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Replacement value of *Puerairia phaseoloides* leaf meal for soyabean meal on performance and carcass evaluation of starter broilers

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ABSTRACT

Aim: Main purpose of the study was to evaluate replacement value of *Puerairia phaseoloides* leaf meal for soya bean meal on the performance and carcass evaluation on starter broiler chicks.
Method and materials: One hundred day old chicks of mixed sexes (straight – run) were reared from day old to four weeks of age following standard procedures and strict bio-security measures, using commercial feed before placing them on experimental diets. Birds were distributed into five dietary treatment groups of twenty birds and replicated four times with five birds per replicate in a completely randomized design.
Results: Significant difference ($p<0.05$) was observed in feed intake, weight gain, feed conversion ratio and carcass evaluation of the birds at the end of 21 days of experimental feeding.
Conclusion: It was concluded that 2.5% inclusion level of *Puerairia phaseoloides* could be used in starter broiler diets without any deterious effect on performance.

Keywords: *Puerairia phaseoloides* Leaf Meal, Soya Bean Meal, Replacement Value, Carcass Evaluation, Starter Broiler Chicks

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Introduction

Poultry, an agricultural enterprise has been suggested as contribution to Nigerian GDP and employment opportunities creation (Akande *et al.,* 2007 and Ahaotu *et al.,* 2015a). In Nigeria, poultry meat and eggs have been suggested as possessing great potentials for bridging the protein associated health deficiencies (Ahaotu *et al.*, 2023a and Madubuike, 1992). However poultry industry in Nigeria is facing hard times with more than 50% of country's poultry farms closed down and another 30% forced to reduce their production capacity due to shortage of diet (Ahaotu *et al.*, 2015b).

High cost of livestock production especially diet has been implicated as one of the factors for example, cost of feeding has been put at 80% of the total cost of production in intensively reared livestock especially poultry (Ogba *et al.*, 2020 and Ahaotu *et al.*, 2015b). Consequently, the prices of protein concentrates like groundnut cake, soybean meal and fish meal conventional protein sources have continued to soar and it is becoming uneconomical to use them in poultry diet (Ahaotu *et al.,* 2016). The need to look for locally available and cheap sources of diet ingredients particularly those that do not attract competition between humans and livestock should be encouraged.

The growth and development of poultry industry in every region of the world depends to a large extent on the availability of feedstuff. Esonu *et al.*, (2001) stated that the most important factors affecting the availability of feed are high cost arising largely from fluctuations in feed supplies, rising prices of feed ingredients, poor quality feeds and inefficiency in production and distribution in the feed industry.

Poultry production in the tropics has been based on the use of wheat offal, brewer's dried grains and palm kernel cake as a source of energy,

fiber and protein (Ahaotu *et al.,* 2023b). These productions constitute up to 10%, 15%, and 20% in starter, finisher and grower mash respectively. Many nutritionists have therefore focus on efforts at finding alternative and proper feed ingredients to replace the more expensive conventional feed ingredients like soybean cake and fish meal in poultry production (Ahaotu *et al.,* 2023c). One such alternative feedstuff which can be used is *Puerairia phaseoloides* leaf meal. The recognition of protein from leaf sources has gained prominence because of its ready availability and perhaps because it is the cheapest and the most abundant potential source of protein (Oko *et al.,* 2022; Ademola and Farinu 2006). Leaf meals serve only as protein sources and also provide necessary vitamins, minerals and also oxy-carotenoid, which causes yellow color of broiler skin, shanks and egg yolks (Oko *et al.,* 2021 and D'Mello *et al.*, 1992). High costs of conventional protein sources have necessitated the use of leaf meal supplements in poultry production. The leaf meals are readily available and cheaper than conventional proteins sources. Leaf meal supplements have been included into diets of poultry as a means of reducing the high cost of conventional protein sources and to improve profit margin. The importance of legume leaf meals in poultry has been recognized by farmers because of their relatively high content of proteins, some minerals and vitamins.

In Nigeria, the very high cost of poultry feed has limited the expansion of the poultry industry as this has forced many poultry producers to folding. This has further drawn the already low intake of animal protein by Nigerians.

Soya bean is however expensive as a feed ingredients and this therefore increased the cost of poultry production. In order to arrest this trend, efforts are being directed towards the use of some unconventional and cheaper feed ingredients one of such efforts is replacing of wheat offal with locally available, cheaper and quality feed ingredients. The use of *Puerairia phaseoloides* meal to replace soya bean meal in broiler diets is a possible way of reducing feed cost and producing cheaper broiler and meat for populace.

The productivity of Nigerian livestock is well below their genetic potential mainly due to poor nutrition and inadequate quality feed. The high cost and poor quality of finished feed in the recent past have caused serious economic losses in poultry in Nigeria (Esonu *et al*., 2006, Emenalom 2004 and Esonu *et al.,* 2001). Effort to improve this situation according to (Abulude 2005), include harnessing the potentials of good quality and relatively inexpensive feed ingredients as replacements of the more expensive feed ingredients.

Different leaf meals have been incorporated into poultry diets, including those of *Leucaena leucocephala, Moringa oleifera, Cindoscolus aconitifolius, Manihot esculenta, Centrosema pubescens*, *Microdesmis puberula* among others (Ekenyem and Madubuike, 2006; Ahaotu *et al.,* 2018; Nworgu and Faphunda, 2002; Ahaotu *et al.,* 2013 and Iheukwumere *et al.,* 2008).

However, various research findings have revealed that the major problem with the use of these feed ingredients and agro-industrial by-product in poultry feeding is their high fibre content and anti-nutritional factors.

The objectives of the study were to determine consumption rate/growth performance and feed utilization of *Puerairia phaseoloides* leaf meal as feed as compared to soya bean meal feed, determine the extent to which soya bean meal in broiler starter diets could be replaced by *Puerairia phaseoloides* leaf meal and evaluate the nutritive value of *Puerairia phaseoloides* leaf meal as compared with soya bean meal. Using *Puerairia phaseoloides* to replace soya bean meal in broiler starter diets will go a long way in reducing cost of production in poultry enterprise thereby making animal protein more available to populace and also improving the profitability of the poultry farmers. Also findings from this research would represent a significant contribution to science and knowledge.

Materials and Methods

The study was carried out at the poultry unit of the Imo State Polytechnic Teaching and Research Farm, Umuagwo, Ohaji, Imo state, Nigeria. The study lasted for a period of four (4) weeks. The site has the coordinates of 7^0 0^1 06^{11} and 7^0 03^1 00^{11}E and 5^0 28^1 00^{11} N and 5^0 30^1 00^{11} N, with an average yearly rainfall of 172 – 190cm.rainfall is uniformly distributed. It has a maximum temperature of 34^{0C} and minimum temperature of 18^{0C} Areola *et al.*, (2002).

Sample Collections/Preparation

The fresh leaves of *Puerairia phaseoloides* (kudzu) was harvested from the surroundings of Teaching and Research Farms of Imo State Polytechnic

Umuagwo. The leaves was detached from the vines and dried at room temperature for two weeks prior to sun drying until it becomes crispy. This measure is to prevent nutrient leaching and maintain the green coloration of the leaves. The dried leaves of *Puerairia phaseoloides* were milled at a nearby hammer mill. Samples of the leaf meals were collected for proximate and chemical analysis. The ground *Puerairia phaseoloides* was thoroughly mixed with broiler feed at rate 0, .5, 5.0, 7.5, 10 for birds in treatment groups2,3,4 and 5 respectively.

Sources of Experimental Birds

A total of one hundred (100) day old unsexed and healthy commercial broiler chicks were purchased from a reputable commercial hatchery in Imo state, Nigeria. They chicks were reared from 0 -4 weeks. Commercial feed was used for one week for standardization before they were placed on experimental diet for 3 weeks.

Feeding and Management of Birds

One hundred (100) day old unsexed broiler chicks were randomly distributed into five (5) dietary treatment (Table 1) groups of twenty (20) birds per group and brooded on a partitioned deep litter floor covered with wood shavings at the experimental site. The birds were vaccinated accordingly. Feed and water were supplied ad libitum with plastic feeders and drinkers throughout the duration of the study.

Each group was sub- divided into four replicates of five (5) birds per replicate. The birds in treatment 1 (control diet) were given normal formulated feed with no *Puerairia phaseoloides* while treatments2, 3, 4 and 5 were given *Puerairia phaseoloides* at the rate of 2.5, 5.0, 7.5, 10.0 of feed respectively.

Proximate Analysis

The proximate composition of *Puerairia* leaf was carried out and determined using the standard methods of the association of official analytical chemists (AOAC, 2005), (Table2).

Data Collection

Data of feed intake was taken on daily basis, while body weight gain was taken at the start of the experiment and on weekly basis thereafter till the end of the experiment and feed conversion ratio (FCR) was calculated based on the data from feed intake and weight gain.

Carcass Characteristics

At the end of experiment, one bird was randomly picked from each replicate group, starved of food for 24 hrs but supplied with water and slaughtered by cutting the jugular vein to cause thorough bleeding. The carcasses were quickly immersed in boiled water followed by de-feathering. They carcasses were then weighed before eviscerated for carcass evaluation. The live body weight and dressed weight of birds were recorded.

Test Diets

Five (5) experimental test diets were formulated at Imo State Polytechnic Umuagwo, Nigeria, feed mill unit. The *Puerairia* leaf meal was incorporated into the diet at 0, 2.5, 5.0, 7.5, and 10.0 in treatment 1, 2, 3, 4 and 5 respectively. Treatment 1 served as the control.

Data Analysis

Data collected on feed intake, weight gain and feed conversion ratio were subjected to one- way ANOVA (Analysis of Variance) procedure of statistical analysis system (SAS). Duncan's multiple range tests as outlined by Steel and Torrie (1980) was used in assessing the significant differences among the treatments.

Table 1: Percentage Composition (%) of Formulated Broiler Starter Diet.

Ingredients	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
Maize	44.0	44.0	44.0	44.0	44.0
Maize bran	22.0	22.0	22.0	22.0	22.0
P K C	5.2	5.2	5.2	5.2	5.2
Puerairia Phaseoloides	0.0	2.5	5.0	7.5	10.0
S B M	10.0	7.5	5.0	2.5	0.0
G N C	10.3	10.3	10.3	10.3	10.3
Fish meal	5.0	5.0	5.0	5.0	5.0
Bone meal	2.5	2.5	2.5	2.5	2.5
Salt	0.2	0.2	0.2	0.2	0.2
Vitamin premix	0.3	0.3	0.3	0.3	0.3
Lysine	0.2	0.2	0.2	0.2	0.2
Methionine	0.1	0.1	0.1	0.1	0.1
TOTAL	100%	100%	100%	100%	100%

Table 2: Proximate Analysis of *Puerairia Phaseoloides*

Dry matter	90.25
Crude protein	11.85
Crude fibre	16.35
Ether extract	1.90
Ash	5.96
Nitrogen free extract	54.17
Tannin	0.62
Phytate	1.07
Oxalate	0.75
Hydrocyanic acid(mg/kg)	0.36
Saponins	0.21

Results and Discussion

The proximate analysis of *Puerairia phaseoloides* in table3 shows that P. *phaseoloides* is very high in crude fiber (16.35). Crude protein constituted (11.85), it is also rich in ash (5.96). The DM content was the dominant component constituting (54.17). Other chemical components found in the p. phaseoloides leaf meal are Oxalate, Phytate, Tannin and Taponin. The most available anti-nutritional factor was phytate.

Various authors (Schmid and Barone, 2004) have reported anti-nutritional effects of *Puerairia phaseoloides* which reduced the absorption, availability and utilization of nutrients for productive purposes. Therefore, birds on the supplemented diet T_5 consumed more food relative to other birds in an attempt to satisfy their nutrient requirements (Ahaotu *et al.* 2018). Feed intake increased with increasing inclusion levels of *Puerairia phaseoloides* (PPLM) for fish meal (FM), but the control diet T_1 significantly ($P<0.05$) consumed less feed than other diets (T_2, T_3, T_4 and T_5). The significantly ($P<0.05$) depressed weight gain and feed conversion ratios of birds on the 10% PPLM diet T_5 could therefore be attributed to the anti-nutritional effect of dietary fiber in this diet (Onumajuru, 2016). The authors stated that as a consequent of high level of crude fiber in the diets in developing countries, growth rate and feed efficiency are severely depressed. The improved performance of birds on 2.5%, 5% and 7.5% PPLM diets T_2, T_3 and T_4 with respect to weight gain and mean live weight at 5 weeks agrees with literature findings that PPLM replacing SBM improves the nutritive value of diets. It has been severally reported (Oladokun and Johnson, 2012; Odunsi, 2003; Darryl *et al.*, 2007) that SBM can be used to remove the anti-nutritive effect of PPLM and therefore offer improvement in production efficiency.

The fact that the PPLM replacing SBM diets in this study were cheaper than the control T_1 at starter phase indicates that PPLM replacing SBM reduces the cost of production as reported by Fasuyi (2002). Broiler starter diet T_5 was produced at the lowest cost while diet T_1 was at the highest cost. The inclusion of 10% PPLM replacing SBM reduced cost by 14.77%.

One bird died each in only treatments T_4 and T_5. The death could be attributed to higher inclusion levels of PPLM in the diets.

From the above growth response, mean daily weight gain of bird per treatment was calculated as 48.16g day $^{-1}$ in T_1; 47.08g day^{-1} T_2; 44.20g day $^{-1}$ T_3; 44.08g day $^{-1}$$T_4$and 44.08g day^{-1} T_5.

Weight gain from treatment T_5 was significantly lower ($P<0.05$) than those of other treatments while the heaviest birds were observed from control diet T_1 (0% FEM).

Birds on the 2.5%, 5% and 7.5% PPLM diets T_2, T_3 and T_4 had similar shank lengths which were ($P<0.05$) significantly longer than shank length of birds on diet T_5. This observation was in collaboration with that of Halim (1992) who observed that birds fed 5% to 8% PPLM diets encouraged higher performance. High *Puerairia phaseoloides* (PPLM) in broiler starter diets have been reported to result in reduction in the fatness of carcassand reduced live weight gain and carcass weight (Monforte-Braga *et al.* 2006). Birds in treatment T_1 had the longest wing length, body length, thigh length and leg length which varies significantly ($P<0.05$) from other treatments. In most cases, values obtained from treatments T_2, T_3 and T_4 were similar and differed ($P<0.05$) from T_5 in all the parameters evaluated.

The average wing lengths were 18.9, 18.1, 17.9, 17.9 and 17.5 cm for birds on dietary treatments T_1, T_2, T_3, T_4 and T_5 respectively. Birds on the 10% PPLM diet T_5 had significantly ($P<0.05$) longest wing length than birds on T_1, T_2, T_3 and T_4. No significant differences were observed among mean wing lengths of birds on diets T_3 and T_4 which were significantly ($P<0.05$) shorter than the wing lengths of birds on treatments T_1 and T_2.

The average body heights were 25.7, 23.7, 23.5, 23.1 and 22.5cms for birds on dietary treatments T_1, T_2, T_3, T_4 and T_5 respectively. Birds on the control diet T_1 had significantly ($P<0.05$) higher body height than birds on the 2.5%, 5% and 7.5% PPLM diets. Birds on treatment T_5 recorded the lowest body height.

The average thigh lengths were 11.3, 10.8, 10.5, 10.3 and 10.1 cms for birds on T_1, T_2, T_3, T_4 and T_5 respectively. Control diet T_1 had the highest thigh length which differ ($P<0.05$) significantly with values obtained for birds on T_2, T_3, T_4 and T_5 while birds on T_5 recorded the lowest which was similar to T_4 , T_2 and T_3.

The average leg lengths were 8.4, 7.9, 7.7, 7.7 and 7.5cms for birds on dietary treatments T_1, T_2, T_3, T_4 and T_5 respectively. Birds on T_5 followed by those on T_3 and T_4 had the least leg lengths while the longest leg length was recorded by birds on the control T_1which followed by treatment T_2.

The average heart girths were 30.7, 30.4, 28.5, 28.2 and 26.4 cms for birds on dietary treatments T_1, T_2, T_3, T_4 and T_5 respectively. Control diet T_1 recorded the highest heart girth which was similar to T_2 and differ ($P<0.05$) significantly with that obtained from birds on diets T_3, T_4 and T_5. Birds on the 10% PPLM replacing 0% SBM diet T_5 had the lowest heart girth.

The average head circumferences were 16.3, 11.4, 11.2, 11.0 and 10.8 cms for birds on dietary treatments T_1, T_2, T_3, T_4 and T_5 respectively. Birds on the 10% had significantly ($P<0.05$) the smallest head circumference followed by T_4, T_3 and T_2 birds which were similar. The biggest head circumference was obtained from birds on diet T_1 which differ significantly with the other diets.

Table 3: Composition of determined and proximate analysis of *Puerairia phaseoloides*

Proximate fractions (% DM)

Puerairia phaseoloides	DM	CP	CF	EE	ASH
	90.25	11.85	16.35	1.90	5.96
	NFE	Tannin	Phytate	Oxalate	Saponins
	54.17	0.62	1.07	0.75	0.21
	HCN(mg/kg)				
	0.36				

DM= Dry matter; CP= crude protein; CF= crude fiber; EE= ether extract; NFE= Nitrogen free extract; HCN= hydrocyanic acid.

Table 4: Effects of Different Dietary Levels of *Puerairia phaseoloides* Leaf meal on Performance Criteria of Starter Broilers.

Parameters	T_1	T_2	T_3	T_4	T_5	SEM
Initial Live Weight (gm)	133	133	134	133	134	0.10^{ns}
Mean live weight at 5 weeks Old (gm)	865^{d}	785^{c}	842^{b}	833.7^{b}	756.75^{a}	4.96*
Mean Daily Weight Gain (gm)	34.57^{c}	31.28^{b}	30.85^{b}	30.20^{b}	28.5^{a}	0.39*
Mean Daily Feed Intake (gm)	48.21^{a}	60.71^{b}	79^{b}	85^{c}	89.29^{c}	2.18*
Feed Conversion Ratio	3.24	3.48	3.49	3.59	3.69	0.03^{ns}
Feed Cost/Kg Weight gain	201.16^{e}	195.6^{d}	184.48^{c}	178.92^{b}	171.44^{a}	2.17*
Mortality	0	0	0	1	1	+

abcde: = Mean within same row, having different superscripts are significantly different ($P<0.05$).

NS=Not significant; * = Significant

Table 5: Carcass evaluation of broiler starter fed varying levels of *Puerairia phaseoloides* leaf meal.

Parameters	T1	T2	T3	T4	T5	SEM
Shank length (cm)	5.7^{b}	5.6^{b}	5.5^{b}	5.4^{b}	5.2^{c}	0.03*
Wing length (cm)	10.5^{a}	9.6^{b}	9.6^{b}	9.4^{c}	9.2^{c}	0.09*
Body length (cm)	18.7^{c}	18.5^{c}	16.2^{b}	15.2^{b}	15.4^{a}	0.29*
Body height (cm)	14.7^{a}	14.6^{a}	13.3^{b}	13.2^{b}	13.1^{b}	0.14*
Thigh length (cm)	5.4^{a}	5.1^{b}	5.6^{a}	5.1^{b}	4.6^{c}	0.25*
Leg length (cm)	4.2^{a}	4.1^{a}	4.2^{a}	3.8^{b}	3.6^{b}	0.15*
Hearth girth (cm)	15.2^{c}	15.2^{c}	14.3^{c}	13.5^{c}	13.1^{a}	0.17*
Head circumference (cm)	9.7^{a}	7.8^{b}	7.6^{c}	7.4^{d}	5.4^{d}	0.16*
Average live weight at 4^{th} Week	895^{d}	820^{c}	820^{c}	795^{b}	748^{a}	1.94*
Dressed carcass weight	825^{d}	746^{c}	746^{c}	715^{b}	698^{a}	1.77*
Eviscerated weight	735^{d}	701^{c}	700^{c}	673^{b}	658^{a}	1.09*

Abcd : means with same row, having different super scripts were significantly different ($p<0.05$).

The leaf meal studied is high in crude fibre. Nworgu (2004) revealed that some tropical legumes have higher nutritive value and that the availability of the component amino acids in the small intestine would be more when the leguminous forage materials are fed dried than when fresh.

The gross energy (GE) of *Puerairia phaseoloides* was 4419kcal/kg. The value is in harmony with the reports of Savon, (2005) who reported that tropical legumes have GE of 4326- 4802 kcal/kg. Raharjo *et al.,* (1986) reported that gross energy of PPLM was 3872kcal/kg. The variation in the CP, CF, GE, EE could be attributed to the age of the cutting, climatic conditions, methods of processing and analysis.

The weight gain of the birds of the broilers fed PPLM supplements significantly ($p<0.05$) and progressively decreased with increase dietary concentration of PPLM.

There were significant difference ($p<0.05$) in carcass evaluation with dietary inclusion of 5.0g, 7.5g, and 10.0g PPLM/kg feed which resulted to decrease in T_3, T_4 and T_5.

Conclusion

In conclusion, it would appear that 2.5% inclusion level of *Puerairia phaseoloides* could be used in starter broiler diets without any deterious effect on performance. Hence, *Puerairia phaseoloides* leaf meal in partial replacement of soybean meal may go a long way in reducing the cost of protein source and on the long run the sustainability of poultry production.

Further research is necessary to determine how to increase the nutritive value of *Puerairia phaseoloides* leaf meal for livestock, in view of its relative and abundance and ease of collection.

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