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Potential of Detoxified Neem Kernel Cake as a Protein Source in Broiler Feeding

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Abstract: *This study evaluated the nutritive potential of detoxified neem kernel cake as source of protein for broiler chickens. Diet-control was 100 percent soybean based. Diets, 1, 2, 3 and 4 had detoxified neem kernel cake included at 25, 50, 75 and 100 percents respectively. These four diets were evaluated in comparison to control, in a seven- week growth and metabolism trial using two hundred day old broiler chicks with an average initial live weight of 39.3 ± 0.1g, divided in to five groups of forty chicks per treatment in a Complete Randomized Design. Five broiler chicks were caged individually per treatment. Feed and water were offered ad libitum. Daily feed intake, daily body weight changes and mortality rate were determined. At the end of seven-week feeding trial, three birds were randomly selected from each treatment and were slaughtered for carcass evaluation. The results revealed that the broiler chickens fed 25% detoxified neem kernel cake diet had improved growth performance comparable to chickens fed soybean diet. Thus detoxified neem kernel cake can be incorporated up to 25% in broiler chicken feeding without any adverse effect on performance of the chickens.*
Keywords*: broiler, cake, chickens, detoxified, kernel, neem, performance*

I. Introduction

Poultry (broiler and egg laying chickens) production is a reliable and renewable venture with high prospect for alleviating poverty in Nigeria and Africa in general. Egg and meat of chicken are being consumed since pre-historic times and used extensively as a delicious food; albumen is used in pharmaceutical preparations and paints. Egg yolk as mineral mixture and young chicks are good laboratory animals because of their small size (Singh, 2010). Poultry dropping is environmental and human friendly and readily supplies essential plant nutrients for plant growth (Abdulazeez, et al, 2007). Profit generation in poultry business is generally reasonable for individual, small, medium and large scale poultry farmers. Nevertheless, feeding the birds remains the most limiting factor that determines profit level of the poultry farmers. This is much connected with the fact that poultry feed ingredients (ground nut, soybean and fish) are being competed for with human beings. Several attempts have been made to find solutions to nutritional problems in Africa in relation to protein intake. Interest in newer sources of protein has grown due to protein shortage in developing countries, especially Nigeria. As part of the quest for newer sources, some lesser-known oil seeds have been evaluated for their nutritional qualities. In Nigeria, locally available but unusual proteins containing foodstuffs have been evaluated for their nutritional potentials, aiming at reducing dependence and competition between livestock and man for the consumable sources (Belewu, 2008).

Neem tree (*Azadirachta indica*, A juss) called Dogonyaro in Northern Nigeria is an evergreen tree which is endemic to the Indian subcontinent and has been introduced to Nigeria. Neem tree is naturally available in every part of Northern Nigeria; there are 1,014 neem trees out of 1239 trees in 42.3 hectares of Federal College of Education (Tech) Bichi (Abdulazeez, 2013). Neem seed cake an unconventional feed is a good source of protein for livestock. The protein in the neem seed cake (NSC) is relatively balanced (34%-38%) in its amino acid content and mineral profile (Gowda and Sastry, 2000). Despite high crude protein content in neem seed cake its incorporation in animal diets was discouraged due to its adverse effect on production trait because of presence of foul odour, bitter taste and toxic triterpenoides, mainly nimbin, nimbidin, azadirachin and salanin (Reddy, 1999). Hence in the present study an attempt has been made to examine the growth rate, nutrient utilization and carcass characteristics in Obamarshall broiler chicks in a seven week feeding trial of detoxified neem kernel cake starter mash and broiler finisher.

1.2 Purpose of the study

The purpose of this trial is to evaluate the potential of detoxified neem kernel cake as source of protein in broiler feeding.

1.3 Objective of the study

Specifically the study sought to:

(i) Assess the growth performance of broilers chickens fed on conventional poultry protein source – soybean diet and broilers chickens fed on non conventional poultry protein source –detoxified neem kernel cake diet.

1.4 Research Hypothesis:

Hypothesis is tested at the 0.05 level of significance.

Ho: There is no significant difference in the mean final live weight gain of broilers chickens fed on conventional source of protein -soybean diet and the broilers chickens fed on four non conventional sources of protein-neem kernel cake diets.

II. Materials and Methods

2.1 Site of study

The study was carried out at the poultry house of Department of Agricultural Education, School of Vocational Education, Federal college of Education (Technical) Bichi (12^0 14əN and 8^0 14ə E), 2775.8m above sea level, average temperature per annum 25^{oc} , and average rainfall per annum 80cm, Sudan savanna zone of Nigeria.

Materials

The materials employed for this study include, two hundred Obamarshall broiler chickens obtained from-Phed Agrovet kano, detoxified neem kernel cake, conventional broiler feed ingredients, weighing machine, poultry feeding and watering equipments.

Experimental Methodology

Experimental Diets

Five groups of complete broiler chicken diets were formulated, conventional diet as control (group 0-soybean) and groups 1, 2, 3, and 4 formulated with non conventional ingredient(detoxified neem kernel cake), (Tables 1 and 2).All the ingredients were thoroughly mixed at the poultry house department of agricultural education and bagged in to five groups of experimental diets.

Experimental broiler chicken management

Two hundred healthy Obamarshall day old broiler chicks with an average initial body weight of 39.3 $\pm$ 0.1g obtained from Obasanjo farm, Igboora, Oyo state through Phed Agrovet Nig. Ltd. Kano branch, were randomly divided into five groups of forty birds each in a Complete Randomized Design (CRD). All the birds were vaccinated, kept in a well ventilated poultry brooder house and supplied with adequate water and the formulated experimental diets (starter mash, table 1) *ad libitum* per treatment. At the end of three weeks, 5 broiler chickens in each group were transferred to rearing house randomly allocated to twenty five poultry metabolic cages at one bird per cage. Clean drinking water and the processed formulated diets as per each treatment (broiler finisher, table 2) were made available ad libitum to each of the 25 broiler chickens throughout the study.

Detoxification of Neem Kernel Cake

Pulps and testa/seed coats were removed from neem seeds and neem kernels ground to neem kernel cake. Water, hexane and concentrated spirit (85%), a method recommended by GTZ (2000) was used to extract the offensive odour and bitter elements from the neem kernel cake at soil laboratory unit of Department of Agricultural Education, Federal college of Education (TECH) Bichi.

Table 1. Ingredients composition (%) of experimental diet-starter mash

Ingredient	T0	T1	T2	T3	T4
Maize	48	48	48	48	48
Soybean cake	***22.5***	***16.9***	***11.25***	***5.6***	---
Neem kernel-Cake	---	***5.6***	***11.25***	***16.9***	***22.5***
Ground-Nut cake	11	11	11	11	11
Lime stone	1.5	1.5	1.5	1.5	1.5
Wheat-Offal	10	10	10	10	10
Methione	0.25	0.25	0.25	0.25	0.25

Lysine	0.1	0.1	0.1	0.1	0.1
Salt	0.45	0.45	0.45	0.45	0.45
Premix	0.2	0.2	0.2	0.2	0.2
Fish meal	3	3	3	3	3
Blood meal	3	3	3	3	3
Total	100	100	100	100	100

T0=100% soybean cake, T1=75% soybean +25% neem kernel cake, T2=50% soybean +50% neem kernel cake, T3= 25% soybean + 75% neem kernel cake, T4= 100% neem kernel cake.

Table 2. Ingredients composition (%) of experimental diet-broiler finisher feed

Ingredient	T0	T1	T2	T3	T4
Maize	48	48	48	48	48
Soybean cake	***10***	***7.5***	***5***	***2.5***	***---***
Neem kernel-Cake	***---***	***2.5***	***5***	***7.5***	***10***
Ground-Nut cake	24	24	24	24	24
Lime stone	1.6	1.6	1.6	1.6	1.6
Beni seed	5	5	5	5	5
Wheat-Offal	5	5	5	5	5
Methione	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1
Salt	0.4	0.4	0.4	0.4	0.4
Premix	0.25	0.25	0.25	0.25	0.25
Fish meal	1	1	1	1	1
Palm kernel Cake	2.5	2.5	2.5	2.5	2.5
Bone meal	2	2	2	2	2
Total	100	100	100	100	100

T0=100% soybean cake, T1=75% soybean +25% neem kernel cake, T2=50% soybean +50% neem kernel cake, T3= 25% soybean + 75% neem kernel cake, T4= 100% neem kernel cake.

Record Taking

Brooding Stage (1-3 weeks old): Due to the fragile nature, size and age (day old to 21 days) of the young broiler chicks, as well as problem of mixing of feed with droppings, the daily feed intake record was not taken but, daily body weight gains were taken in group and average recorded per treatment.

Rearing stage (4-7 week old)

Body weight gains: Each of the five randomly selected birds in metabolic cages in each group were weighed daily before feeding and watering in the morning to determine live weight gains from 4 to 7 weeks of age. Efficiency of feed intake and nutrient utilization was calculated as unit intake per unit body weight gain. Feed cost per kilogram body weight gain was determined by multiplying feed intake per unit body weight gain with cost (#) of kilogram feed. After growth trial (seven weeks), three birds from each group were randomly selected to study the carcass.

Daily feed intake

1000g of the experimental feed was given to each of the five randomly selected birds in each group to allow ad libtum feed intake. Leftovers of the feed residues were weighed 24 hours post feeding to ascertain daily feed intake or consumption.

Blood and flesh analysis

At fifth week of the experimental trial three birds from each group were taken to National Veterinary Research Institute (NVRI) Vom, blood and flesh samples collected from each bird and histology was determined.

Protein Digestion metabolic

Protein digestion metabolic was determined at 5^{th} week by collection of birds' droppings. The total droppings per each group was dried under shade and crushed to homogeneous mixture. 100gm from each

mixture was taken to Department of Animal Science Faculty of Agriculture Bayero University, Kano for proximate analysis.

Feed ingredient formulation and chemical composition.
The pooled and ground representative samples of feed offered per treatment were subjected to proximate analysis (Table 3).

Table 3 Proximate composition (g) per 100grams of sample and energy content (kcl/100g DM) of experimental diets.

Sample Diets	moisture	crude protein	crude fibre	crude fat	ash	NFE	calcium	phosphor-rous	M.E kcl/100g
T0	8.0	20.90	4.70	4.89	9.70	51.85	1.63	0.39	334.65
T1	8.5	21.90	4.60	4.50	8.90	53.00	1.55	0.23	331.01
T2	8.5	22.40	4.40	4.50	8.75	54.00	1.00	0.23	330.75
T3	8.5	22.70	4.20	4.30	8.50	55.00	0.85	0.23	327.80
T4	9.00	23.64	4.10	4.10	8.15	56.21	0.65	0.29	323.54

T0=100% soybean cake, T1=75% soybean +25% neem kernel cake, T2=50% soybean +50% neem kernel cake, T3= 25% soybean + 75% neem kernel cake, T4= 100% neem kernel cake.

Statistical Analysis
The experimental data were subjected to Least Square Analysis of Variance (Snedecor and Cochran, 1968) and the treatment means were tested for significance by Duncan's (1955) range test.

III. Results and Discussion

Research Hypothesis:
Hypothesis is tested at the 0.05 level of significance.
Hoi: There is no significant difference in the mean final live weight gain of broilers chickens fed conventional source of protein -soybean diet and the broilers chickens fed four non conventional sources of protein-neem kernel cake diets.
Re-hypothesis
The Null hypothesis (Ho) is rejected: There is significant difference in the mean final live weight gain of broilers chickens fed conventional source of protein -soybean diet and the broilers chickens fed three (50%, 75% and 100%) of non conventional sources of protein-detoxified neem kernel cake diets.
Growth performance

Final live weight gain
The results of growth performance of broiler chickens fed soybean diet and different percentages of detoxified neem kernel cake diets are presented in table 4. Final live weight gain showed a significant ($P<0.05$) difference across dietary treatments. Chicken fed control diet (T0) had the highest final live weight gain (1434g) followed by broiler chicken fed treatment one (T1=1402g) and chicken fed treatment four (T4) recorded the least final live weight gain (1115g). Table 4, column e and figure 1). The slow growth in final live weight gain recorded in broiler chicken fed detoxified neem kernel diets may be due to low quantity of essential amino acids in the detoxified neem kernel diet which was probably removed during de-oiling and detoxification of neem kernel cake. This finding disagree with Gowda and Sastry (2000) who reported that protein in the neem seed cake is relatively balanced in its amino acid content and mineral profile.

Feed intake
Table 4, column b, shows the feed intake of broiler chickens fed different levels of detoxified neem kernel diets and soybean diet. Significant ($P<0.05$) difference across dietary treatments was noted. Broiler chickens fed control diet (T0) and treatment one (T1) had the least feed intake (73.4g) compared to other three treatments. The high feed intake (75.7g) observed in treatment four (T4) was due to the inherent natural appetizer in the detoxified neem kernel cake diet. Ogbuemu, et al, (2011), also reported that neem seed has natural substances that stimulate the appetite for feed intake.

Cost of feeding
There was significant ($P<0.05$) difference in the cost of feeding. The cost of feed/kg weight gain was low (#68.0) for conventional diet (T0=control) due to low cost in processing (simple frying and grinding) while, high costs (#81.0-#91.0) of feed/kg weight gain were recorded in detoxified neem kernel cake diets (T1, T2, T3 and T4) due to additional cost involved in processing-removing neem seeds pulps and seed coats, industrial

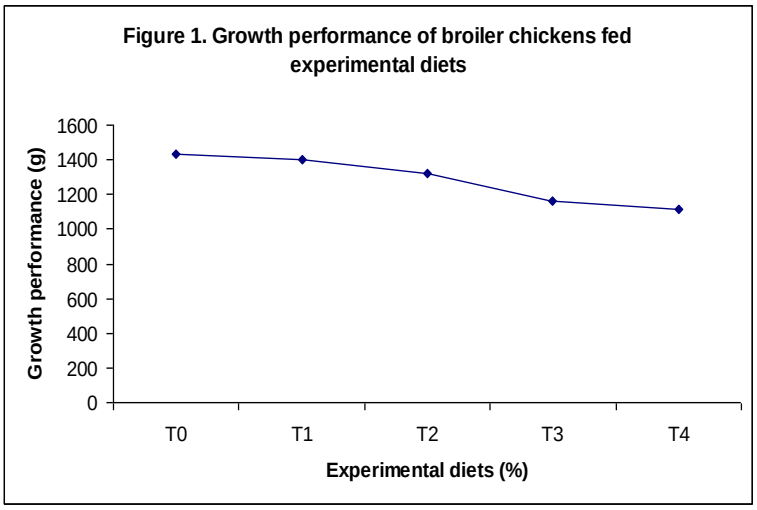
milling and chemicals for detoxification of neem kernel cake. (Table 4, column f). Weight gain per day (Table 4, column c) and food efficiency (Table 4, column d) reduced downward from control diet to treatment four, probably due to low essential amino acids in the detoxified neem kernel cake diets as observed in the final live weight gain.

Table 4 Mean Growth-related performance of broiler chickens fed detoxified neem kernel cake diets.

Diet	Initial weight g/bird (a)	performance feed intake g/bird/day (b)	weight gain g/bird/day (c)	food efficiency gain food (d)	final weight gain g/bird (e)	cost/kg gain(#) (f)
T0	39.3±0.1	73.4[b]	25.6[a]	0.53[a]	1434[a]	68[d]
T1	39.3 ±0.1	73.4[b]	24.3[a]	0.50[b]	1402[a]	81[c]
T2	39.3±0.1	74.2[c]	21.1[b]	0.47c	1320[b]	84[b]
T3	39.3±0.1	74. 5[c]	20.8[b]	0.44[d]	1163[c]	87[b]
T4	39.3 ±0.1	75.7[a]	17.3[c]	0.41[e]	1115[d]	91[a]
SEM	----------	0.39	1.45	0.02	63.5	3.9

[a,b,c.] Means in a column bearing different superscripts differ (P<0.05).

T0= control= 100% soybean diet, T1= 75% soybean + 25% neem kernel diet,
T2= 50% soybean + 50% neem kernel diet, T3= 25% soybean + 75% neem kernel diet
T4=100% neem kernel diet.



T0=100% soybean diet, T1= 75% soybean + 25% neem kernel diet, T2= 50% soybean + 50% neem kernel diet

T3= 25% soybean + 75% neem kernel diet, T4= 100% neem kernel diet.

Mortality

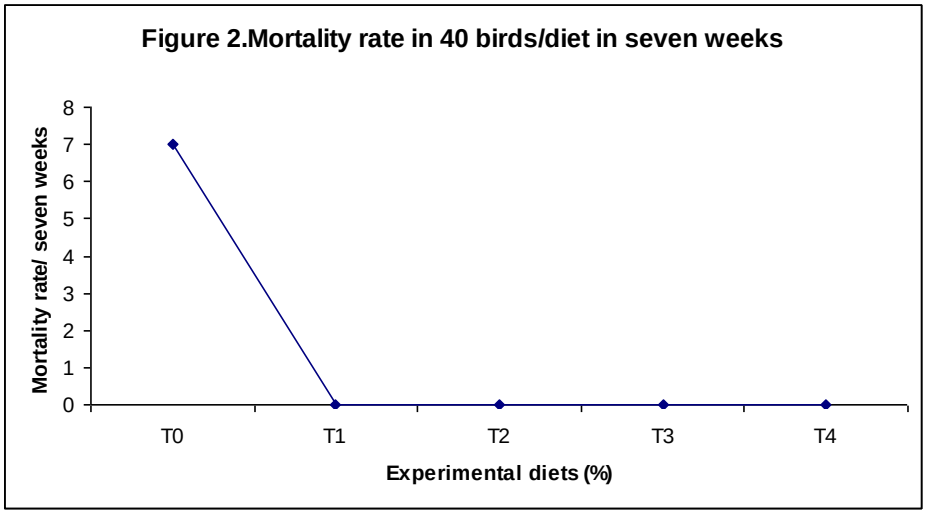
Table 5, figure 2, summarize mortality rate across the treatment diets. At seventh week, a total of seven mortality was observed in control diet (T0), while there was no mortality in any of the four detoxified neem kernel cake diets. This is in consonance with Fajinmi et al, (1990) and Gowda et al (2000) who did not observe mortality in rabbit fed processed neem seed cake diet.

Table 5 Mortality rate in 40 birds per treatment

Period	TO	TI	T2	T3	T4
Week 1	1	-	-	-	-
Week 2	2	-	-	-	-
Week 3	1	-	-	-	-
Week 4	1	-	-	-	-
Week 5	2	-	-	-	-

Week 6	-	-	-	-	-
Week 7	-	-	-	-	-
Total	7	-	-	-	-

T0=100% soybean cake, T1=75% soybean + 25% neem kernel, T2=50% soybean + 50% neem kernel,T3=25% soybean + 75% neem kernel, T4= 100% neem kernel cake diet.



T0=100% soybean diet, T1= 75% soybean + 25% neem kernel diet, T2= 50% soybean + 50% neem kernel diet

Kernel diet, T3= 25% soybean + 75% neem kernel diet, T4= 100% neem kernel diet.

Carcass characteristics

Carcass and organs characteristics were presented in Table 6. There were increased trends in the values of carcass; heart, liver, kidney and gizzard from treatment four diets to control diet. This is also due to low quality of essential amino acids in the detoxified neem kernel cake diets. This is in agreement with the findings of Gowda et al (2000) who reported lower percentage in organs of rabbits fed processed neem seed cake compared to conventionally fed rabbits.

Table 6 Mean Carcass yield and organ weights (%) of broiler chickens fed detoxified neem kernel cake diets.

Carcass/organ weights.	T0	TI	T2	T3	T4	SEM
Pre slaughter weight (g)	1434^{a}	1402^{a}	1320^{b}	1163^{c}	1115^{d}	63.5
Carcass weight (g)	1354^{a}	1351^{a}	1309^{a}	1032^{b}	1027^{b}	75.0
Heart (% of carcass)	0.61^{a}	0.54^{b}	0.52^{c}	0.51^{c}	0.45^{c}	0.02
Liver "	3.6^{a}	3.1^{b}	2.6^{c}	2.6^{c}	2.6^{c}	0.2
Kidney "	0.29^{a}	0.24^{b}	0.2^{c}	0.17^{d}	0.13^{e}	0.02
Gizzard "	4.7^{a}	4.4^{b}	4.1^{c}	3.9^{d}	3.6^{e}	0.19

$^{a,b,c.}$ Means in a row with different letters differ significantly (P<0.05).
T0= control= 100% soybean diet, T1= 75% soybean + 25% neem kernel diet,
T2= 50% soybean + 50% neem kernel diet, T3= 25% soybean + 75% neem kernel diet
T4=100% neem kernel diet.

Blood profile

The mean values of haematological parameters are summarized in Table 7. A significant (P<0.05) decrease in pack cell volume, and haemoglobin was observed from chickens fed detoxified neem kernel cake diets (T4,T3,T2 and T1) to control diet (T0) and significantly increased was observed in total protein from treatment four to control diet and this may be due to essential components in the control diet. No abnormality in the flesh/meat nor toxic substance or anti-nutritional factor observed in the blood of all the experimental

chickens. This is in agreement with the findings of Fajinmi et al,(1990) who reported that neem seeds are valuable materials and not inimical to human and livestock health.

Table 7 Blood profile of broiler chicken fed detoxified neem kernel cake diet at five weeks old.

Parameter	T0	T1	T2	T3	T4	SEM
Pack cell volume	23^{d}	24^{c}	24^{c}	25^{b}	26^{a}	0.50
Total protein	1.3^{a}	1.3^{a}	1.2^{a}	1.2^{a}	1.1^{a}	0.37
Haemoglobin	7.8^{e}	8.0^{d}	8.2^{c}	8.4^{b}	8.7^{a}	0.16

[a, b, c.] Means values on the same row with different superscripts differ significantly (P<0.05)
T0=100% soybean, T1=75% soybean + 25% neem kernel, T2=50% soybean + 50% neem kernel
T3=25% soybean + 75% neem kernel, T4= 100% neem kernel cake diet.

Protein digestion Metabolic

Significant (P<0.05) higher protein digestion metabolic was observed in all broiler chicken fed treatment diets from T4 to control (Table 8). Increased protein digestion metabolic was reported (Gowda et al 2000) and this was attributed to the effect of the detoxified neem kernel cake diet, but it did not positively add to daily body weight gain of the broiler fed detoxified neem kernel cake due low quality of essential amino acids.

Table 8 Digestion metabolic of broiler chicken fed treatment diets.

Parameter	T0	T1	T2	T3	T4	SEM
Protein intake (g/d)	20.9^{d}	21.9^{c}	22.4^{b}	22.7^{b}	23.6^{a}	0.40
Protein out (g/d)	4.4^{c}	4.6^{c}	4.9^{b}	5.2^{a}	5.4^{a}	0.2
Protein retention(g/d)	16.5^{c}	17.3^{b}	17.5^{b}	17.5^{b}	18.2^{a}	0.3

[a, b, c.] Means values on the same row with different superscripts differ significantly (P<0.05)
T0=100% soybean, T1=75% soybean + 25% neem kernel, T2=50% soybean + 50% neem kernel
T3=25% soybean + 75% neem kernel, T4= 100% neem kernel cake diet. d=diet

IV. Summary

Four unconventional diets (detoxified neem kernel cake) were evaluated in comparison to one conventional diet (soybean meal) in a seven-week growth and metabolism trial with 200 Obamarsall broiler chickens

V. Conclusion

The study reveals that the detoxified neem kernel cake is a potential and safe source of quality protein in broiler chicken feeding. The presence of little quantity of bitter substance (Azadirachin) in the detoxified neem kernel cake exhibited the tendency to suppress diseases, improve the health and lower the mortality rate of the broiler chickens, a big advantage to poultry farmers. The observed moderate high values in final live weight gains, high feed intake and zero mortality in chickens fed detoxified neem kernel cake diets showed that the study can key in to small scale business in Nigeria and poverty reduction programme in Africa. Higher final live weight gain can be achieved in chicken fed detoxified neem kernel cake diets if the bitter substance in the neem kernel cake can be removed with little or no effect on its essential amino acids. It can be concluded that detoxified neem kernel cake can be a potential protein substitute in broiler chicken diets from 25% to 100% to mitigate chronic shortage of scare and costly conventional protein sources. Further research studies on debitterization of neem kernel cake with little or no effect on its essential amino acids, vitamins and minerals is recommended.

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References

Journal Papers:

[1] Singh, R.A. (2010*). Poultry Production*. Kalyani Publication. New Delhi. India. P. 1-5.
[2] Abdulazeez, A, Mukhtar, F.M and Ajeigbe, H.A. (2007). Effect of different types and levels of organic fertilizer on growth and yield of some maize varieties. Environmental protection and food security through life science. *Journal of Research in Bioscience*. International Research and Development Institute. Vol.3. No.4. 13-23.
[3] Belewu, M.A (2008). Replacement of fungus treated jatropha kernel meal for soybean meal in the diet of rats. *Green Farming*, 2(3):154-157.
[4] Abdulazeez, A. (2013). Assessment of Agricultural Trees for Combating Desertification in Federal College of Education (Tech) Bichi (in press. Paper no: Pana/2013/097) . *International Journal of Agriculture*. Pan African Research and Development Network. Accra, Ghana. P.12
[5] Gowda, S.K and Sastry, V.R. (2000). Neem seed cake in animal feeding. Asian-Australia Journal of Animal Science.13: 720-728.
[6] Reddy, G.V. (1999). Dry fallen leaves as roughage source in the complete feed for sheep. Indian Journal of Animal Sciences. 8:39-42.
[7] GTZ, (2000). Case studies of neem processing projects. Htt://www.fastonline.org/ CD3WD_40CD3WD. Retrieved 4/29/2013.
[8] Snedecor, G.W and Cochran, W.G (1968). Statistical Methods. 6th edition. Oxford and IBH publishers. New Delhi. India.
[9] Duncan, D.B. (1955). Multiple range and multiple F-test. Biometrics.11: 1-42.
[10] Ogbuemu, I.P, Esonu, B.O, and M.U. Iloeje (2011). The growing importance of neem in Agriculture, Industry, Medicine and Environment. Research Journal of Medicinal plants. 5(3): 230-245. Academic Journals. Inc.
[11] Fajinmi, A.D, S.K. Adedeji, W.A. Hssan and G.M Babatunde (1990). Inclusion of non-conventional feed stuff in rabbit concentrate ration. A case study on neem. Journal of Applied Rabbit Research .13: 125-128.