design. Treatment 1 (T1) was fed diet with no PLM, T2, T3, T4 and T5 were fed diet with PLM replacing wheat offal at 5 %, 10 %, 15 % and 20 % respectively. Results on proximate analysis of PLM revealed the presence of dry matter (91.40 %), crude protein (10.01 %), crude fibre (19.70 %), ether extract (0.18 %), ash (6.02 %) and energy (1510 kcal/kg). Mineral analysis showed that PLM contained calcium (71.22 mg/100g), phosphorus (67.12 mg/100g), potassium (11.23 mg/100g), iron (5.32 mg/100g), sodium (92.31 mg/100g) and magnesium (19.33 mg/100g). Qualitative phytochemical analysis revealed the presence of alkaloids (1.08 mg/100g), tannins (2.21 mg/100g), flavonoids (13.10 mg/100g), terpenoids (3.09 mg/100g) and phenols (2.28 mg/100g). Weight gain, Average daily feed intake and feed: gain were significantly influenced by PLM (P<0.05). Birds in T1 had the highest mortality (3.00 %) while T2 recorded (1.26 %), none was recorded in T3, T4 and T5 (P<0.05).It was concluded that PLM could be used to replace wheat offal up to 20 % without causing any negative effect on the general performance of birds.

Keywords: broiler chicks, *Polyalthia longifolia* leaf, phytochemicals, wheat offal

Introduction
Feed has been a major cost in modern broiler production, accounting about 70% of the total production cost (Onigemo, 2012) [38]. The increase in feed price may therefore imply in the increase in total production cost and thus decrease the profit margin of broiler industry. Attempt has recently been taken to reduce the cost of feed, including the incorporation of agro-industrial by-products in broiler diets as an energy source (Alu *et al*., 2012) [35]. However, some limitations may exist when using the agro-industrial by-products as ingredients in broiler rations. The high and low contents of fibre and protein in the by-products may limit the digestibility and thus inclusion level of such by-products (Sugiharto *et al.,* 2018a). In addition to the agro-industrial by-products, the application of leaf meal as the ingredient in broiler feeds has also been conducted (Aletor, 2007) [33]. Compared to agro-industrial by-products, the content of crude protein in leaf meal is much higher (Etuk *et al*., 2011) [34]. This may be beneficial in reducing the proportion of the conventional-expensive protein-rich feed ingredients in broiler rations.
It has been known that some particular foliage's contain a number of bioactive compounds that are beneficial for the health of chickens (Rama Rao *et al.,* 2019). These compounds include vitamins, phenolic acids, flavonoids, isothiocyanates, tannins as well as saponins (Olafadehan *et al*., 2020) [27]. In this regard, the use of leaf meal in rations may not only reduce the cost of feeds, but also elicit the health-promoting effect on broiler chickens. Another way of making protein available to people in cheaper prices especially in developing countries is by the use of agricultural by-products and tropical plants (leaf meal) which are not directly used by humans as food to feed livestock (Asar *et al*., 2010) [30]. It has been reported that some leaf meal provides animals with necessary vitamins, minerals, oxycarotenoids and protein (Francis, 2010), for instance *Polyalthia longifolia* leaves are found to be loaded with minerals and vitamins. It also an excellent source of sulphur containing amino acids which are often limiting in most feedstuff used for feeding animals (Alagbe, 2007).
The aim of this experiment was to determine the nutritional and growth performance of feeding *Polyalthia longifolia* leaf meal (PLM) as partial replacement of wheat offal in the diet of broiler chicks.

Materials and Methods
Experimental site
The study was carried out at the poultry section of the Teaching and Research Farm of the Faculty of Agriculture University of Abuja, Abuja Nigeria. The study carried out lasted for 8 weeks. The study territory exist in the southern guinea savanna ecological zone of Nigeria, geographically situated within latitude $08^0$25' and 9^0 20' N and longitude 06^0 45' and $07^0$39' E.
Collection and Processing of *Polyalthia longifolia* Leaf
Fresh, healthy and mature *P. longifolia* leaves were obtained in Kuje, Kuje Area Council of the Federal Capital Territory. The leaves were washed with running tap water to remove the dirt's, it was later air dried separately until constant weights were obtained and made to meal using a hammer mill. The sample was later stored in an air tight container at 4^{o}C for further analysis.

Animals and their management

Two hundred and fifty (250), Ross 308 one-day- old unsexed broiler chicks were randomly assigned to five dietary treatment groups of fifty birds per group with five replicates consisting of ten birds in a Completely Randomized Experimental Design. The birds were reared on a deep litter system and given anti-stress on arrival and antibiotics. Vaccination was administered according to the prevailing disease condition in the area. Feed and water were provided *ad libitum.* Feed intake, mortality were recorded daily while record of live weight were taken weekly throughout the experiment which lasted for 56 days.

Experimental diets and design

Birds were fed five experimental diets with *Polyalthia longifolia* leaf meal (PLM) replacing wheat offal at 0%, 5%, 10 %, 15 % and 20 % respectively in Completely Randomized Design.

Data collected

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Dry Matter Intake (g)}}{\text{Live weight gain}} \times 100$$

$$\text{Average daily gain (ADG)} = \frac{\text{Final body weight} - \text{Initial body weight}}{\text{Total days of the experiment}}$$

Laboratory analysis

Proximate compositions of experiment diet and test materials were determined by using official method of analysis by AOAC (2000). Phytochemical composition of tannins, alkaloids, flavonoids, phenols and terpenoids were estimated using methods described by Harbone (1973), Odebiyi and Sofowora (1978) [23], Boham and Kocipai (1974) [21]. Minerals were determined using Atomic Absorption Spectrophotometer (Model NF-123D, Punjab, India

Statistical analysis

All data were subjected to one -way analysis of variance (ANOVA) using SPSS (18.0) and significant means were separated using Duncan multiple range tests (Duncan, 1955) [16]. Significant was declared if $P \leq 0.05$.

Table 1: Composition of experimental diet (Broiler starter) 0 – 4 weeks

Ingredients	T_1 0 %	T_2 5 %	$T_3$10 %	$T_4$15%	T_5 20%
Maize	50.00	50.00	50.00	50.00	50.00
PLM	0.00	0.35	0.07	1.05	1.40
Wheat Offal	7.00	6.65	6.93	5.95	5.60
G/Cake 44%	5.50	5.50	5.50	5.50	5.50
Soya cake	30.05	30.05	30.05	30.05	30.05
Fish meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
Vit TM Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00
Calc. Analyses					
%CP	23.00	22.98	22.99	22.93	22.91
ME:Kcal/kg	2727	2728	2727	2730	2730
E:Prot ratio	118.59	118.73	118.62	119.02	119.16
EE %	4.59	4.58	4.59	4.56	4.55
CF %	4.71	4.74	4.72	4.80	4.83
Ca %	1.50	1.50	1.50	1.50	1.50
Avail P %	0.58	0.58	0.58	0.58	0.58
Ca: P ratio	2.60	2.60	2.60	2.60	2.60
Lysine %	1.43	1.44	1.43	1.44	1.44
Met + cys (%)	0.91	0.91	0.91	0.91	0.91

Table 2: Chemical composition of experimental diet (Broiler finisher) 5-8 weeks

Ingredients	T_1 (0%)	T_2 (5 %)	T_3 (10 %)	T_4 (15 %)	T_5 (20 %)
Maize	60.00	60.00	60.00	60.00	60.00
PLM	0	0.25	0.26	0.75	1.01
Wheat Offal	5.05	4.80	4.90	4.30	4.04
G/Cake 44%	1.50	1.50	1.50	1.50	1.50
Soya bean meal	26.0	26.0	26.0	26.0	26.0
Fish meal (imported)	2.00	2.00	2.00	2.OO	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30
Vit TM Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.110	100.00	100.00
Calc. Analyses					
%CP	20.07	20.06	20.08	20.03	20.01
ME:Kcal/kg	2853	2854	2855	2855	2856
E:Prot ratio	142.15	142.29	142.24	142.55	142.69
EE %	4.40	4.40	4.40	4.38	4.38
CF %	4.14	4.16	4.18	4.20	4.22
Ca %	1.48	1.48	1.48	1.48	1.49
Avail P %	0.57	0.57	0.57	0.57	0.57
Ca : P ratio	2.60	2.60	2.60	2.60	2.60
Lysine %	1.27	1.27	1.27	1.27	1.27
Met + cys (%)	0.83	0.83	0.84	0.84	0.84

*Premix supplied per kg diet :- Vit A, 7,000 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg; Vit B12, 16mg; Choline chloride, 120mg; Mn, 5.2mg; Zn, 25mg; Cu, 2.6g; Folic acid, 2mg; Fe, 5g; Pantothenic acid, 10mg; Biotin, 30.5g; Antioxidant, 56mg

Table 3: Proximate composition of *Polyalathia longifolia* leaf meal

Parameters	Concentration
Dry matter (%)	91.40
Crude protein (%)	10.01
Crude fibre (%)	19.70
Ether extract (%)	0.18
Ash (%)	6.02
Energy (kcal/kg)	1510.0

Table 4: Mineral composition of *Polyalathia longifolia* leaf meal

Parameters	Composition (mg/100g)
Calcium	71.22
Phosphorus	67.12
Potassium	11.23
Iron	5.32
Sodium	92.31
Magnesium	19.33

Table 5: Phytochemical analysis of *Polyalthia longifolia* leaf meal

Parameters	Composition (mg/100g)	*Permissible range
Alkaloids	1.08	3.50
Tannins	2.21	7.50
Flavonoids	13.10	31.50
Terpenoids	3.09	-
Phenols	2.28	-

Table 6: Performance characteristics of broiler chicks fed different levels of PLM

Parameters	T1	T2	T3	T4	T5	SEM
IBW (g)	40.11	40.02	40.00	40.01	40.03	0.02
FWG (g)	1834.1^{c}	1994.6^{b}	2007.5^{a}	2100.2^{a}	2100.8^{a}	5.67
WG (g)	1794.0^{c}	1954.6^{b}	1967.5^{b}	2060.2^{a}	2061.0^{a}	8.11
TFI (g)	3800.8^{a}	3700.9^{a}	3687.5^{b}	3680.7^{b}	3680.0^{b}	12.5
ADF (g)	67.86^{a}	66.08^{b}	65.85^{c}	65.73^{c}	65.71^{c}	0.56
Feed:gain	2.11^{a}	1.89^{b}	1.87^{b}	1.79^{c}	1.78^{c}	0.02
Mortality (%)	3.00	1.26	-	-	-	0.01

Means in the same row with different superscripts differ significantly ($P<0.05$)

Initial body weight (IBW); final body weight (FBW); weight gain (WG); average daily weight gain (ADWG); total feed intake (TFI)

Result and Discussion

Proximate composition of experimental diet

Table 1 and 2 shows the proximate composition of experimental diet. Broiler starter diet was fed between 0-4 weeks while finishers mash was fed between 5-8 weeks. It was observed that the crude fibre and ash content increased with increase in *Polyalthia longifolia* leaf meal inclusion. The values were highest in T4 and T5, crude protein and energy level fall within the ranges recommended by NRC (1994). The ether extract obtained from this study are in conformity with the values obtained by Aduku (2004) [19]; Olafadehan *et al*. (2020) [27] and Alagbe and Oluwafemi (2019) [24] the ash content obtained are in accordance with the reports of Alagbe *et al*. (2020).

Proximate and mineral composition of *Polyalthia longifolia* leaf meal (PLM)

Table 3 and 4 revealed the proximate and mineral composition of PLM. The proximate component contained dry matter (91.40 %), crude protein (10.01 %), crude fibre (19.70 %), ash (6.02 %), ether extract (0.18 %) and energy (1510.0 kcal/kg). This result conforms to the findings of Ojewuyi *et al*. (2014) [13] but contrary to the findings of Alagbe (2017), these differences could be attributed to processing methods, geographical location and age of plants. Mineral composition of PLM revealed the presence of calcium (71.22 mg/100g), phosphorus (67.12 mg/100g), potassium (11.23 mg/100g), iron (5.32 mg/100g), sodium (92.31 mg/100g) and magnesium (19.33 mg/100g). In order of abundance sodium > calcium > phosphorus > magnesium > potassium > iron. According to Enin *et al*. (2014) sodium is responsible for the regulation of phosphorus, osmotic pressure, water balance, transmission of nerve impulses, transport of glucose and amino acid. Calcium plays a vital role in rigidity, strength and teeth formation (Alagbe, 2019; Ibrahim *et al*., 2001). Potassium is vital in the regulation of water, electrolyte and functioning of the muscles (Musa *et al*., 2020). Sodium is important in acid base balance (Uzama *et al*, 2012) [7]. Magnesium is an activator of several key enzyme systems, including kinases, (ie. enzymes that catalyse the transfer of the terminal phosphate of ATP to sugar or other acceptors), mutases (transphosphorylation reactions), muscle ATPases, and the enzymes cholinesterase, alkaline phosphatase, enolase, isocitric dehydrogenase, arginase (magnesium is a component of the arginase molecule), deoxyribonuclease, and glutaminase (Alagbe and Motunrade, 2019). Iron is an essential for haemoglobin formation, normal functioning of the central nervous system, oxidation of carbohydrates, fats and protein (Uzama *et al*., 2012) [7].

Table 5 revealed the phytochemical analysis of PLM. The sample contained alkaloids, tannins, flavonoids, terpenoids and phenols at 1.08 mg/100g, 2.21 mg/100g, 13.10 mg/100g, 3.09 mg/100g and 2.28 mg/100g respectively. According to Oluwafemi *et al*. (2020) [27], phytochemicals are bioactive chemicals or secondary metabolite which performs multiple biological roles. Terpenoids exhibit various pharmacological activities i.e., anti-inflammatory, anti-malarial, anticancer, antiviral and antibacterial roles (Mahato and Sen, 1997; Abdul *et al*., 2013) [6]. Tannins are known to posses antimicrobial (Alagbe, 2017) and Anti-viral activity (Adisa *et al*., 2010) [11]. Flavonoids and phenols have been reported to perform antioxidant activity; it has the ability to scavenge free radicals and prvent disease in the body of animals (Ojewuyi *et al*., 2014) [13]. Alkaloids play a role of anagelsics, antimicrobial and anti-inflammatory activities (Babajide *et al*., 1999). However, all values reported for PLM were within lethal levels reported by Alagbe and Oluwafemi, 2019; Alagbe (2020) [24].

Performance characteristics of broiler chicks fed different levels of PLM

Table 6 revealed the performance characteristics of broiler chicks fed different levels of PLM. Initial body weight (IBW); final body weight (FBW); weight gain (WG); total feed intake (TFI) and average daily feed intake (ADF) ranged between 40.00 – 40.11 g, 1834.1 – 2100.2 g, 1794.0 – 2061.0 g, 3680.0 – 3800.8 g and 65.71 – 67.86 g were significantly different ($P<0.05$) among the treatments. Birds in treatment T4 and T5 had the highest weight gain of 2060.2 g and 2061.0 g respectively, T1 had the lowest weight gain of 1794.0 g. The weight gain could be attributed to the presence of phytochemicals in PLM. Scientific reports showed that plant demonstrated a considerable antibacterial, antifungal, hepatoprotective, immunostimulatory, cytotoxic and antiviral activities (Olubukola *et al*., 2020; Abdul *et al*.,

2013, Alagbe, 2017, 2019; Onasanwo *et al*., 2011; Wakimoto *et al*., 2008) [6, 3]. The results obtained is in conformity with the findings of Mohammed *et al.* (2016); Obajuluwa *et al*. (2020) when Yohimbe (Pausynistalia yorimbe) and larvacide was feed to broiler chickens. T3, T4 and T5 recorded no mortality probably due to the presence of flavonoids in PLM; similar result was recorded by Alagbe (2017) when PLM was fed to broiler chicks as a phytogenic feed additive. T4 andT5 had the best feed conversion ratio of 1.79 and 1.78; this result is in agreement with the reports of Adjei *et al*. (2015) when allicin was fed to broiler chicks.

Conclusion

There are larger numbers of leaf meals with enormous potentials in Nigeria and one of such is *P. longifolia* leaf. *P. longifolia* leaf has high energy, vitamins and antimicrobial activities which makes it a good replacement for other feed stuffs. The experiment has clearly shows that PLM can be partially used to replace wheat offal up to 20 % without any negative effect on the growth and health of birds.

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