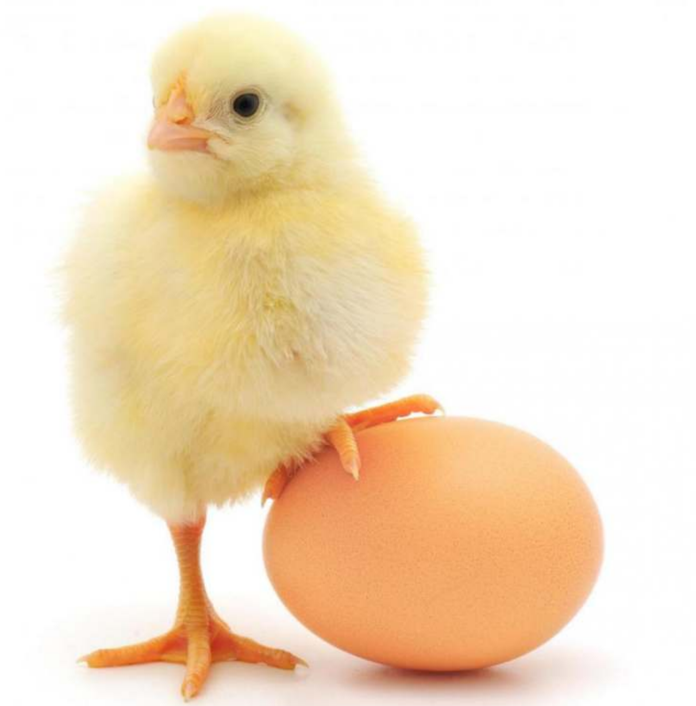
ISSN 1682-8356
ansinet.org/ijps



INTERNATIONAL JOURNAL OF
POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 11 (2): 131-137, 2012
ISSN 1682-8356

Effect of Different Levels of the Processed *Lablab purpureus* Seeds on Laying Performance, Egg Quality and Serum Parameters

H.I. Ragab[1], K.A. Abdel Ati[2], C. Kijora[3] and S. Ibrahim[4]
[1]Department of Animal Production, Faculty of Natural Resources and Environmental Studies, Peace University, P.O. Box 20, El Fulla, Sudan
[2]Department of Animal Nutrition, [4]Department of Poultry Production, Faculty of Animal Production, University of Khartoum, P.O. Box 32, Khartoum North, Sudan
[3]Institute of Animal Sciences, Humboldt-University of Berlin, Philippstr. 13, 10115 Berlin, Germany

Abstract: *L. purpureus* is considered to substitute some of conventional plant protein sources in poultry diets. In 12 weeks feeding trial the processed *L. purpureus* seeds were investigated for its impacts on laying performance, egg quality and serum constituents of Hisex White hens. Diets contain 0, 5, 10, 15 and 20% *L. purpureus* were allotted randomly following completely randomized design to 25 units of three birds each. Hen day egg production, egg weight, egg mass, FCR and weight gains were significantly ($p<0.01$) high up to 10% *L. purpureus*. Shell percentage and thickness were significantly ($p<0.05$) high in control and 20% *L. purpureus* groups. 15 and 20% *L. purpureus* dietary groups were of high egg albumin index and percentage. The utmost ($p<0.05$) yolk index and percentage were shown in 15 and 10% *L. purpureus* groups, respectively. Comparable high Haugh units were shown in different treatment groups. 15% *L. purpureus* groups, recorded significant ($p<0.01$) high serum total protein and globulin. All *L. purpureus* treatment groups were of significant ($p<0.05$) low serum albumin. Serum glucose was significantly ($p<0.01$) lowered in *L. purpureus* groups, while serum cholesterol was insignificantly ($p>0.05$) reduced due to *L. purpureus* inclusion. The 20 and 10% *L. purpureus* groups when compared to control were found of low serum P and Ca, respectively. In conclusion, up to 10% dietary inclusion of *L. purpureus* is appropriate to provide similar laying performance as the standard layers diet.

Key words: Egg quality, *Lablab purpureus*, laying performance, serum constituents

INTRODUCTION

The development of poultry industry depends mainly on providing cheap and cost effective feeds (Akinmutimi and Okwu, 2006). Most of the conventional plant protein sources as peanut, sesame cakes and soybean meal might sometimes be limited in poultry feeding. That is due to their costly prices (Onu and Okongwu, 2006). This situation inevitably guides to look for unconventional substitutes as legumes, especially those of down-graded varieties and of no human preference (Ojewola and Ewam, 2005). This is the case for the legume of our study *L. purpureus* formerly known as Dolichos lablab (Mortuza and Tzen, 2009). The utilization of legumes seeds as protein sources for poultry is limited for the uncertainty of their nutritional quality (Elamin and Abdelati, 2008). Legumes are, to some extent, cheap and rich in most nutrients. *L. purpureus* is considered as suitable source of functional protein, due to its good balance of high bio-available amino acids (Arinathan *et al*., 2003; Ragab *et al*., 2010). Moreover, it is well suited to wide range of environments and soil types and is drought resistant and cold tolerant (Venkatachalam and Sathe, 2007). It is lesser-known and hasn't received attention by nutritionists (Ramakrishna *et al*., 2006). *L. purpureus* as other grain legumes was reported to contain variety of antinutritional factors as trypsin, chymotrypsin, amylase inhibitors, phytic acid, flatulence factors, etc. (Vijayakumaris *et al*., 1995; Devaraj and Manjunath, 1995; Ramakrishna, 2008). Proper processing as aqueous and dry heating, toasting, germination and boiling could be undergone to *L. purpureus* seeds to minimize their negative physiological effects (Osman, 2007; Ramakrishna *et al*., 2006).

The objective of this work is to investigate the influence of different levels of the processed *L. purpureus* seeds on layers performance traits, egg quality measurements and serum constituents.

MATERIALS AND METHODS

Housing, experimental birds: The experiment was carried out in an open sided house, in the poultry unit, University of Khartoum. It lasted for 12 weeks period. 75 Highsex layers of 26 weeks' age were selected then

Corresponding Author: H.I. Ragab, Department of Animal Production, Faculty of Natural Resources and Environmental Studies, Peace University, P.O. Box 20, El Fulla, Sudan

adapted for three weeks on standard layer ration. At 29th weeks' age hens were on the average body weight of 1450 g and maximum laying rate of 81%. Groups of three birds with nearly identical weights were replicated five times under five experimental diets. Water and feed were provided *ad-libitum*. Birds were brought in a wooden shave deep litter system. Each cage was supplied with single local nest.

Seeds processing and chemical analysis: *L. purpureus* seeds variety are the Rongai of brown color. Seeds were brought from the market, then were cleaned, mixed, submerged in water for 48 h and boiled for 30 min. Water change was every 24 h and before the boiling process. Thereafter, seeds were sun dried for 72 h. After the milling of seeds to particle size of I mm seeds were analyzed for proximate composition according to the standardized method VDLUFA 4th Ed. (Naumann *et al*., 2004).

Experimental diets: Five experimental diets contained 0, 5, 10, 15 and 20% *L. purpureus* seeds of the whole diets were formulated to meet the outlined recommendation of Hisex Breeder Management Guide. Proximate composition of *L. purpureus* seeds are shown in Table 1. Feed ingredients, calculated and determined analysis of experimental diets according to AOAC (1990) methods are shown in Table 2.

Table 1: Proximate composition of raw and processed *L. purpureus* seeds (% DM)

Composition	Raw seeds	Soaked and boiled seeds
Dry matter(1) (2)	93.30	88.90
Crude protein(1)	23.40	25.70
Ash(1)	3.73	2.20
Ether extract(3)	0.92	2.12
Crude fiber(3)	10.20	11.50
NFE(4)	61.80	58.50

(1)Values are averages of three determinations
(2)DM on fresh basis
(3)Values are averages of two determinations
(4)Values are calculated by difference as following: (NFE) = 100 - (Ash + CP + EE + CF)

Data collection: Feed intake and body weight were determined as averages for each replicate on weekly basis. Fresh laid eggs were weighted daily and pooled for every week. Feed Conversion Ratio (FCR) was

Table 2: Composition of treatment diets containing *L. purpureus* seeds

	Levels of *Lablab purpureus* seeds (%)				
Ingredients	0 LP	5 LP	10 LP	15 LP	20 LP
Sorghum	63.40	59.30	54.80	50.90	46.50
Groundnut cake	13.70	12.50	11.50	13.60	13.02
Sesame cake	5.59	5.97	6.20	3.25	3.00
Lablab purpureus	0.00	5.00	10.00	15.00	20.00
Wheat bran	2.74	2.66	2.95	2.60	2.85
Super concentrate(1)	5.00	5.00	5.00	5.00	5.00
Di-calcium	0.72	0.72	0.72	0.76	0.77
Lime stone	7.98	7.98	7.99	8.09	8.11
Salt	0.40	0.40	0.40	0.40	0.40
Lysine	0.22	0.17	0.13	0.07	0.02
Methionine	0.00	0.00	0.00	0.03	0.03
Vit. + min(2)	0.30	0.30	0.30	0.30	0.30
Calculated analysis					
ME (kcal/kg)	2867.00	2870.00	2869.00	2870.00	2868.00
CP (%)	18.90	18.90	18.90	18.90	18.90
Crude fiber (%)	3.91	3.96	4.05	4.11	4.19
Ca (%)	3.85	3.85	3.85	3.85	3.85
Av. Phosphorus (%)	0.42	0.41	0.41	0.41	0.42
Lysine (%)	0.88	0.88	0.88	0.88	0.88
Methionine (%)	0.46	0.46	0.46	0.46	0.46
Meth.+ Cystine (%)	0.67	0.67	0.67	0.67	0.66
Determined analysis					
CP (%)	18.50	18.80	18.70	19.10	18.10
Crude fiber (%)	4.20	4.03	4.03	4.00	3.91
EE (%)	3.40	2.65	2.95	3.25	2.65
Ash (%)	6.15	6.25	5.57	6.50	6.90
NFE (%)	63.70	62.30	63.12	61.20	64.50

1Supplied the following per kg = 35% CP, 2150 kcal ME, 4% C.F, 5% EE, 10% Ca, 4.5% P, 5.7% lysine and 4.5% methionine.
2Supplied the following per kg of the diet: Vitamin A 500.000IU, Vitamin D_3 100.000IU, Vitamin E 750 mg, Vitamin K_3 100 mg, Vitamin B_1 75 mg, Vitamin B_2 200 mg, Pantothenic acid 450 mg, Vitamin B_6 100 mg, Vitamin B_{12} 1.25 mg, Nicotinic acid 1.250, Folic acid 37.5 mg, Choline Chloride 25.00 mg, Iron 3.000 mg, Copper 300 mg, Manganese 3.000 mg, Zinc 2.500 mg, Iodine 25 mg, Selenium 10 mg, Phosphorus 12.9%, Lysine11.30%, Methionine 4.9%

calculated either as weekly feed consumption (kg) per weekly produced (kg) eggs weight, or weekly feed consumption (g) per weekly dozens of laid eggs. Hen-day egg production was calculated from the number of laid eggs expressed as a percentage of the number of hens per pen on weekly basis. Egg masses were computed by multiplying hen day egg production by eggs weights.

Egg quality measurements: In two weeks intervals, ten eggs per treatment were selected for eggs characteristic study. After weighing of freshly laid eggs, they were broken in a wide flat Petri dish. Egg shells were weighted then peeled of any membranes. Shell samples from top, middle and bottom, were measured for thickness using 0.01 mm micrometer screw gauge model.

Yolk was carefully removed from albumin then weighed. Albumen weight was calculated by difference. Shell, Yolk and Albumin percentages were calculated as rates of the whole eggs weights. Height and diameter of yolk and Albumin for indices calculation were measured using 0.02 mm Vernier.

Haugh's unit was computed by using the formula:

$$\text{Haugh's unit} = 100 \log (H + 7.57 - 1.7W^{0.37})$$

H = Albumen height in millimeters.
W = Egg weight in grams.

Blood collection and serum analysis: Blood samples were taken in the trial last week from 10 birds per treatment, by method of venipuncture of the brachial vein by syringe. Serum samples after collection were kept deep frozen prior to analysis.

Statistical analysis: The experiment was conducted following the completely randomized design. Data were subjected to analysis of variance according to Steel and Torrie (1960). Treatment means were compared using Duncan multiple range test (1989).

RESULTS

Seeds' processing practiced in this work was of slight impact upon nutrients. Meanwhile, it faintly fortified CP, EE and CF; it decreased ash contents and NFE for about 41% and 5.4%, respectively.

Laying performance (30th-41st) week: Regarding feed consumption, none considerable (p>0.05) variation was noticed between treatment groups for the overall and daily feed intake. Total number of laid eggs, hen day egg production and egg mass were shown comparable and significantly (p<0.01) high for birds fed on 0 LP, 5 LP and 10 LP diets. Whereas, the lowest values for these parameters were observed in 15 LP and 20 LP dietary groups. Regarding overall weight of laid eggs, birds on 0 LP and 10 LP diets laid eggs of utmost (p<0.01) overall weight. The least overall eggs' weight was for birds on 15 and 20 LP diets. In both two ways of measuring feed conversion ratio FCR, the poorest and poorer FCR, were proven to 20 LP and 15 LP treatment groups, respectively. Concerning average egg weight, all *L. purpureus* dietary groups, laid eggs of comparable (p>0.05) weights. A part from others, only the groups on 5 LP and 10 LP diets laid eggs of analogous (p>0.05) weight to control group. Regarding body weight change, the groups on 15 LP and 20 LP diets lost comparable weight, while the others on 0 LP, 5 LP and 10 LP diets both attained equivalents (p>0.05) weights.

Egg quality: High shell percentage and thickness were similarly recorded in favor of 0 LP and 20 LP groups. Comparable high albumin index and percentage were apparent in the 15 LP and 20 LP treatment groups. High yolk index was evident in 15LP dietary group, however, the remaining groups showed similar yolk index. The superior yolk percentage was encountered in the 10LP treatment group. All treatment groups laid eggs of comparable Haugh units.

Serum parameters: As illustrated in Table 5, significant (p<0.01) high serum total protein was detected in15 LP

Table 3: Layers hens' performance fed graded levels of processed *L. purpureus* seeds (30th-41st) weeks of age

	Dietary levels of *L. purpureus* seeds (%)					
Parameters	0 LP	5 LP	10 LP	15 LP	20 LP	SEM
Feed intake, g/hen/12week	8907.00	84767.00	8943.00	8570.00	8847.00	398.00
Feed intake, g/hen/day	106.00	101.00	106.00	102.00	105.00	4.74
Total laid eggs, eggs/hen/12week	79.00^{a}	72.00^{a}	78.00^{a}	55.00^{b}	47.00^{b}	2.65
Hen-day egg production, %	94.60^{a}	90.50^{a}	92.30^{a}	65.50^{b}	58.20^{b}	2.58
Total eggs weight, g/hen/12week	4411.00^{a}	3938.00^{b}	4217.00^{ab}	2863.00^{c}	2507.00^{c}	142.00
Egg weight, g/egg	55.60^{a}	54.70^{ab}	54.40^{ab}	52.20^{b}	52.80^{b}	0.78
Egg mass, g/hen/day	52.50^{a}	49.50^{a}	50.20^{a}	34.10^{b}	30.70^{b}	1.30
FCR, g feed/g eggs	2.02^{a}	2.15^{a}	2.12^{a}	3.01^{b}	3.55^{c}	0.11
FCR, kg feed/dozens of egg	1.35^{a}	1.41^{a}	1.39^{a}	1.89^{b}	2.25^{c}	0.08
Body weight change, g	61.10^{b}	66.80^{b}	40.10^{b}	-65.90^{a}	-38.60^{a}	23.50

^{ab}Means in the same raw with different superscripts were significantly different

Table 4: Egg quality of layers fed dietary levels of processed *L. purpureus* seeds

	Levels of *L. purpureus* seeds (%)					
Parameters	0 LP	5 LP	10 LP	15 LP	20 LP	SEM
Shell (%)	11.200[a]	10.700[b]	10.700[b]	10.600[b]	11.100[a]	0.120
Shell thickness (mm)	0.370[a]	0.350[bc]	0.360[b]	0.340[c]	0.370[a]	0.004
Albumin index	0.130[b]	0.129[b]	0.129[b]	0.137[a]	0.131[ab]	0.002
Albumin (%)	62.700[bc]	63.300[ab]	62.600[c]	63.900[a]	63.700[a]	0.270
Yolk index	0.410[b]	0.420[b]	0.420[b]	0.440[a]	0.420[b]	0.010
Yolk (%)	25.900[b]	26.100[b]	26.600[a]	25.600[bc]	25.200[c]	0.230
Haugh units	90.600	89.900	90.500	91.200	89.700	0.590

[ab]Means in the same raw with different superscripts were significantly different

Table 5: Serum constituents of layers fed dietary levels of processed *L. purpureus* seeds

	Levels of *L. purpureus* seeds (%)					
Parameters	0 LP	5 LP	10 LP	15 LP	20 LP	SEM
Total protein (g/dL)	5.45[c]	6.39[ab]	5.84[bc]	6.82[a]	5.52[c]	0.23
Albumin (g/dL)	2.75[a]	2.39[b]	2.29[b]	2.22[b]	2.14[b]	0.10
Globulin (g/dL)	2.70[c]	4.00[ab]	3.55[b]	4.60[a]	3.38[bc]	0.25
Uric acid (mg/dL)	5.83	6.21	6.33	6.28	6.34	0.39
Glucose (mg/dL)	204.00[a]	193.00[ab]	169.00[c]	153.00[c]	175.00[bc]	7.71
Cholesterol (mg/dL)	130.00[b]	124.00[b]	115.00[b]	129.00[b]	154.00[a]	7.65
P (mg/dL)	7.63[a]	7.58[a]	7.09[ab]	6.76[ab]	6.36[b]	0.29
Ca (mg/dL)	14.10[a]	13.60[a]	12.90[b]	12.70[ab]	12.70[ab]	0.52

[ab]Means in the same raw with different superscripts were significantly different. Values are means of 10 blood samples

group; it is in consonance ($p>0.05$) only with the 5 LP group. As compared to control, comparable ($p>0.05$) lower serum albumin was detected in all *L. purpureus* treatment groups. Regarding serum globulin, the highest ($p<0.01$) value was noticed in the 15LP group. With exception of 20 LP group, the control for serum globulin, significantly ($p<0.01$) ranked below *L. purpureus* groups. Serum uric acid wasn't affected by treatment diets, however, it was slightly ($p>0.05$) raised in *L. purpureus* dietary groups.

Serum glucose was significantly ($p<0.01$) lowered in *L. purpureus* treatments groups. For the cholesterol, an insignificant ($p>0.05$) reduction was detected in *L. purpureus* dietary groups, conversely, the group on 20LP diet showed the highest ($p<0.05$) cholesterol level. Regarding phosphorus P, as compared to control, only the significant ($p<0.05$) low P was detected in 20 LP group. Serum calcium Ca was slightly ($p>0.05$) lowered in most *L. purpureus* treatment groups. However the group on 10LP diet showed significant ($p<0.05$) lower serum calcium compared to control and 5 LP treatment groups.

DISCUSSION

The study investigated the effect of levels of processed *L. purpureus* seeds in laying performance, egg characteristics and serum constituents of High sex white hens.

Concerning laying performance, the similarity in overall feed intake across treatment groups could be attributed to the equality of dietary treatments in energy and nitrogen components. However, all experimental diets were formulated on this basis. Moreover, it might be due to well adaptability of layers to differently composed treatment diets. Amaefule *et al.* (2006) either before reported non-significant difference in feed intake of pullets fed differently processed levels of *C. cajan* based diets.

The high production rate (76 number of laid eggs out of 84 housed hens) up to 10 LP level within 12 weeks was remarkable. This reflects the tolerance birds to *L. purpureus* seeds up to this level. Additionally, data collection was within the laying age between 30th and 41st weeks, which is the age range when High sex hens reach peak production. The drop in egg production and the negatively influenced average egg weight at high *L. purpureus* levels were in harmony with that of Abeke *et al.* (2008). In tandem, this was applied as well with the overall weight of laid eggs.

The negative influence on egg weight might be due to some toxic residues left in seeds after processing. It is the fact previously investigated by Akanji and Ologhobo (2007). Tannins and phytic acid are of the residues in the processed *L. purpureus* seeds (Osman, 2007; Ramakrishna *et al.*, 2006), they as shown by Bawa *et al.* (2003) are resistant to heat processing and their left over negative effects beyond processing could be exaggerated by increasing the seeds level. They can form complexes with proteins and polypeptides preventing their digestion and assimilation, hence reducing the sufficient protein for egg production (Card and Nesheim, 1975). Where egg mass is computed basing on the egg production rate, so the declined egg mass at high *L. purpureus* levels was in parallel with egg production declined rate.

Despite the similarity of 15 LP and 20LP dietary groups in feed consumption with 0 LP, 5 LP and 10 LP groups; they oppositely exerted remarkable reduction in the overall weight and total number of laid eggs. It is evidence of low quality of these two diets, which was eventually shown as poor FCR in these treatment groups.

The body weight losses at high *L. purpureus* levels are similar to that observed by Robinson and Singh (2001). The authors primarily attributed the losses to trypsin inhibitor activity, which was detected by them as the only ANF in direct significant correlation with body weight change. Robinson and Singh (2001) detected that, the viscosity and TIA of *L. purpureus* were lower than Jack beans and chick peas; however, oppositely, *L. purpureus* demonstrated the inferior performance. The authors hence suspected the poor performance with *L. purpureus* diets to factors other than high viscosity and TIA. The sameness of shell thickness of the 20LP and 0LP groups is suspected to be of more Ca affluence in the blood stream of 20 LP groups. This was due to their reduced exploitation for egg shell formation owing to the low laying rate. Additionally, it might be in part for the likely serum calcium of the 0 LP and 20 LP groups. This trend applied in turn to shell percentage.

Egg albumin index attained for different treatment groups fall within the normal albumin index of eggs, 0.078-0.13 (Nair and Elizabeth, 1983; Kondaiah *et al*., 1983. The reduced yolk percentage at high *L. purpureus* levels is preferred by consumers because laid eggs are then expected to include low cholesterol. Caston *et al*. (1994) reported decreases in yolk percentage when 10 or 20% flaxseed diets were fed from 39 to 43 weeks of age. The hormones responsible for yolk formation as follicle stimulating hormones and progesterone were reported to be negatively interfered by haemagglutinins (Pusztai *et al*., 1975; Card and Nesheim, 1975; Akanji and Ologhobo, 2007). Haemagglutinins residual effect beyond seeds processing might have brought about the slight decrease in yolk percentage at high Lablab beans' level.

As for albumin index, the 15 LP group laid eggs of significant high yolk index. The comparable Haugh units of eggs along *L. purpureus* treatment groups when compared with control refer to high albumin quality and freshness state of eggs when measured for quality.

However, Durunna *et al*. (2005) regarded the 72 Haugh units and more as an indicator of eggs' freshness.

The treatment diets were formulated on CP equality basis and when chemically detected for CP, the 15 LP diet was of slightly high CP. However, this might in turn explains the high serum total protein and globulin in these treatment groups. Crevieu *et al*. (1997) stated that some of the pea's albumin molecules were less susceptible to hydrolysis and digestion and remained indigestible till the end of the digestive tract. Similarly, this case can help to explain why the serum albumin in case of *L. purpureus* feeding is at minimal level.

There was an evidence of a synchronized reduction relationship between albumin and cholesterol demonstrated before by Viveros *et al*. (2007), which correspondingly shown slightly in this study.

The decrease of serum cholesterol and glucose in *L. purpureus* groups compared to control can be clarified basing on their reduced carrying over on the blood stream. That is owing to their lessened absorption from the intestine, due to the raised viscosity of intestine ingesta. The viscosity might occurred, to some extent as a result of the NSP left after *L. purpureus* seeds processing (Gallaher *et al*., 1993a,b; Magni *et al*., 2004; Viveros *et al*., 2007). The elevated serum cholesterol in the 20 LP treatment group might be due to their low laying rate. The amount of 209-211 mg/100 mL cholesterol in egg yolk (Chowdhury *et al*., 2002, 2005) arrives directly from the blood stream. And whereas egg production is decreased, serum cholesterol is expected to rise for no more egg drain to get hold of serum cholesterol. The decrease in serum phosphorus as compared to control wasn't considerable except at 20 LP treatment group. That may be due to the residual capturing effect of either leftover tannin or phytic acid at this high *L. purpureus* level, which prohibited phosphorus full absorption, assimilation and occurrence in the blood stream.

In conclusion, *L. purpureus* seeds processed in the way shown in this study could safely be included up to 10% level in layers' rations without any problems in laying performance.

ACKNOWLEDGMENTS

The author would like to acknowledge the Ministry of Higher Education, Sudan for funding support of this work and to Dr. J. Danier for his utmost assistance in the proficient Amino acids analysis of tested beans.

REFERENCES

Abeke, F.O., S.O. Ogundipe, A.A. Sekoni, I.I. Dafwang, I.A. Adeyinka, O.O. Oni and A. Abeke, 2008. Effect of dietary levels of cooked *Lablab purpureus* beans on the performance of broiler chickens. Am. J. Food Technol., 3: 42-49.

Akanji, A.M. and A.D. Ologhobo, 2007. Effect of some raw tropical legume seeds on egg quality and laying performance of exotic hens. Am.-Eurasian J. Agric. Environ. Sci., 2: 648-654.

Akinmutimi, A.H. and N.D. Okwu, 2006. Effect of quantitative substitution of cooked *Mucuna utilis* seed meal for soybean meal in broiler finisher diet. Int. J. Poult. Sci., 5: 477-481.

Amaefule, K.U., G.S. Ojewola and M.C. Ironkwe, 2006. Pigeon Pea (*Cajanus cajan*) seed meal as protein source for Pullets: 2. response of pullets to higher inclusion level and prolonged feeding of raw or processed pigeon pea seed meal diets. Int. J. Poult. Sci., 4: 289-295.

AOAC, 1990. Official methods of analysis. Association of Official Analytical Chemists, Arlington, Virginia, 15th Edn., pp: 1298.

Arinathan, V., V.R. Mohan and A.J.D. Britto, 2003. Chemical composition of certain tribal pulses in South India. Int. J. Food Sci. Nutr., 54: 209-217.

Bawa, G.S., T.S.B. Tegbe and S.O. Ogundipe, 2003. Effect of feeding graded dietary levels of lablab seeds as a replacement for soyabean on performance characteristics of young pigs. Proc. 28th NSAP Conf, Ibadan, Nigeria, 28: 230-232.

Card, L.E. and M.D. Nesheim, 1975. Poultry Production. 11th Edn., Lea and Febiger, Philadelphia, pp: 214-218.

Caston, L.J., E.J. Squires and S. Leeson, 1994. Hen performance, egg quality and the sensory evaluation of eggs from SCWL hens fed dietary flax. Can. J. Anim. Sci., 74: 347-353.

Chowdhury, S.R., S.D. Chowdhury and T.K. Smith, 2002. Effects of dietary garlic on cholesterol metabolism in laying hens. Poult. Sci., 81: 1856-1862.

Chowdhury, S.R., D.K. Sarker, S.D. Chowdhury, T.K. Smith, P.K. Roy and M. Wahid, 2005. Effects of dietary tamarind on cholesterol metabolism in laying hens. Poult. Sci., 84: 56-60.

Crevieu, I., B. Carre, A.-M. Chagneau, L. Quillien, J. Guéguen and S. Berot, 1997. Identification of resistant pea (*Pisum sativum* L.) proteins in the digestive tract of chickens. J. Agric. Food Chem., 45: 1295-1300.

Devaraj, V.R. and N.H. Manjunath, 1995. Effect of cooking on proteinase inhibitors of *Dolichos Lablab* beans (*Dolichos lablab purpureus* L.). Plant Foods Human Nutr., 48: 107-112.

Duncan, D.B., 1989. Multiple range and multiple F-tests. Biometrics, 11: 1-42.

Durunna, C.S., M.C. Clwakwe and N.J. Okeudo, 2005. Influence of replacing soybeans meal with varying dietary levels of *Anthonata macrophyla* seeds meal on the quality of chicken egg. Proc. 30th Ann. Conf. NSAP, pp: 217-219.

Elamin, M.A. and K.A. Abdelati, 2008. Effect of dietary levels of processed *Leucaena leucocephala* seeds on broiler performance and blood parameters. Int. J. Poult. Sci., 7: 423-428.

Gallaher, D.D., C.A. Hassel and K.J. Lee, 1993a. Relationships between viscosity of hydroxypropyl methylcellulose and plasma cholesterol in hamsters. J. Nutr., 123: 1732-1738.

Gallaher, D.D., C.A. Hassel, K.J. Lee and C.M. Gallaher, 1993b. Viscosity and fermentability as attributes of dietary fiber responsible for the hypo-cholesterolemic effect in hamsters. J. Nutr., 123: 244-252.

Kondaiah, N., B. Panda and R.A. Singhal, 1983. Internal egg quality measure of quail eggs. In. J. Anim. Sci., 55: 1261-1264.

Magni, C., F. Sessa, E. Accardo, M. Vanoni, P. Morazzoni, A. Scarafoni and M. Duranti, 2004. Conglutin γ, a lupin seed protein, binds insulin *in vitro* and reduces plasma glucose levels of hyperglycemic rats. J. Nutr. Biochem., 15: 646-650.

Mortuza, M.G. and J.T. Tzen, 2009. Physicochemical and functional properties of cultivars of seem (*Lablab purpureus L.*), an underexploited bean in Bangladesh. J. Sci. Food Agric., 89: 1277-1283.

Nair, R.S. and V.K. Elizabeth, 1983. Effect of age and season on quality of chicken eggs. Int. J. Poult. Sci., 18: 207-210.

Naumann, C., R. Bassler, R. Seibold and C. Barth, 2004. Methodenbuch Band iii, Die chemische Untersuchung von Futtermitteln. 4th Edn., Darmstadt: VDLUFA-Verlag.

Ojewola, G.S. and U.E. Ewam, 2005. Response of growing broiler to varying dietary plant protein. Int. J. Poult. Sci., 4: 765-771.

Onu, P.N. and S.N. Okongwu, 2006. Performance characteristics and nutrient utilization of starter broilers fed raw and processed pigeon pea (*Cajanus cajan*) seed meal. Int. J. Poult. Sci., 5: 693-697.

Osman, M.A., 2007. Changes in nutrient composition, trypsin inhibitor, phytate, tannins and protein digestibility of *Dolichos lablab* seeds [*Lablab purpureus* (L) sweet] occurring during Germination. J. Food Technol., 5: 294-299.

Pusztai, A., G. Grant and R. Palmer, 1975. Nutritional evaluation of kidney bean (*Phaseoulus vulgaris*) the isolation and partial characterization of toxic constituents. J. Sci. Food Agric., 26: 149-156.

Ragab, H.I., C. Kijora, K.A. Abdel Ati and J. Danier, 2010. Effect of traditional processing on the nutritional value of legumes seeds produced in Sudan for poultry feeding. Int. J. Poult. Sci., 9: 198-204.

Ramakrishna, V., 2008. Changes in anti-nutritional factors in Indian bean (*Dolichos lablab L.*) seeds during germination and their behavior during cooking. Nutr. Food Sci., 38: 6-14.

Ramakrishna, V., P. Rani and P. Rao, 2006. Anti-nutritional factors during germination in Indian bean (*Dolichos lablab* L.) seeds. World J. Dairy Food Sci., 1: 06-11.

Robinson, D. and D.N. Singh, 2001. Alternative protein sources for laying hens. A report for the Rural Industries Research and Development Corporation, Queensland Poultry Research and Development Centre. RIRDC Publication No 00/144 RIRDC Project No DAQ-241A.

Steel, R.G.D. and J.H. Torrie, 1960. Principles and procedures of statistics. McGraw-Hill Book Company, Inc., New York.

Venkatachalam, M. and S.K. Sathe, 2007. Val bean (*Lablab purpureus* L.) proteins: Composition and biochemical properties. J. Sci. Food Agric., 87: 1539-1549.

Vijayakumaris, K., P. Siddhuraju and K. Janardhanan, 1995. Effects of various water and hydrothermal treatments on certain antinutritional compounds in the seeds of the tribal pulse, *Dolichos lablab* var. vulgaris L. Plant Foods Human Nutr., 48: 17-29.

Viveros, A., C. Centeno, I. Arija and A. Brenes, 2007. Cholesterol-lowering effects of dietary Lupin (*Lupinus albus* var Multolupa) in chicken diets. Poult. Sci., 86: 2631-2638.