Effect of Feeding Raw kapok (*Ceiba pentandra*) seed meal on the Growth Performance, Nutrient digestibility, carcass and organ weights of Weaner Rabbits

R.J. Wafar[1], B.Yakubu[2]; B.C Lalabe[1]

1. Department of Animal production and Health, Federal University Wukari, Taraba State
2. Department of Animal Science and Range Management, Modibbo Adama University of Technology Yola, Adamawa State.

Authors' contributions

This work was carried out in collaboration between the authors. Author R.J Wafar designed and coordinated data collection . Author B. Yakubu wrote the protocol, performed the analysis and managed the analyses of the study. B.C Lalabe wrote the first draft and managed the literature searches. All authors read and approved the final manuscript

Corresponding Author: wafar@fuwukari.edu.ng

ABSTRACT

The study was carried out to evaluate the effects of feeding raw kapok seed meal on growth performance, nutrient digestibility and carcass characteristics of weaner rabbits. Thirty (30) weaner rabbits were used for the study. Five diets were compounded using raw kapok seed meal (RKSM) at 0, 5, 10, 15 and 20% inclusion levels. The rabbits were weighed and randomly assigned to the five dietary treatments replicated three times with two rabbits per replicate in a completely randomized design. The proximate composition of raw kapok seed meal showed it contains 89.51% dry matter, 17.45% crude fibre, 22.59%, crude protein, 10.05% ether extracts, 6.53%, Ash and 43.38%. Nitrogen free extract. The seed meal also contains tannin (2.53%), Alkaloid (3.34%), phenol (2.48%), flavonoid (2.95%), saponin (1.30%) trypsin inhibitors (17.97%), hemagglutinin (1.69%) and total oxalate (1.12%).The result of growth performance and nutrient digestibility decreased significantly ($P<0.01$) as the dietary levels of raw kapok seed meal increases. Similarly carcass and internal organ weights were significantly influenced by the dietary levels of RKSM. The relative weights of liver, lungs and kidney significantly ($P<0.01$) increased beyond 15% RKSM inclusion in the diet. It was concluded that RKSM can be fed to weaner rabbit up to 10% inclusion levels without any adverse effect on the rabbit performance.

Keywords: weaner rabbit, Performance, nutrient digestibility, carcass characteristics, kapok seed,

1. Introduction

Over the years conventional protein and energy sources such as groundnut cake and soybean meal have remained the major protein source in the diets of non- ruminant animals [1]. The ingredients are highly consumed by human beings and industries as such; there is tacit competition between humans and livestock as well as industries for these scarce commodities [1, 2]. Hence their prices are becoming exorbitant. There is the need therefore to search for possible alterative protein and energy sources which are cheap, readily available and has comparable nutritive quality to the conventional protein and energy sources. One of such under exploited non-conventional feedstuff is kapok seed.

Kapok is a tropical tree of the order *Malvales* and the family *Malvaceae* native to Mexico, Central America and the Carribean, Northern South America and to tropical West Africa. The tree is also known as the Java cotton, Hara kapok, Silk cotton or Ceiba [3].It is the largest African forest tree and severally known among some Nigerian ethnic groups as *Rimi* (Hausa), *Bamtami* (Fulani), *Arabaogungun* (Yoruba) and *Akpi* (Igbo) [4]. In Nigeria, the leaves are cooked in form of slurry sauce comparable to Okra. The young leaves or the shoots are normally used for soup (sausage). A powder prepare from dried leaves is used to prepared sauce during the dry season [3].

The proximate composition of kapok seeds on dry matter basis have been reported to contain 20-35% crude protein (CP), 20-26% crude fibre (CF), 5-9% ether extracts (EE), 5-7% total ash and 29 -31% Nitrogen free extracts (NFE) [5,6].The seed has high potential as protein and energy sources in non-ruminant feed. Studies conducted by [7,8 and 9]on the effects of feeding unprocessed kapok seed meal to broiler chicken resulted to depressed appetite, loss of weight, growth depression and discoloration of the egg yolk in layers. However, there is scanty information on the utilization of raw kapok seed meal in rabbits' diet. The study was therefore carried out to determine the effects of raw kapok seed meal on the growth performance of weaner rabbits.

2. Material and methods

2.1 Study area:

The study was conducted at the Rabbit unit of Teaching and Research Farm of the Department of Animal Production and Health, Federal University Wukari, Taraba State. Wukari is located at longitude $9^0$47'0"E and latitude $7^0$51'0" N longitude $9^0$47' 0"E. The vegetation of the area is predominantly characteristics of savannah zone and with major climatic seasons of wet or rainy seasons, which starts in March or April, and ends in October and the dry season, and the dry season which starts in November and ends in March or April [10]. The experiment was conducted during dry season between the months of January – March, 2017.

2.2 Source and processing of kapok seeds meal

The seeds were procured from local market in Shelleng, Adamawa State Nigeria. The seeds were screened of stones and dirts to avoid contamination. The seeds were later milled using 2mm sieve hammer mill to form RKSM.

2.3 Experimental diets

Five dietary treatments were compounded using raw kapok seed meal (RKSM). Diet 1 served as control, while diets 2, 3, 4 and 5 contain RKSM at 5.00, 10.00, 15.00 and 20.00 % inclusion levels respectively (Table 1).

Table 1: Ingredient composition of experimental diets

	Inclusion levels of raw kapok seed meal (%)				
Ingredient	0	5	10	15	20
Maize	49.49	50.00	50.00	50.00	50.00
Soybean meal	16.00	14.00	10.34	9.12	6.15
Raw Kapok seed meal	0.00	5.00	10.00	15.00	20.00
Fishmeal	3.21	3.21	3.21	3.21	3.21
Maize Offal	20.00	16.49	15.15	11.37	9.34
Wheat offal	10.00	10.00	10.00	10.00	10.00
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Salt	0.30	0.30	0.30	0.30	0.30
Premix*	0.50	0.50	0.50	0.50	0.50
Total	100.00	100	100	100	100
Determined analysis (%)					
Dry matter	89.45	89.39	89.40	89.42	89.41
Crude protein	17.12	17.10	17.10	17.11	17.10
Crude fibre	5.34	5.30	5.33	5.31	5.32
Ether extracts	4.38	4.32	4.36	4.35	4.33
Ash	6.23	6.24	6.22	6.23	6.24
NFE	66.83	67.04	66.99	67.00	67.01
ME/Kcal/kg**	3356.68	3362.54	3364.50	3363.92	3362.28

** Calculated using the formula [46]. ME (kcal/kg) = 37 x % CP + 81 x % EE + 35.5 x % NFE.*premix composition (per kg of diet): vitamin A, 12500 IU; vitamin D3, 2500 IU; vitamin E, 50.00 mg; vitamin K3, 2.50 mg; vitamin B1, 3.00 mg; vitamin B2, 6.00 mg; vitamin B6, 6.00 mg; niacin, 40 mg; calcium pantothenic, 10 mg; biotin, 0.08 mg; vitamin B12, 0.25 mg; folic acid, 1.00 mg; chlorine chloride, 300 mg; manganese, 100 mg; iron, 50 mg; zinc, 45 mg; copper, 2.00 mg; iodine, 1.55 mg; cobalt, 0.25 mg; selenium, 0.10 mg; and antioxidant, 200 mg.

2.4 Experimental design and animal management

Thirty (30) weaner rabbits with an average weight of 503±0.10 were procured from National Veterinary Research Institute Vom, Plateau State, Nigeria. The rabbits were divided into five groups of six animals per group. Each rabbit was housed in a cage measuring 100 × 120 × 70cm and raised 60cm from the ground in a three-tier hutch system. Hutches were provided with feeders and drinkers. Animals were dewormed using Piperazine® before the commencement of the experiment. The animals were fed *ad libitum* and the experiment lasted for 56 days.

2.5Data collection

2.5.1 Growth performance

Data collected included initial body weight, weekly body weight, final body weight, daily feed intake, and feed conversion ratio. The rabbits were weighed at the beginning of the experiment to obtain their initial body weights. Daily feed intake was determined by subtracting the weight of left over feed from the weight of the feed fed the previous day. Feed intake and weight gain recorded were used to calculate feed conversion ratio.

2.5.2 Nutrient digestibility study

The nutrient digestibility study was carried out at the end of the 7th week of the experiment. Three rabbits per treatment (one from each replicate) were selected randomly and transferred to metabolic cages. Two days adaptation period was observed, then five days of feacal collection. The feaces were collected using metallic sheet inserted under each metabolic cage. The feaces were sun dried, bulked and representative samples taken for chemical analysis as described by [11]. The digestibility values were calculated as nutrient intake minus nutrient excreted divided by nutrient intake multiplied by hundred

2.5.3 Carcass and internal weight s evaluation

At 56th day, three rabbits per treatment (one per replicate) were randomly selected, starved overnight to clear the gut, while water was offered. The following morning they were weighed to determine their live weight then slaughtered, skinned, eviscerated and dressed. Internal organs were carefully removed, weighed and expressed as percentage of the live weight. Dressing percent was determined as

$$\frac{Dressed\ weight}{Live\ weight}\ x\ 100$$

2.6 Chemical analysis

The proximate composition of raw kapok seed meal, experimental diets and faecal samples were determined for dry matter (DM), Crude protein (CP), crude fibre (CF), ether extracts (EE) ash and nitrogen free extracts (NFE) as well as Alkaloid,,trypsine inhibitors using[11] methods. Total oxalate was determined according to [12] procedure. Phytate was determined using the method described by [13]. Saponin was determined using the method of [14] as modified by [15]. While tannin was determined using the method of [16]. Phenol, haemagglutinin, flavonoid were determined using the method of [11].

2.7 Statistical analysis

All data obtained during the experiment were analysed according to the ANOVA model, using the ONEWAY procedure of [17] version 19. Duncan's Multiple range test was used to separate means.

3. Results and discussion

3.1 Proximate composition and anti-nutrients of raw kapok seed meal

The proximate composition and anti-nutrients of raw kapok seed meal are shown in Table 2.The high dry matter (89.51%) content of the raw kapok seeds is an indication that they can be stored for a long time and less prone to microbial attack during storage [18 and 19]. Ether extracts (10.05%) is lower than 34% as reported by [18] and 21-29 % reported by [20] The crude protein content recorded is however lower than 36.70% reported by [19] but within the range of 22-30% reported by [18]. The observed variations in proximate composition could be attributed to climatic conditions, edaphic factors as well as methods of processing and laboratory analysis [21].

The tannin content (2.53%) of raw kapok seed is higher than 0.34% in African oil bean seed reported by [22], 0.94g reported for winged bean [23], 0.42 % in raw lablab seed by [24] and 1.41% found in mucuna [25]. The value of saponin recorded in the present study is higher than 1.1% observed in mucuna seed [25] and also higher than 0.23-0.57mg/kg reported by [26] and 0.96-1.33% for raw lablab. The high concentration of tannins implies possibilities of poor protein digestibility caused by formation of protein tannin complexes which irreversibly bind digestive enzymes, thus inhibiting the activities of the enzymes making them unavailable for breaking down proteins and other nutrients [27 and 28].

Saponin in seeds imposes an astringent taste that affects feed palatability, reduce feed intake, utilization of protein and consequently body growth [29]. The raw kapok seed also contain trypsin inhibitor lower 2.89% obtained by [24] for raw lablab seed. The haemaglutinin value recorded in this study was lower than the range of 41.37-53.64HU/mg as reported by [30] for raw lablab seed but higher than 4.0HU/mgN for winged bean [23] and 8.0 HU/mgN for *M. pruriens* seed flour [31].High hemagglutinins concentration bind intestinal membrane of animals and impair the normal absorption of dietary nutrients [32]. Total oxalate content is lower than 1.95% found in raw mucuna seed [25]. [32] reported that high concentration of oxalates bind calcium present in feed thereby rendering calcium unavailable for normal physiological and biochemical roles. The phytate concentration of RKSM is higher than 1.06% reported for mucuna by [25]. High phytate contents have been reported to retard growth, caused abnormalities in the intestinal histology, reduce the bioavailability of dietary phosphorus, inhibit dietary proteins and activity of trypsin and pepsin and reduces the solubility of starch [33 and 34].

Table 2: proximate and anti- nutrients composition of raw kapok seed meal as fed basis

Nutrients	Composition (%)
Dry matter	89.51
Crude protein	22.59
Crude fibre	17.45
Ether extracts	10.05
Ash	6.53
Nitrogen free extracts	43.38
*ME Kcal/kg	3180
Anti- nutrients composition (%)	
Phenol	2.48
Alkaloid	3.34
Flavonoid	3.95
Tannin	2.53
Saponin	1.30
Phytate	1.27
Trypsin inhibitors	17.97
Hemagglutinin	1.69
Total oxalate	1.12

*Metabolizable Energy calculated according to the formula of [46] . ME (kcal/kg) = 37 x % CP + 81 x % EE + 35.5 x % NFE

3.2 Growth performance of weaner rabbits fed raw kapok seed meal (RKSM)

The growth performance of weaner rabbits fed RKSM is presented in Table 3. The result showed significant ($p<0.01$) difference across inclusion levels. The final body weight, total feed intake and total weight gain of the rabbits decreased as the levels of RKSM increased in the diets. The result is in consonant with the observations of [35; 36] on broiler chicken when they fed raw jack bean and raw tallow seed meals respectively. The decrease in final body weight, total feed intake and total weight gain could be attributed to inherent anti-nutrients in the raw kapok seed meal which probably reached a threshold level beyond the tolerance levels of the rabbits. Several studies have attributed impaired feed utilization, depressed growth, loss of appetite and pancreatic hypertrophy in the experimental animals to anti-nutritional factors [25, 36,37,38,39 and 40]. Rabbits on 0%, 5% and 10% inclusion levels had superior ($p<0.05$) feed conversion ratio suggesting there was better absorption and utilization of nutrients by the rabbits.

Table 3: Growth performance of weaner rabbits fed raw kapok seed meal

Parameters	Inclusion levels of raw kapok seed meal (%)					
	0	5	10	15	20	SEM
Initial body weight (g)	503.66	503.33	503.61	503.00	504.01	12.26^{ns}
Final body weight (g)	1823.11^{a}	1752.14^{b}	1670.39^{c}	1121.27^{d}	1001.15^{d}	13.27^{**}
Total weight gain (g)	1319.45^{a}	1248.87^{b}	1166.78^{c}	618.27^{d}	497.14^{e}	8.79^{**}
Average daily weight gain (g)	23.56^{a}	22.30^{b}	20.83^{c}	11.04^{d}	8.87^{e}	0.31^{**}
Total feed intake (g)	3859.96^{a}	3696.48^{ab}	3415.21^{b}	2104.84^{c}	1982.14^{c}	28.21^{**}
Average daily feed intake (g)	68.92^{a}	66.00^{ab}	60.98^{b}	37.58^{c}	35.39^{c}	0.49^{**}
Feed conversion ratio	2.92^{b}	2.95^{b}	2.92^{b}	3.40^{a}	3.98^{a}	0.16^{**}

Means in the same row bearing different superscripts differ significantly (P<0.01), **=Significantly different (P<0.01), Ns = not significant different (P>0.01),SEM = Standard error mean

3.3 Nutrient digestibility of weaner rabbits fed raw kapok seed meal

Table 4 showed the nutrient digestibility of weaner rabbits fed RKSM. There was significant (P<0.01) decrease in the digestibility of nutrients with increasing levels of RKSM in the diets. Rabbits fed 0%, 5% and 10% diets had similar nutrient digestibility which implied that they could tolerate up to 10% RKSM level of inclusion. The reduction in nutrient digestibility beyond 10% is ascribed to the presence of the anti-nutritional factors in RKSM. Anti-nutritional factors (ANFs) interfere with metabolic process such that growth and bioavailability of nutrients are negatively influenced [41].

Table 4: Nutrient digestibility of weaner rabbits fed raw kapok seed meal

Parameters	Inclusion levels of raw kapok seed meal (%)					
	0	5	10	15	20	SEM
Dry matter	88.89^{a}	85.45^{a}	71.78^{b}	60.90^{b}	60.45^{b}	0.77^{**}
Crude Protein	84.84^{a}	80.92^{a}	79.99^{a}	61.34^{b}	60.45^{b}	0.40^{**}
Ether Extracts	74.47^{a}	72.32^{a}	71.10^{a}	58.91^{c}	57.27^{c}	0.64^{**}
Crude fibre	76.09^{a}	73.20^{a}	72.48^{a}	60.16^{b}	58.14^{c}	1.21^{**}
Ash	84.17^{a}	80.18^{a}	79.32^{a}	59.56^{b}	56.15^{b}	1.25^{**}
Nitrogen free extracts	74.18^{a}	73.89^{a}	70.57^{a}	61.54^{b}	58.97^{c}	0.43^{**}

Means in the same row bearing different superscripts differ significantly (P<0.01), **=significantly different (P<0.01), SEM = Standard error mean

3.4 Carcass characteristics and internal organs of weaner rabbits fed raw kapok seed meal

Live weights were significantly (P<0.01) higher in rabbits fed 0%, 5% and 10% RKSM 15%, while rabbits fed 20% RKSM recorded significant lower (P<0.01) live weight .Dressing percentage of rabbits fed 0%, 5% and 10% RKSM were significantly higher than 15% and 20% .The result of live weights recorded were higher than the range of 1375.00 - 1650.00g reported by [42].Dressing percentages observed were lower than the ranged of 73.01- 76.20% reported by [43] for tropical rabbits. The poor dressing percent observed in rabbits fed T4 and T5 diets might be due to reduction in feed intake and impaired nutrient utilization attributed by the high ANFs in the raw kapok seeds. The development of carcass trait, organs and muscular growth in animals depend on nutrition among other factors [44]. The relative weight of heart of rabbits fed 0, 5 and 10% RKSM were not significantly lower (P>0.05). Higher weights of liver and kidney of rabbits on 15 and 20% RKSM may be due to illicit toxic response of liver and kidney which are the major organs of detoxification [45].

Table 5: Carcass yield and internal organs of weaner rabbits fed raw kapok seed meal

	Inclusion levels of raw kapok seed meal (%)					
Parameters	0	5	10	15	20	SEM
Live weight (g)	1800.22^{a}	1700.80^{a}	1600.05^{b}	1100.85^{c}	986.25^{d}	14.04**
Pelt weight (g)	122.33^{abc}	116.14^{c}	124.12^{ab}	119.26^{bc}	126.78^{a}	2.12**
Head weight (g)	119.26^{ab}	114.88^{ab}	109.52^{b}	126.26^{ab}	131.68^{a}	5.38**
Dressed weight (g)	997.74^{a}	922.32^{b}	850.67^{b}	560.91^{c}	501.80^{c}	21.46**
Dressing (%)	55.42^{a}	54.22^{a}	53.16^{a}	50.95^{b}	50.87^{b}	0.50**
S I length (cm)	118.58^{c}	125.56^{c}	160.11^{b}	169.57^{b}	209.40^{a}	8.79**
S I weight (g)	9.02	9.54	9.43	9.34	10.15	0.65^{ns}
L I length (cm)	102.69^{b}	105.87^{b}	104.73^{b}	108.76^{b}	115.30^{a}	2.69**
L I weight (g)	17.75	19.90	23.76	26.76	26.24	2.05^{ns}
Caecal length (cm)	17.33	17.31	17.72	19.41	20.16	1.73^{ns}
Caecal weight (g)	83.75^{c}	104.83^{b}	107.33^{b}	109.72^{b}	115.98^{a}	0.83**
Internal organs % live weight						
Liver	2.52^{b}	2.92^{b}	2.31^{b}	5.86^{a}	6.56^{a}	0.15**
Heart	0.32	0.27	0.26	0.29	0.35	0.11^{ns}
Lungs	0.67^{c}	0.72^{c}	0.99^{c}	1.19^{ab}	1.39^{a}	0.10**
Kidney	0.67^{b}	0.67^{b}	0.70^{b}	1.12^{a}	1.22^{a}	0.12**

Means in the same row bearing different superscripts differ significantly (P<0.01), **=significantly different (P<0.01), ns = not significant different (P>0.01), SEM = Standard error mean, S.I = Small intestine, L.I= Large intestine

Conclusion

The study showed that raw kapok seed meal has rich nutrients composition and anti- nutritional factors. The raw seed meals can be fed to weaner rabbit up to 10%.

Ethical consideration

The study was conducted with permission from the animal welfare and ethics committee of Department of Animal Production and Health, Federal University Wukari, Taraba State Nigeria. Ethical No.FU-LR-2017-023

References

[1] Amao, OA and Showunmi, KA. Reproductive Characteristics of Rabbit Bucks Fed Diet Containing Raw or Fermented Cottonseed Cake. British Biotechnology Journal, 2016 10(3): 1-7

[2] Muriu, JI., Njoka-Njiri, EN., Tuitoek, JN. and Nanua, JN. Evaluation of sorghum (Sorghum bicolor) as replacement of maize in the diet of growing rabbit (Oryctolagus cuniculus). Asian-Australisian Journal of animal science, 2002.15: 565-569.

[3] Enechi, DC Ugwu, KK. Ugwu,OPC and Omeh, YS."Evaluation of the antinutrient levels of Ceiba pentandra leaves", International Journal of Research and Review in Pharmacy and Applied Science, 2013 Vol. 3(3), 394

[4] Anigo, KM Dauda, BMD; Sallau, AB. and Chindo, IE. "Chemical composition of Kapok (Ceiba pentandra) seed and physicochemical properties of its oil", Nigerian Journal of Basic and Applied Science, 2012. Vol. 21(2),105

[5] Ari, MM., Barde, RE.,Ogah, MD. , Yakubu, A and Aya, VE. Performance of Broilers Fed Silk Cotton Seed (Ceiba petandra) Based Diets producction Agriculture Technology Journal, 2011 7 (2): 20-28

[6] Rajaguru, ASB; Ravindran, V. Metabolisable energy values for growing chicks of some feedstuffs from Sri Lanka. J. Sci. Food Agric.,1985 36 (1): 1057-106

[7] Thanu, K. Evaluation of kapok seed (Ceiba pentandra) as a feed ingredient in broiler rations. M.V.Sc. Thesis. Tamil Nadu Agricultural University, Coimbatore, India,1981:45-78

[8] Kadirvel, R. ; Natanam, R. ; Udayasurian, K. Use of kapok as a poultry feed. Poult. Sci.,1986 65 (12): 2363-2365

[9] Narahari, D and Asha Rajini, R. Chemical composition and nutritive value of kapol seed meal for broiler chickens. British Poultry Science,2003: 44 505 -509.

[10] Taraba State Diary. State Annual Official Diary Reports, 2008

[11] AOAC. Association of Analytical Chemist. Official Methods of Analysis 17th Edition AOAC Ic, Arlington, Virginia, USA.2000.

[12] Day, RA and Underwood, A L. Quantitative analysis. 5th ed. Prentice-Hall publication. 1986 701.

[13] Reddy,MB. and Love, M. The impact of food processing on the nutritional quality of vitamins and mineral. Adv. Exp. Med. Boil.,1999. 459:99-106

[14] Birk, Y., Bondi, A., Gestetner, B. and Ishaya, IA. (1963). Thermostable hemolytic factor in soybeans. Natural,1963; 197: 1089-1090

[15] Hudson, BJ., EL-Difrawi, EA. The sapogenins of the seeds of four lupin species. J. Plant Food, 1979; 3: 181-86.

[16] Trease, GE and Evans, WC. A Text book of pharmacognosy. 11ed.Bailliere-Tindall, London. 1978

[17] SPSS. Statistical Package for Social Sciences.SPSS Inc.2006

[18] Hassan, LG., Sokoto, AM., Dangoggo, SM. and Ladan, MJ. Proximate, amino acids and minerals compositions of silk cotton seeds (Ceiba pentandra). African Journal of Natural Sciences, 2006; 9: 29-35.

[19] Anigo, KM Dauda, BMD; Sallau, AB and Chindo, IE. "Chemical composition of Kapok (Ceiba pentandra) seed and physicochemical properties of its oil", Nigerian Journal of Basic and Applied Science, 2012; 21(2),105

[20] Heuzé, V., Tran, G. Kapok (Ceibapentandra). Feedipedia.org. A project by INRA,CIRAD,AFZ and FAO. http://www.trc.zootechnie.fr/node/48 Retrieved on September 9, 2011, 11:30.

[21] Ojewole, GS, Okoye, FC and Ukoha, OA. Comparative utilization of three animal protein sources by broiler chickens. Int. J. poult. Sci., 2005; 4:462-467

[22] Enujiugha, VN. and Agbede, JO. Nutritional and Anti-Nutritional Characteristics of African Oil Bean (Pentaclethra Macrophylla Benth) Seeds. Appl. Trop. Agric.,2000; 5, (1) 11-14.

[23] Igene, FU., Agbede, JO., Omueti, JO. and Aletor,V.A. Nutrient and Anti-Nutrient Composition of Raw and Processed Winged Bean Seeds (Psophocarpus tetragonolus). Journal of Applied Science,2001; 4 (4):2305-2318.

[24] Osman, MA. Effect of Different Processing Methods, on Nutrient Composition, Antinutrional factors, and in vitro Protein Digestibility of Dolichos Lablab Bean [Lablab purpuresus (L) Sweet] Pakistan Journal Of Nutrition, 2007; 6 (4): 299-303,

[25] Tuleun CD. and Patrick, JP. Effect of Duration of Cooking Mucuna utilis Seed on Proximate Analysis, Levels of Anti-nutritional Factors and Performance of Broiler Chickens. Nigerian Journal of Animal Productio,2007 34(1):45-53.

[26] Abeke, FO., Ogundipe, SO., Dafwang, II., Sekoni, AA., Abu, A and Adeyinka. Effect of Duration of Cooking on The Level of Some Anti-Nutritional Factors of Nine Varieties of Lablab Purpureus Bean. Nigerian Journal of Animal Production.2008; 35 (2): 217-223.

[27] Aletor, VA. Allelochemical in plant food and feeding stuffs. Nutritional, biochemical and physiopathological aspects in animal production. Vet. Hum Toxicol.1993; 35: 57-67

[28] Onochie, BE. The Potential Value of Soybean Supplement in Nigerian Diet. Proceeding 3rd Annual conference of Agricultural Society of Nigeria.1965; 4:43-46.

[29] Aletor, VA. Anti-nutritional Factors as Nature's Paradox in Food and Nutrition Securities. Inaugural Lecture series 15 organized by The Federal University of Technology, Akure, on Thursday, August 12,1999: 10-15`

[30] Shaahu, DT., Kaankuka, FG., Okpanachi, U. Proximate, Amino Acid, Anti-Nutritional Factor And Mineral Composition Of Different Varieties Of Raw Lablab Purpureus Seeds. International Journal of Scientific &Ttechnology Research,2015; 4, 157-161

[31] Agbede, J.O. and Aletor, VA. Studies of the Chemical Composition and Protein Quality of Differently Processed Canavalia Ensiformis and Mucuna Pruriens Seeed Flours. Journal of Food Composition and Analysis,2005;18: 89-103.

[32] Ladeji, O., Akim, CU and Umaru, HA. Level of Anti-nutritional Factors in Vegitables Commonly Eaten in Nigeria. African Journal of Natural Sciences, 2004; 7:71-73.

[33] Ahamefule, FO. Evaluation of Pigeon Pea-Cassava Peel Based Diets for Goats Production in South-Eastern Nigeria Ph.D. Thesis. College of Animal Science and Animal Production, MOUAU, Umudike, Nigeria 2005;

[34] Akinmutimi, AH. Effect of cooking periods on the nutrient composition of velvet beans (Mucuna pruscens). In: Proceeding of the 32nd Annual Conference of the Nigeria Society for Animal production March 18th–21st. University of Calabar, Calabar,2007;.223–236.

[35] Ologhobo, AD., Apata,DF. and Oyejide, A. Utilization of raw Jackbean (Canavalia ensiformis) andjackbean fraction in diets for broiler chicks. Brit.Poultry Sci.,1993; 34: 323 – 337.

[36] Obun, CO; Lalabe, BC, Wafar RJ., Olusiyi, JA and Ojinnaka, EP.Effects of feeding broiler chicks differently processed Tallow (Detarium microcarpum, Guill and Sperr) seed meal on performance and blood constituents In: F.O. Ajayi, L.A.F. Akinola, B.O.Agaviezor and O.S George (editors). In Proceedings 21 Annual Conference of Animal Science Association of Nigeria 18 – 22, 2016, Port Harcourt. Pp. 845-849.

37] Bagepallis, S., Narasinga, R. and Tatinemi, P. .Tannin contents of food commonly consumed in India and its influence on ionizable iron. Journ. Sci. Fd. Agric.,1992; 33:89-96.

[38] Olomu, JM. Monogastric Animal Nutrition: Principles and practice. 1st edn. A Jachem publication,Benin city, Nigeria, 1995; 157

[39] Sotelo, AEC. and Flores, S. Nutritional values and content of anti-malnutrition compounds and toxics in ten wild legumes of Yucatan peninsula. Plant Foods for Human Nutrition,1995; 47: 115-123

[40] Reed, J D. Condensed Tannins, A factors limiting the using of cassava forage. Journal of Science Food Agric, 2001 33:213-217.

[41] Binita, R. and Khetarpaul, N. Probiotic fermentation: Effect on anti-nutrients and digestibility of starch and protein of indigenous developed food mixture. J. Nutr. Health, 1997; 139-147.

[42] Eustace, A., Iyayi, O., Oluwakemi, O. and Odueso, M. Response of some metabolic and biochemical indices in rabbitsfed varying levels of dietary cyanide. African Journal of Biomedical Research, 2003 6(1): 43-47.

[43] Okorie, KC. The Effect of palmitic acidfortified maize wet milling by-product on the performance of weaner rabbits. Czech. J. Anim Sci,2003 48(9): 365-370.

[44] Schrews, FJG. Post mortem changes in chicken muscle. World Poultry Science Journal,2000 56:319-346

[45] Bone, FJ. Anatomy and Physiology of Farm Animals. 2nd Edn., Reston Publishing Comp, IncVirginia, USA, 1975 pp: 560.

[46] Pauzenga, U. Feeding parent stock. Zootech characteristics of weanling rabbits fed graded levels International, 1985; 34: 22-25.