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Growth performance and cost-benefit of producing broiler chickens fed diets containing raw and processed *Lablab purpureus* seed meal

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Target Audience: *Poultry farmers, Animal Scientist and students of Animal Science.*

Abstract

Generally, cost of conventional feed stuffs for feeding livestock especially poultry is very exorbitant thus, the need to use other non-conventional ingredients like lablab which could drastically reduce the cost producing poultry and other livestock. A study was conducted to assess growth performance and cost- benefits of producing broiler chickens fed diets containing raw, soaked and cooked lablab seed. A 63- day feeding trial was conducted using 126 day-old Anak[(R)] strain of broiler chicks. The birds were balanced for weight, randomly divided into 6 groups of 21 chicks. Each of the 6 groups was replicated thrice with 7 chicks each in a completely randomized design. Birds in group 1, 2, 3, 4, 5 and 6 were fed control diet, diet containing raw lablab, soaked lablab and lablab seeds soaked and cooked for 20, 40 and 60 minutes respectively. Results showed that final weight, weight gain, feed/gain ratio and protein efficiency were significantly ($p<0.05$) influenced. Birds on control diet and diets containing raw lablab seed meal had highest (2052.38 g) and least (1640.47 g) values for final body weights respectively. Body weight gained followed a similar trend of variation as the final body weight. Inclusion of processed lablab seed meal in the diets of broiler chickens increased cost of producing broiler chickens. It can be concluded that cooking lablab seed gave a better growth performance. However, increased cost of broiler chicken production compared to control diet.

Key words: *Raw, soaked, cooked, lablab, growth, broiler*

Description of Problem

The animal husbandry sector in Nigeria in its current state is unable to ensure self-sufficiency, in the production of animal products, despite significant livestock resources endowed with [1]. Increasing animal protein production in Nigeria and other developing countries of the world has been advocated as the way out of the present problem of malnutrition in these countries [2]. This has necessitated urgent call for fervent quest to search for alternative non-conventional feedstuffs as replacement for escalated market prices of cereal grains like maize and legumes such as soy beans which form bulk of feed ingredients in livestock industries [3]. This menace is due solely to stiff competition for the little available conventional feed stuff [4] occasioned by low crop yield and crisis among other factors in Nigeria. In attempt to circumvent this problem, use of locally grown crops with less competition for human utilization to alleviate problem of feed inadequacy in poultry industries and consequently improve the nutritional status of an average Nigerian becomes indispensable. In view of this, animal science studies have been launched to investigate and assess other unconventional protein and energy sources from a number of alternative plant protein sources for non-ruminant, especially poultry, pigs and other livestock species [5].

Identification and exploitation of other novel legumes particularly those indigenous to the tropics would therefore, go a long way to ensure perennial sustainability of the livestock industries in Sub-Saharan African countries with Nigeria inclusive. *Lablab purpureus* is now acting as buffer crop for feeding livestock [6]. However, lablab seed is known to contain numerous anti-nutritional factors like tannin, phytic acids among others that are successfully deactivated by heat treatment [4]. Therefore, this study was designed to determine the efficacy of feeding diets containing raw, soaked, and soaked and cooked *lablab purpureus* seeds meal on growth performance and cost- benefit of producing broiler chickens.

Materials and methods

Experimental site

The study was conducted at the Poultry Unit of Livestock Teaching and Research Farm, Joseph Sarwuan Tarka University Makurdi, Benue State, Nigeria. Makurdi lies on the geological coordinates of Latitude 7°38ˈ -7°44ˈ north and longitude 8°24ˈ-8°38ˈ East with an ambient temperature range of 22– 39°C, average annual rainfall of 135-325.57mm and the relative humidity of 37-58% [7].

Source and Preparation of Feed Ingredients

Lablab seed was purchased from Agishi Farm, Zaria, Kaduna State. Five samples (25kg) each of lablab seed were weighed. One of the samples was left raw and the other four samples were soaked in water for twelve (12) hours. One of the four samples soaked in water was left at this stage and the other three (3) samples were put in boiling water (100°C) and allowed to boil for 20, 40 and 60 minutes respectively. These processed samples were sun-dried on concrete floor to a moisture content of less than 10 %.

Experimental diets

Six iso-nitrogenous diets were formulated for starter and finisher broiler chickens as presented in Tables 1 and 2, respectively. A maize-soya bean based control diet, raw lablab seed, raw soaked-lablab seed, soaked-cooked lablab seed (20 minutes), soaked-cooked lablab seed (40 minutes) and soaked-cooked lablab seed (60 minutes) were incorporated in the broiler starter and finisher diets at 20 and 25 %, respectively and the diets were designated as T1, T2, T3, T4, T5 and T6, respectively.

Proximate Analysis of Lablab Seed and Experimental Diets

Samples of raw, soaked, soaked-cooked (20 minutes), soaked-cooked (40 minutes) and soaked-cooked (60 minutes) were analysed for proximate composition according to procedure reported by [8].

Management of Experimental Animal

The broiler chicks were allowed 2-week adjustment period before feeding trial commenced. Feed and water were provided *ad libitum* and routine management practices were kept within standard procedures. Experimental broiler chicks were administered New castle disease vaccine intra ocular, New castle disease vaccine-Lasota via drinking water at day old, 21-day old and 28-day old, respectively.

Experimental Design

One hundred and twenty-six day-old broiler chicks of Anak$^{(R)}$ strain were used for a 9-week study. After 14-day acclimatization period, the chicks were balanced for weight and randomly divided into six (6) groups of 21 chicks and replicated thrice with 7 chicks per replicate in a Completely Randomised Design.

Data collection

Growth Performance

Growth performance indices include; initial weight recorded prior to commencement of the study, average feed intake was calculated by subtracting leftover feed from feed offered on weekly basis and divided by 7 days and by 7 birds per replicate, weight gain was calculated on weekly basis by subtracting previous weight from the present weight and dividing by 7 days and by 7 birds per replicate. Feed to gain ratio was calculated by dividing feed intake by weight gain, protein efficiency was determined as product of crude protein percentage of diet consumed and feed intake in grams, and operative protein efficiency ratio was calculated as the ratio of daily body gain to daily protein intake.

Table 1: Ingredient and analyzed proximate composition of broiler chicks starter diets

	Treatments					
Ingredients (Kg)	T1	T2	T3	T4	T5	T6
Maize	48.10	37.62	37.15	36.98	37.33	37.21
Full Fat Soybeans	36.90	27.38	27.85	28.02	27.67	27.79
Lablab seed	20.00	20.00	20.00	20.00	20.00	20.00
Maize offal	8.00	8.00	8.00	8.00	8.00	8.00
Blood meal	3.00	3.00	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.40	0.40	0.40	0.40	0.40	0.40
Methionine	0.35	0.35	0.35	0.35	0.35	0.35
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**	**100**
Analysed Composition						
Dry matter (%)	90.20	90.05	89.96	90.11	90.03	90.12
Crude protein (%)	23.05	23.52	23.39	23.05	23.63	23.73
Crude fibre (%)	3.60	3.68	3.62	3.76	3.87	3.77
Ether extract (%)	3.60	3.66	3.57	3.70	3.82	3.73
Gross Energy (Kcal/g)	4.13	4.15	4.15	4.16	4.16	4.17

T1= Maize-soya beans (control); T2= Raw lablab seed; T3= Soaked lablab seed; T4= Soaked lablab seed cooked for 20 minutes; T5= Soaked lablab seed cooked for 40 minutes; T6= Soaked lablab seed cooked for 60 minutes

**Vitamin-mineral premix (1 kg) contained: Vitamin A:15,000,000 I.U., Vitamin D3: 3,000,000 I.U., Vitamin E: 30,000 I.U., Vitamin K: 2500mg, Thiamine: 2000mg, Riboflavin: 6000mg, Pyridoxine:4000mg, Niacin: 40,000mg, Vitamin B12: 20mg, Pantothenic acid: 10,000mg, Folic Acid: 1000mg, Biotin: 80mg, Chlorine chloride: 500g, Antioxidant: 125g, Manganese: 96g, Zinc: 60g, Iron: 24g, Copper: 6g, Iodine: 1g, Selenium:240mg and Cobalt 240mg*

Cost-benefit analysis

Cost-benefit analysis was determined at the end of the study by difference of all the expenses and the income earned at completion of the experiment. The following indices were considered; cost of broiler chicks, cost of feed, cost of vaccines/medicines, and other operational cost.

Statistical Analysis

Data obtained were subjected to Analysis of Variance (ANOVA) in a Completely Randomised Design (CRD).

Significant differences ($p<0.05$) between treatment groups were separated by Duncan Multiple Range Test (DMRT) using Statistical Package for Social Science [9].

Table 2: Ingredient and analyzed proximate composition of broiler chicken finisher diets

	Treatments					
Ingredients (Kg)	T1	T2	T3	T4	T5	T6
Maize	52.22	39.12	38.54	38.52	38.76	38.62
Full Fat Soya bean	31.08	19.18	19.76	19.98	19.54	19.69
Lablab seed	25.00	25.00	25.00	25.00	25.00	25.00
Maize offal	10.00	10.00	10.00	10.00	10.00	10.00
Blood meal	2.60	2.60	2.60	2.60	2.60	2.60
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50	0.50	0.50
Methionine	0.35	0.35	0.35	0.35	0.35	0.35
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**	**100**
Analysed Composition						
Dry matter (%)	90.02	89.93	89.92	89.96	89.86	89.94
Crude protein (%)	20.11	20.23	20.34	21.07	20.79	21.13
Crude fibre (%)	4.03	4.24	4.51	4.57	4.66	4.61
Ether extract (%)	3.63	3.57	3.66	3.60	3.65	3.73
Gross Energy (Kcal/g)	4.37	4.40	4.43	4.35	4.42	4.17

T1= Maize-soya beans (control); T2= Raw lablab seed; T3= Soaked lablab seed; T4= Soaked lablab seed cooked for 20 minutes; T5= Soaked lablab seed cooked for 40 minutes; T6= Soaked lablab seed cooked for 60 minutes

**Vitamin-mineral premix (2.5kg) contained: Vitamin A:15,000,000 I.U., Vitamin D3: 3,000,000 I.U., Vitamin E: 30,000 I.U., Vitamin K: 2500mg, Thiamine: 2000mg, Riboflavin: 6000mg, Pyridoxine:4000mg, Niacin: 40,000mg, Vitamin B12: 20mg, Pantothenic acid: 10,000mg, Folic Acid: 1000mg, Biotin: 80mg, Chlorine chloride: 500g, Antioxidant: 125g, Manganese: 96g, Zinc: 60g, Iron: 24g, Copper: 6g, Iodine: 1g, Selenium:240mg and Cobalt 240mg*

Results and Discussion

Effects of Raw, Soaking, and Soaking and Cooking of Lablab Seed on Anti-Nutritional Factor Content

Effects of raw, soaking and soaking and cooking of lablab seed on anti-nutritional factor content is presented in Table 3. Results on effect of processing lablab seed revealed that all anti-nutritional factors assayed in this study were significantly reduced from T1 to T6. Raw lablab seed had the highest 42.11 TIU/mg, 1.66 mg/Kg, 51.25 HIU/mg, 250.00 mg/100g, 910.00 mg/100g and 800.00 mg/100g for trypsin, cyanide, haemagglutinins, phytic acid, alkaloids and tannin, respectively while the least values for these parameters were recorded for lablab seed that was soaked and cooked for 60 minutes. Result of the present study on trypsin inhibitor and cyanide collaborated the findings of [10] who reported decreased trypsin inhibitor and phytic acid level when *Lablab purpureus* seed were subjected to 45 minutes cooking regimes. Similarly, [11] reported a drastic reduction in anti-nutritional factors such as phytic acids, tannin content when mucuna *utilis* was subjected to heat treatmemnt. The authors attributed this reduction to solubility of hydrocyanic acid as well as enzymes; rhodanase that release hydrocyanic acid from seed and finally reported that cooking was an effective way of reducing tannin content.

Haemagglutinin values decreased in the present study was in consonance with the findings of [12] who reported a reduction in phyto- haemagglutinin activity with increased cooking time of lima beans. Similarly, [13] also reported that tannic acid is destroyed when lima beans were cooked for 60 minutes.

Table 3: Effect of raw, soaking, and soaking and cooking of lablab seed on anti-nutritional factor content

	Treatments					
Anti-nutritional factors	Raw	Soaked	SC20	SC40	SC60	SEM
Trypsin (TIU/mg)	42.11^{a}	38.16^{b}	25.00^{c}	17.11^{d}	6.58^{e}	±1.84
Cyanide (mg/Kg)	1.66^{a}	1.21^{b}	0.79^{c}	0.61^{d}	0.48^{e}	±0.02
Haemagglutinins (HIU/mg)	51.25^{a}	45.34^{b}	37.95^{c}	32.52^{d}	25.63^{e}	±1.43
Phytic acid (mg/100g)	250.00^{a}	200.00^{b}	130.00^{c}	80.00^{d}	50.00^{e}	±14.00
Alkaloids (mg/100g)	910.00^{a}	690.00^{b}	510.00^{c}	370.00^{d}	180.00^{e}	±40.00
Tannin (mg/100g)	8.00^{a}	7.00^{b}	6.00^{c}	4.00^{d}	3.00^{e}	±0.28

a,b,c,d,e = Means on the same row with different superscripts are significantly ($p<0.05$) different

SEM= Standard Error of Mean

SC20= soaked lablab seed cooked for 20 minutes; SC40= soaked lablab seed cooked for 40 minutes; SC60= soaked lablab eed cooked for 60 minutes

Proximate composition of raw, soaked and soaked-cooked lablab seed meal

Result on proximate nutrient composition of raw, soaked and soaked-cooked lablab seed meal is presented in Table 4. Dry matter was highest for lablab seed meal soaked and cooked for 20 minutes (95.97 %) while raw, lablab seed soaked and cooked for 40 and 60 minutes had the least and similar values for dry matter (92.86 %). This present result was similar to DM values (89.70-90.25 %) of *Mucuna utilis* seed reported by [4] for raw, soaked and cooked-in-potash. Crude protein values were highest and similar for raw, soaked Lablab seed meal (23.28 %) while lablab seed that was soaked-cooked for 20 minutes had the least value for crude protein (22.32 %) which is consistent with the values of 23.29 % CP reported by [14] for lablab seed meal. However, (11) reported higher CP values (27.93 -29.62 %) for *Mucuna utilis.*

The results of the present study buttressed the observation of [15] who reported that processing methods such as soaking and cooking reduced the crude protein content of lablab due to solubilization of some nitrogenous compounds. Crude fibre was highest for raw lablab seed meal (11.00 %) while lablab seed that was soaked-cooked for 40 minutes had the least value for crude fibre (7.86 %) which agreed with the findings of [14] who reported the CF of lab lab to be 11.19 %. Raw lablab seed meal had the highest ether extract (9.24 %) while lablab seed that was soaked-cooked for 60 minutes had the least value for ether extract (8.75 %). Lablab seed that was soaked-cooked for 20 and 40 minutes had similar values for ether extract (8.97%) in this study. This was in line with the work of [14] who reported 9.13 % EE for lablab. Lablab seed meal that was only soaked had the highest ash content (4.00 %) while the least ash value (3.75 %) was recorded for lablab seed soaked and cooked for 60 minutes. This was similar with the work of [14] who reported 4.00 % ash for lablab. Ether extract (EE) and ash in the present study decreased due to boiling of lablab seed which could be imputed to volatility of fat content of lablab seed which was in agreement with the findings of [16] who reported a loss of EE and ash of soaked (48 hours) and boiled (I Hour) in legume seeds.

Soaked-cooked lablab seed had the highest and similar values (56.49) for nitrogen free extract (NFE) while raw lablab seed meal had the least value for NFE (52.59). [11] reported lower NFE values of 43.20 to 44.47 for raw, soaked and cooked *Mucuna utilis* compared the values in the present study. Gross energy decreased across the group (T1-T6) as the dietary treatments were applied. Raw lablab seed meal and lablab seed that was soaked-cooked for 40 minutes had the highest (4.45 Kcal/g) and least (3.77 Kcal/g) gross energy, respectively. These results are slightly higher than the values of 3.46-3.67 Kcal/g reported by [11] for raw, soaked and cooked *Mucuna utilis.*

Table 4: Proximate composition (g/100gDM) and energy content for raw, soaked and cooked Lablab seed

	Treatment					
Parameters	Raw	Soaked	SC20	SC40	SC60	SEM
Dry matter (%)	92.86^{c}	94.51^{b}	95.97^{a}	90.52^{c}	91.30^{c}	±0.20
Crude protein (%)	23.28^{a}	22.58^{a}	22.32^{c}	22.84^{ab}	22.67^{bc}	±0.18
Crude fibre (%)	11.00^{a}	10.22^{b}	9.04^{d}	7.86^{e}	9.50^{c}	±0.060
Ether extract (%)	9.24^{a}	9.16^{b}	8.97^{c}	8.99^{c}	8.75^{d}	±0.02
Ash (%)	3.90^{b}	4.00a	3.86^{c}	3.82^{d}	3.75^{e}	±0.01
NFE (%)	52.59^{c}	54.05^{b}	55.82^{a}	56.49^{a}	55.82^{a}	±0.40
Gross energy (Mcal/g)	4.45^{a}	4.32^{b}	4.18^{c}	3.91^{d}	3.77^{e}	±0.05

a,b,c,d,e= Means on the same row with different superscripts are significantly ($p<0.05$) different
SEM= Standard Error of Mean
DM= dry matter
SC20= soaked lablab seed cooked for 20 minutes; SC40= soaked lablab seed cooked for 40 minutes; SC60= soaked lablab seed cooked for 60 minutes

Effects of Raw, Soaking, and Soaking and Cooking of Lablab Seed on Growth Performance of Broiler Chickens

Results on effects of inclusion of raw, raw soaked, and soaked and cooked lablab seed on growth performance of broiler chickens is presented in Table 5. The study revealed that final weight gain, weight gain, feed to gain ratio and protein efficiency ratio were significantly ($P<0.05$) influenced while feed intake, protein intake and mortality did not differ significantly ($p>0.05$) among treatment groups. Birds on control diet (T1) had the highest final weight (2052.38 g/bird), weight gain (37.51 g/bird), protein efficiency ratio (1.92) and the best values for feed to gain ratio. Birds fed diet containing raw lablab seed meal recorded the least value for final weight (1640.47 g), daily weight gain (29.40 g) and the poorest feed to gain ratio (2.99). The result on final and daily weight gain in the present study indicated a higher and effective utilization of the control diet by broiler chickens compare to those fed diets containing lablab seeds. The results suggested that anti-nutritional factor present in lablab seed (as in the case with other legumes) were partially deactivated by the processing methods employed in this study, resulting to final weight and weight gain of birds fed lablab seed diets differing significantly from the control birds. Depressed final weights and weight gain of birds fed diets containing raw lablab seed meal compared to cooked lablab seed meal in this study agreed with the findings of [4] who reported that broiler chickens fed diets containing raw *Mucuna utilis* seed had depressed growth which was made possible due to residual anti-nutritional factors present in the test diets that hamper effective usage of the nutrient content of the diets. Similarly, [17] reported drastic reduction in final weight and body weight gain of broiler chickens fed diets containing raw lablab seed meal due to the presence and action of anti-nutritional factors in the diet. In the same vein, [18] attributed poor growth of broiler chickens fed diets containing anti-nutritional factors to the presence of these harmful substances that impaired proper nutrient absorption and subsequent utilization by the body tissues. [16] observed that raw mucuna seed like other legumes contain anti-nutritional factors such as phytic acids, tannin among others which hampered nutrient availability and utilization hence, depressed growth.

Table 5: Effect of inclusion of raw, soaked, and soaked and cooked lablab seed meal on growth performance of finisher broiler chickens

	Treatment						
Parameters	T1	T2	T3	T4	T5	T6	SEM
Initial weight (g/bird)	214.29	214.29	214.29	195.24	214.29	214.29	±2.90
Final weight (g/bird)	2052.38^{a}	1640.47^{c}	1773.18^{bc}	1928.57^{ab}	1871.43^{abc}	1992.86^{ab}	±56.14
Daily weight gain (g/bird)	37.51^{a}	29.40^{c}	31.83^{bc}	35.37^{ab}	33.82^{abc}	36.30^{ab}	±1.12
Daily feed intake (g/bird)	85.02	87.70	87.70	94.21	90.27	93.47	±1.34
Feed/gain ratio	2.33^{c}	2.99^{a}	2.75^{ab}	2.67^{b}	2.68^{b}	2.60^{b}	±0.08
Protein intake	20.36	21.61	21.36	23.60	22.25	23.35	±0.46
Protein efficiency ratio	1.92^{a}	1.21^{c}	1.59^{b}	1.55^{bc}	1.39^{bc}	1.63^{ab}	±0.09

a,b,c = Means on the same row with different superscripts are significantly ($p<0.05$) different
SEM= Standard Error of Mean
T1= Maize-soya beans (control); T2= Raw lablab seed; T3= Soaked lablab seed; T4= Soaked lablab seed cooked for 20 minutes; T5= Soaked lablab seed cooked for 40 minutes; T6= Soaked lablab seed cooked for 60 minutes

Cost-benefit analysis of Broiler Chickens Fed Diets Containing Raw, Soaked, and Soaked and Cooked Lablab Seed Meal

Results on cost-benefit analysis of broiler chickens fed diets containing raw, soaked, and soaked and cooked lablab seed meal is presented in Table 6. One kg of raw lab lab seed cost ₦ 40.00 and was put at ₦ 42.00 post- processing. The cost per kg of feed increased as lablab seed meal were included in the diets. Feed cost (₦) to raise a broiler chick to the nine weeks increased from ₦273.23 to ₦325.85 as a result of inclusion of lablab seed meal in the diets. This is not in agreement with the findings of [17] who reported a decrease in feed cost due to inclusion of lablab seed meal compared to the control diet. Feeding broiler chickens using diets containing lablab seed meal increased cost per kg weight gain (₦ 148.66 to ₦212.70) in the present study which disagreed with the report of [17] who observed a reduction in feed cost per kg weight gain (₦78.73 - ₦66.70) with the exception of birds fed 30 % replacement for both ground nut cake and maize. This unusual increase in feed cost per kg gain could be attributed to lack of large scale production leading to scarcity of lablab seeds in the market with attendant high price tag (₦40/kg as at the time of the study). This result agreed with the finding of [4] who reported increased feed cost per Kg gain when diets containing *Mucuna utilis* were fed to broiler chickens.

Table 6: Cost-benefit analysis of feeding diets containing raw, soaked and cooked lablab seed meal to broiler chickens

	Treatment						
Parameters	T1	T2	T3	T4	T5	T6	SEM
Total feed intake (kg)	4.76	4.91	4.91	5.28	5.06	5.23	±0.08
Total weight gain (kg)	1.84	1.43	1.56	1.73	1.66	1.78	±0.06
Cost/kg diet (₦)	57.39	61.76	61.65	61.76	61.72	61.71	±0.66
Cost of total feed consumed/bird (₦)	273.23	303.30	302.76	325.85	312.00	322.99	±7.09
Cost of feed/kg weight gain (₦)	148.66	212.70	194.20	188.02	188.29	181.66	±7.82

SEM= Standard Error of Mean
T1= Maize-soya beans (control); T2= Raw lablab seed; T3= Soaked lablab seed; T4= Soaked lablab seed cooked for 20 minutes; T5= Soaked lablab seed cooked for 40 minutes; T6= Soaked lablab seed cooked for 60 minutes

Conclusion and Applications

1. Incorporation of cooked lablab seed meal in broiler chickens' diet gave the best growth performance compared to raw and soaked lablab seed meal.
2. Generally, inclusion of lablab seed meal increased cost of broiler chicken production compared to birds fed control diet.
3. Lablab seeds should be soaked and cooked for 60 minutes before inclusion in broiler chicken diet to improve growth performance. Hence, this duration of cooking deactivated all the anti-nutritional factors present.

References

1. Gavrilova, N. (2020). Improving food security in Nigeria through livestock innovation. E3S Web Confrenece, 176: 01010. https://doi.org/10.1051/e3sconf/2020 17601010.
2. Ekenyem, B.U. (2002). The economic viability of raising weaner rabbits on guinea grass (*Panicum maximum*) supplemented with graded levels of poultry grower ration. Proceedings of 27th NSAP Conference, Akure, Nigeria. Pp 180-181.
3. Okah, U and Ehuriah, S.A. (2015). Haematological and serum biochemical characteristics of weaner pigs fed graded levels of Bambara groundnut offal. *Nigerian Journal of Agriculture,* 46(2): DOI: 10.4314/naij.v46i2.
4. Tuleun, C.D., Offia, B. and Yaakugh, I.D.I. (2010). Comparative performance of broiler fed diets containing raw and processed Mucuna seed meal. *International Journal of Poultry Science*, 9(11): 1056-1062.
5. Igwebuike, J. U. (2001) Utilization of acacia pods (*Acacia albida Del.*) for rabbit feeding. PhD. Thesis submitted to the Department of Animal Production, University of Agriculture, Makurdi.
6. Adu, I.F., Fajemisin, B.A., Illena, S.W., Tanko, R.J., Eduvie, L.D. and Dewuyi, A.A. (1991). The use of *Lablab purpureus* as supplement to sorghum stover fed to Yankasa sheep. In; proceeding of work shop on; forage production and utilization in Nigeria held at National Livestock Development Project, Kaduna. Pp 151-156.
7. Google Earth (2022). www. googleearth.com.
8. A.O.A.C. (2005). Association of

Official Analytical Chemist. Official Methods of Analysis. 18th edition, Arlighton, Virginia, Washington D.C.

9. Statistical Package for Social Science (2015). IBM SPSS Incorporation Statistics for windows Version 23.0 Armonk, New York. IBM Corp.
10. Bawa, G.S., Tegbe, T.S.B., Ogundipe, S.O., Dafwang, I.I. and Abu, E.A. (2003). The effect of duration of cooking lablab seed on the level of some anti-nutritional factors. In: proceeding of the 28th Annual Conference of Nigerian Society for Animal Production (Eds); A.A. Taiwo, A.M. Raji, J.U. Ogbonna and F.A. Adebowale, Ibadan, Nigeria. Pp 233-234.
11. *Tuleun*, C.D., Patrick, J.P. and Tiamiyu, L.O. (2009). Evaluation of raw and boiled velvet (*Mucuna utilis*) as feed ingredient for broiler chickens. *Pakistan Journal of Nutrition*, 8(5): 601-606.
12. Egbe, A.A. and Akinyele, I.O. (1990). Effect of cooking on the anti-nutritional factors of lima beans (*Pheseolus lunatus*). *Food Chemistry*, 45:81-87.
13. Ologhobo, A.D. (1980). Biochemical and nutritional studies of cowpea and lima beans with particular reference to some inherent anti-nutritional components. Ph.D Thesis, University of Ibadan.
14. Ogundipe, S.O., Abeke, F.O., Sekoni, A.A., Dafwang, I.I. and Adeyinka, I.A (2003). Effect of cooking duration on the utilization of *Lablab purpureus* beans by pullet chicks. In: proceeding of the 28th Annual Conference of Nigerian Society for Animal Production (Eds); A.A. Taiwo, A.M. Raji, J.U. Ogbonna and F.A. Adebowale, Ibadan, Nigeria. Pp 233-234.
15. Mbajunwa, K.C. (1995). Effects of processing on the nutritional composition of African oil bean seed (*Pentaclethra marcrophylla* Benth). *Journal of Science, Food and Agriculture*, 68:153-156.
16. Ukachukwu, S.N. and Obioha, F.C. (1997). Effect of time duration on thermal treatment on nutritive value of *Mucuna cochinchinensis. Journal of Applied Chemistry and Agricultural Research*, 4:39-43.
17. Abeke, F.O., Ogundipe, S.O., Sekon, A.A., Dafwang, I.I. and Adeyinka, I.A. (2008). Effect of dietary levels of cooked lablab purpureus beans on the performance of broiler chickens. *American Journal of Food Technology*, 3(1): 24-49.
18. Siddhuraju, P., Vijayakurmarri, K. and Jonardhanan, K. (1996). Chemical composition and protein quality of the little known legume, Velvet beans (*Mucuna Pruriens* L.). *Journal of Agriculture and Food Chemistry*, 44:2636-2641.