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Performance of Broiler Chicken Fed Diferently Processed Karanj Seed (Pongomia Pinnata) Meal in Semi Arid Zone of Borno State

Benisheikh, A.A., Marte, A.M., Jibrin, T.A. and Mustapha, A.

Abstract: *The study evaluated the performance of Broiler birds fed differently processed karanj seed (Pongamia pinnata) meal. Two hundred and forty (240) day old chicks were used for the experiment. The chicks were fed control diet and subsequently treatment diets containing the differently processed karanj seed meal designated T1, T2, T3, T4, T5 and T6 respectively. Completely Randomized Design (CRD) was used with four replication and ten (10) birds per replicates. The parameters evaluated include feed intake, daily weight gain, daily feed intake, Feed Conversion Ratio (FCR) and Protein Efficiency Ratio (PER). Results obtained showed that final weight, daily weight gain, daily feed intake, Feed Conversion Ratio (FCR) and protein efficiency ratio (PER) were significantly different between the treatment means. The results revealed that broiler chicken fed 0 % KSM, 5 % SKSM, 5% B. 30 M KSM and 5 % TKSM efficiently utilized the protein in their diets. These tallied with the better daily weight gain and FCR obtained from these treatments.*

Keywords: *Karanj Seeds Meal (KSM), Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER)*

INTRODUCTION

Background of the Study

Agriculture is an efficient and solid backbone for social, economic and industrial progress or development of any nation. For Nigeria to make giant strides in technological development, it needs to have optimum food security. Food supply has been a serious problem in the developing tropical countries. This has been aggravated by the increase in human population which according to Vandijk *et al*. (1982) has grown exponentially, almost doubling in less than a century, which has resulted into competition for food between human and animals. This emphasizes the need for alternative source of feed for livestock. Feed represents the major cost of poultry production, constituting up to 70 % of the total cost (Scott *et al*., 2008; Olomu, 2011). Of the total feed cost, about 95 % is used to meet energy and protein requirements, about 3 to 4 % for major minerals, trace minerals and vitamins requirements and 1 to 2 % for various feed additives. Energy sources constitute the largest component of poultry diets, followed by plant protein sources and animal protein sources (Scott *et al*., 2008; Olomu, 2011).
Pongamia pinnata popularly known as karanj, belongs to the family *Leguminosae*, and is a medium-sized glabrous tree capable of growing under wide range of agro-climatic conditions. The tree is abundantly found in Andhra Pradesh, Bihar, Karnataka, Maharastra, Tamil Nadu and West Bengal. It naturalized from India, Pakistan and Sri Lanka throughout south-east Asia to north-eastern Australia, Fiji and Japan. It is planted in the humid tropical lowlands around the world, and has been introduced into Egypt and the United States (Orwa *et al.,* 2009); It is also available in Nigeria as ornamental plant. The objective of the study was to assess the performance of broiler birds fed graded levels of karanj seed meal

MATERIALS AND METHODS

The study was conducted at the Livestock Unit of the Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic, Maiduguri. Maiduguri is located between latitude 11°5' and 12^0 North, longitude 13°09' and 14^0 East at an altitude of 354 m above sea level (DNMA, 2013).

The karanj seeds were obtained from pongamia plant (karanj) *(Pongomia pinnata)* across the University of Maiduguri Campus. The seeds were divided into five (5) batches. The first batch was left raw, while the other four (4) batches were classified according to the following processing methods;

1. Process 1: The second batch was soaked in tap water for 24 hours at room temperature in a plastic container. At the end of soaking, the water was decanted and the seeds later sun-dried for three days or more depending on the weather.
2. Process 2: The seeds was boiled for 60 minutes. Timing was commence few minutes after adding the karanj seeds in boiling water. The boiled seeds was drained and sun-dried.
3. Process 3: The seeds was boiled for 30 minutes. Timing was commence few minutes after adding the karanj seeds in boiling water. The boiled seeds was drained and sun-dried.
4. Process 4: The karanj seeds was toasted on open frying pan containing sand; it was stirred continuously until the seeds are crispy and acquired a characteristic aroma of roasted beans. The processed seeds was milled and stored in bags until needed for feed formulation.

A total of 240 day- old broiler chicks were purchased from Amo hatchery for the study. The chicks were brooded for two weeks during which they were fed commercial broiler starter diet and then fed the formulated/ experimental starter diet from three to four weeks and experimental finisher diet from 5^{th} to the 9^{th} weeks.

Experimental diets at the starter and finisher phases were formulated using locally procured feed ingredients which include maize, wheat offals, full-fat soya bean, karanj seed meal, fish meal, bone meal, limestone, premix, methionine, common salt and lysine. Six starter and finisher diets were formulated with the same inclusion levels of 5% of karanj seed meal. The diet were designated as: T1 (control) (0% karanj seed meal), T2 (5% meal from raw karanj), T3 (5% meal from karanj seed soaked in water), T4 (5% meal from boiled karanj seed), T5 (5% meal from boiled karanj seed) and T6 (5% meal from roasted karanj seed) as shown in Tables1 and 2. The experimental birds were allocated to the experimental diets in groups of 40 birds each and each treatment group were replicated four times with 10 birds per replicate in a completely randomized design (CRD). The study lasted for 7 weeks.

Table 1: Ingredient Composition and Calculated Analysis of the Experimental Broiler Starter diets

Ingredient	Level of karanj seed meal included					
	T_1	T_2	T_3	T_4	T_5	T6
	(0% KSM)	(5% RKS)	(5% SSKM)	(5% BKSM A)	(5%BKSM)	(5% TKSM)
Maize	47.93	44.95	45.27	44.73	44.73	46.14
Full-fat Soya bean meal	28.37	25.85	25.53	26.07	26.07	24.66
GNC	05.00	05.00	05.00	05.00	05.00	05.00
KSM	00.00	05.00	05.00	05.00	05.00	05.00
Wheat offal	10.00	10.00	10.00	10.00	10.00	10.00

Fish meal	05.00	05.00	05.00	05.00	05.00	05.00
Limestone	01.00	01.00	01.00	01.00	01.00	01.00
Bone meal	02.00	02.50	02.50	02.50	02.50	02.50
Min-vit-premix*	00.25	00.25	00.25	00.25	00.25	00.25
Methionine	00.10	00.10	00.10	00.10	00.10	00.10
Lysine	00.10	00.10	00.10	00.10	00.10	00.10
Table salt (NaCl)	00.25	00.25	00.25	00.25	00.25	00.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis						
Crude protein (%)	23.88	23.35	22.59	23.69	23.69	22.96
Crude fibre (%)	04.00	04.06	04.10	04.07	04.07	04.10
Ether extract (%)	03.89	03.87	03.65	03.85	0385	03.77
Methionine (%)	00.48	00.47	00.46	00.44	00.44	00.44
Lysine (%)	01.49	01.48	01.46	01.44	01.44	01.39
Calcium (%)	01.00	01.00	01.00	01.00	01.00	01.00
Phosphorus (%)	00.65	00.65	00.65	00.65	00.65	00.65
ME (kcal/kg)	2848.15	2841.65	2854.49	2850.54	2850.54	2921.44

ME= Metabolizable energy; GNC= groundnut cake, KSM= karanj seed Meal, RKS= Raw karanj seed Meal, SSKM= Meal from seeds soaked in water for 24 hours, BKSM A= Boiled for 60 minute karanj seed Meal, BKSM= Boiled for 30 minute karanj seed Meal, RKSC= Roasted karanj seed Meal.

Table 2: Ingredients Composition and Calculated Analysis of the Experimental Broiler Finisher diets.

Ingredient	Level of karanj seed meal included					
	T_1 (0% KSM)	T_2 (5% RKSM)	T_3 (5% SSKM)	T_4 (5% BKSM A)	T_5 5% BKSM)	T_6 (5% TKSM)
Maize	49.64	46.66	46.98	46.44	46.44	47.86
Full fat Soya bean meal	21.16	19.14	18.82	19.36	19.36	17.94
GNC	05.00	05.00	05.00	05.00	05.00	05.00

KSM	00.00	05.00	05.00	05.00	05.00	05.00
Wheat offal	15.00	15.00	15.00	15.00	15.00	15.00
Fish meal	05.00	05.00	05.00	05.00	05.00	05.00
Limestone	01.00	01.00	01.00	01.00	01.00	01.00
Bone meal	02.50	02.50	02.50	02.50	02.50	02.50
Min-vit-premix*	00.25	00.25	00.25	00.25	00.25	00.25
Methionine	00.10	00.10	00.10	00.10	00.10	00.10
Lysine	00.10	00.10	00.10	00.10	00.10	00.10
Table salt (NaCl)	00.25	00.25	00.25	00.25	00.25	00.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis						
Crude protein (%)	21.00	21.00	21.00	21.00	21.00	21.00
ME (kcal/kg)	2854.16	2854.30	2940.93	2936.97	2936.97	2947.29

ME= Metabolizable energy; GNC= groundnut cake, KSM= karanj seed Meal, RKSM= Raw karanj seed Meal, SSKM= karanj Meal from seeds soaked in water for 24 hours, BKSM A= Boiled for 60 minute karanj seed Meal, BKSM= Boiled for 30 minute karanj seed Meal, RKSM= Roosted karanj seed Meal.

RESULTS AND DISCUSSION

4.1 Proximate Composition of Karanj (*Pongamia pinnata*) Seed Meal

The results of the proximate composition of karanj seed meal (KSM) are presented in Table 3. The raw karanj seed meal (RKSM) contained 89.70% dry matter (DM), 18.55% crude protein (CP), 5.26% crude fibre (CF), 7.61% ether extract (EE), 4.50% ash and 53.88% nitrogen-free extract (NFE). The dry matter (DM) content of the raw and processed karanj seed meal ranged from 88.14 to 90.25%. The toasted karanj seed meal has the highest DM content (90.25%) while lowest value (88.14 %) was obtained in karanj seed soaked for 24 hours. This may be attributed to the leaching of some of the karanj seed components in the soaking water. Igwebuike (2001) reported similar findings in soaked *Faidherbia albida* pods. Similarly, other workers (Udedibie and Carlini, 2000; Onu *et al*., 2001; Aguibe and Kehinde, 2019) associated this with solubilization and leaching of some nitrogenous compounds in the water used for soaking.

Table 3: Proximate Composition of Differently Processed Karanj (*Pongamia pinnata*) Seed Meal

Processing Methods	Raw	Soaked for 24 h.	Boiled 30 M	Boiled 60 M	Toasted
Dry matter (DM)	89.80	88.14	88.70	88.75	90.25
Crude protein (CP)	18.55	24.83	19.25	21.36	24.43
Crude fibre (CF)	5.26	4.85	5.22	5.00	7.13

Ether extract (EE)	7.61	8.00	7.87	7.50	5.73
Ash	4.50	5.23	4.63	4.72	7.21
NFE	53.88	42.23	50.73	50.17	45.75
ME (Kcal/kg)	3215.50	3065.88	3138.36	3186.14	2992.17

NFE = Nitrogen-Free Extract, ME = Metabolizable energy, Boiled 30 M = Boiled for 30 Minutes
Boiled 60 M = Boiled for 60 Minutes

Productive Performance of Broiler Chickens Fed Differently Processed Karanj *(Pongamia pinnata)* **Seed Meal**

The productive performance of broiler chicken fed differently processed karanj *(Pongamia pinnata)* seed meal are presented in Table 4. The parameters were final live weight, daily weight gain, feed conversion ratio and protein efficiency ratio. The result showed significant ($P<0.05$) differences in these parameters among the treatment groups.

The average daily feed intake of the birds which ranged from 144.82 to 165.53 g significantly ($p<0.05$) differed among the treatment groups. The birds in the control (0% KSM) consumed significantly ($P<0.05$) more feed than the other groups while RKSM group recorded the lowest feed intake (144.82 g/bird/day). This may be due to the presence of anti-nutritional factors such as tannins, trypsin inhibitor and karanjin in the meal which are known to depress feed intake (Kumar *et al*., 2017).

The average daily feed intake in TKSM diet group (149.19 g) is comparable to 148.84 and 146.75 g from B. 60 M. KSM and B.30 M. KSM treatment groups. Atteh (2004) reported 140 g/head/day which is comparable to the 144.82 – 152.12 g obtained from this study for the groups receiving KSM. Nwambe *et al*. (2008) and Kwari *et al*. (2008a) reported 128.07 g/head/day and 109.64 g/head/day, respectively which are lower than the range (144.82 – 165.53 g) obtained from this study. Musama *et al*. (2016) reported 124.97 – 156.65 g/head/day for broiler chicken fed karanj seed cake in finishing phases which is also lower than the values obtained from this study. This may be due to disparity of weather or different processing methods of the seeds.

Generally, the lower average daily feed intake in the KSM groups may be due to effect of some residual anti-nutritional factors such as tannins, trypsin inhibitor and karanjin which are known to depress feed intake as corroborated by some workers (Kumar *et al*., 2017).

The average final live weight and daily weight gain of broiler chickens fed KSM revealed that the chickens fed 0% KSM and 5 % TKSM diets recorded significantly ($P<0.05$) superior final live weight compared to the chickens fed other treatment diets. However, broiler chickens fed 0 % KSM and 5 % TKSM recorded similar final live weight and daily weight gain which are significantly ($P<0.05$) better than chickens fed 5 % RKSM and 5 % B. 60 Min. KSM. Similarly average daily weight gain showed significant ($P<0.05$) differences among all the treatment groups, showing a trend similar to the final mean weight. The reduced body weight gain observed, especially in RKSM diet group, could be associated with the reduced feed intake and possibly poor utilization of the feed due to residual effect of tannins, trypsin inhibitor and karanjin in the diet (Doss *et al*., 2011).

Table 4: Growth Performance of Broiler Chicken Fed Differently Processed Karanj (*Pongamia pinnata***) Seed Meal**

Experimental Diets							
Parameters	TI(0% KSM)	T2(5% RKSM)	T3(5% SKSM)	T4 (5%B.30 M. KSM)	T5(5%B.60 M. KSM)	T6(5% TKSM)	SEM
Initial weight(g)	336.23	316.30	322.70	314.47	323.72	326.28	9.79^{NS}
Final weight(g)	2284.80^{a}	1788.80^{d}	2141.80^{bc}	2083.00^{c}	1870.80^{d}	2241.20^{ab}	38.43^{*}
Daily Weight Gain (g/bird)	46.39^{a}	35.061^{d}	$43.31b^{c}$	42.11^{c}	36.84^{d}	45.59^{ab}	1.01^{*}
Daily feed intake (g/bird)	165.53^{a}	144.82^{c}	152.12^{b}	146.75^{bc}	148.84^{bc}	149.19^{bc}	2.06^{*}
FCR	3.57^{b}	4.14^{a}	3.52^{bc}	3.49^{bc}	4.05^{a}	3.28^{c}	0.10^{*}

PER	1.42[a]	1.24[b]	1.38[a]	1.42[a]	1.19[b]	1.45[a]	0.03[*]
Mortality (%)	0.8	0.4	0.4	0.8	-	-	00[NAS]

* = Significant (P < 0.05): SEM = Standard Error of Mean; NS = Not Significant (P>0.05)
a, b, c, d = Means within the same row bearing different superscripts differ significantly (P < 0.05)
RKSM = Raw karanj seed meal
SKSM = Karanj seed meal Soaked for 24 h.
B.30 M. KSM = Karanj seed meal boiled for 30 minutes
B.60 M. KSM = Karanj seed meal boiled for 60 minutes
TKSM = Toasted karanj seed meal
FCR =Feed Conversion Ratio
PER = Protein Efficiency Ratio
NAS = Not analysed statistically

The results of feed conversion ratio (FCR) revealed similar trend to that of feed intake and weightgain. This is because FCR is directly related to other productive performance parameters (feed intake and weight gain). The depression in feed intake and growth rate also reflects the poor FCR among broiler chicken fed RKSM and B.60 M. KSM. From the results, the birds fed RKSM diet group had poorer feed FCR than those on control, SKSM, B. 30 M. KSM and TKSM diets. Some workers (Asafa *et al*., 2012, Halilu *et al*., 2016; Omojola and Adesehinwa, 2007) reported FCR of 2.40 - 2.68; 2.51 - 2.99 and 2.57 - 2.67, respectively. Although the values of 3.28 – 3.57 obtained here are inferior to these values but similar to the 3.48-3.58 reported by Onu *et al*. (2011) for broiler chickens at the finishing phase.

The protein efficiency ratio (PER) of broiler chicken fed KSM showed significant (P<0.05) differences among the treatment groups. Broiler chickens fed 0 % KSM, SKSM, boiled for 30 M. KSM and TKSM recorded higher values of 1.42, 1.38, 1.42 and 1.45, respectively. Broiler chickens fed 5 % RKSM recorded the lowest values (1.24). The results revealed that broiler chicken fed 0 % KSM, 5 % SKSM, 5% B. 30 M KSM and 5 % TKSM efficiently utilized the protein in their diets. These tallied with the better daily weight gain and FCR obtained from these treatments.

The mortality rate did not follow any particular pattern. However, the low mortality rate recorded suggest that inclusion of KSM in the diet of broiler chicken did not cause death beyond the normal mortality rate (5%) for broiler chicken reported by Ganiyu (2005).

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Response of Poultry Manure and Irrigation Intervals on Yield Parameters of Onion (*Allium cepa* L.) in Maiduguri

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Abstract: *Field trial was carried out during the 2016/2017 and 2017/2018 cold dry seasons in Maiduguri Sudan Savanna, Nigeria (Latitude 11 05' N and Longitude 13 05' E and at about 350 meters above sea level) to determine the response of onion (Allium cepa L.) to varying levels of poultry manure fertilization and irrigation interval. The treatment consisted of four levels of poultry manure (0, 20, 25, and 30 kg/ha) and three levels of irrigation intervals (2, 4 and 6 days) which were laid out in a Randomized complete block design (RCBD) and replicated three times. Parameters studied were establishment count, plant height, number of leaves per plant, fresh bulb yield, fresh bulb weight, cured bulb weight, bulb diameter and percentage marketable weight. During the both seasons 2016/2017 and 2017/2018 and the combined years, there was significant effects of poultry manure and irrigation interval on the both growth and yield parameters studied. Application of poultry manure at 30 t/ha and irrigation interval at 6 days had significantly (P>0.05) recorded the highest effects on all the parameters examined. The interaction between poultry manure and irrigation interval was significant (P>0.05) in both seasons and the combined years.*

Keywords: *Poultry manure, Irrigation intervals, Yield parameters and Onion*

INTRODUCTION

Onion (*Allium cepa* L.) belongs to the family *Alliaceae* and is believed to have originated in South West Asia or the Mediterranean (Tindal, 1983). Onion is biennial crop that is the most important for the bulb crops because it is widely grown and consumed worldwide. It is ranked second to tomatoes in importance in soup making. It can be grown on a wide range of climatic conditions, but thrives best in a mild climate without excessive rain fall or extreme of temperature. It requires soils with mild acid to neutral reaction (pH 6.0 – 7.0) and high soil moisture content for good yields. Onion is a thermo-photoperiodic crop; temperature has a marked influence on bulbing. Under short days, they form leaves without bulbing. Photoperiod also controls bulbing, the critical day length varies from 11-16 hours (Raemarkers, 2001). World production of onion is estimated at over 61.6 million metric tons of bulb annually, with 18.45 tonnes average yield per hectare, 14.8 tons/ha is obtained as an average yield in Nigeria. Onion can be eaten raw in salad, fried, boiled or roasted and used as flavours in soups, stew, canned food products and other savory dishes. It is used in every home virtually on daily basis (Hussaini *et al*., 2000). The bulb is used traditionally as medicinal herb for the treatment of measles, pneumonia, cold and catarrh. Recent studies have confirmed that onion helps in fighting Osteoporosis or bone loss (Biochemist, 2005).

Statement of the Problem

Despite the place of onion as the second most important vegetable in Nigeria, its production is limited to the northern part of the country, even there, it can only be grown in flood plains under irrigation during the dry season.

Onion is a shallow rooted high input crop that demands adequate fertilization and irrigation water. In recognition of the increased cost of fertilizer and growing concern for other prospective effect of excess fertilizer use, fertilizer efficiency has become more important in cropping system for environmental as well as economic reasons (Alhassan, 2004). The shallow roots system of onion also made it more sensitive to weeds and yield reduction of up to 70% has been reported (Akobundu, 1989). These constraints call for a well-planned irrigation strategy and judicious application of fertilizer that will ensure optimum crop yield at the same time reducing farmer's unnecessary expenses and drudgery.

There is a fierce competition for *fadama* land between urban dwellers for habitation and farmers for the growing of crops; more land is lost to habitation (Dankani, 2005). Similarly, global warning through climate change has resulted in drier areas due to temperature changes, siltation and land degradation, (NIMET, 2008). Part of *fadama* have been overtaken through the construction of dams, drainages and waterways, and the water table has gone down making the *fadama* areas too dry for onion cultivation.

Justification of the Study

The use of organic fertilizer on crop production is encouraged due to its numerous advantages like; cheapness, availability and environment friendliness, most farmers who have traditionally used chemical fertilizers can no longer afford them (Biswas *et al*., 2010). Thus an alternative to the use of inorganic fertilizers is the application of organic manure which according to Gambo (2010), are locally available and cheaper sources of maintaining soil fertility.

In view of increasing demand of food due to human population pressure, dwindling land for onion production, its production has to be intensified. This could be achieved by using superior onion genotypes, better plant nutrition and application of efficient and timely weeding methods (Alasiri, 2002). The present production levels do not meet the demand of the teeming populace. Accurate and reliable production figures are not readily available, but an estimate import figure of 12,000 metric tons was reported in 2010 **(**FAO, 2017). Similarly, limited changes in the traditional production practices may still be lagging behind the national demand (Denton and Ojeifo, 1990).

Farmers do not know the correct dosage of fertilizers, the critical phenological stage of the crop at which to apply and the correct mode of application for optimum yield (Umar *et al*, 2004; Akoun, 2004).

Significance of the Study

The research will provide appropriate rate of poultry manure and the most suitable irrigation interval for onion production. The result of the study will further boost food security, serve as reference for future studies and contribute to entrepreneur skill development, in line with the present agricultural drive of the Federal Government, under President Muhammadu Buhari.

Objectives of the Study

The objectives of the study are to determine:

i. the response of poultry manure on the growth and yield of onion,
ii. the effect of different irrigation intervals on the growth and yield of onion,
iii. cost benefit

MATERIALS AND METHODS

Experimental Site

Field trials were conducted at Teaching and Research Farm, Faculty of Agriculture, University of Maiduguri, Maiduguri (11^{o} 50'N; 13^{o}10E and 319m above sea level) during the cool dry harmattan seasons of 2016 and 2017.

Source of Planting Materials

Bama red variety of onion was obtained from Borno State Agricultural Development Programme (BOSADP), Maiduguri office. The variety has a large bulb, red outer skin and is highly pungent: it is known to be the best variety of onion in Borno State. It is highly preferred in the market because of its high pungency, with yield of about 25t/ha when grown in cool season in Borno State (BOSADP, 1993).

Source of Manure

Poultry Manure was obtained from the University of Maiduguri Poultry Farm. The organic manure collected was analyzed in Soil Science Department laboratory, University of Maiduguri for nutrient compositions. Table 1 show the table of the nutrient composition analyzed

Source of Irrigation Water

Gasoline- powered water pumping machine was used for irrigation during the trials. The experimental plots were irrigated at 2,4 and 6day irrigation interval using gasoline powered pumping machine, the source of water was bore-hole.

Treatments and Experimental Design

The experimental design used for the field experiment was a Randomized Complete Block Design (RCBD) replicated 3 times as shown in Figure 1. The treatments consist of four levels of organic manure (0, 20, 25, and 30 t/ha) and three levels of irrigation intervals (2, 4, and 6 days).

Management Practices

Land preparation and management

A well-tilled seedbed raised at 1.0 x 2m with a fine loose surface was marked out. Poultry manure was incorporated during land preparation as required per plot (t/ha). The land was harrowed by a tractor and leveled manually; using a hoe then pegged and laid out into plot size of 2 x 2 ($4m^2$) with their accompanying water channels for irrigation.

Transplanting

The prepared land was supplied with water to field capacity two hours before transplanting. Seedlings were transplanted at spacing of 15cm inter row and 25cm intra row spacing. Seedlings were transplanted at the 5^{th} weeks after sowing. The nursery bed was irrigated to ease up-rooting of the seedlings.

Irrigation

Irrigation method used was surface furrow, using gasoline powered water pumping machine till first leaf stage were emerged The crop was irrigated daily for four days to avoid transplanting shocks, after that it continued in respective plots according to sub- plot treatments during evenings and maintained until two weeks to harvest.

Weeding

Weeding was done manually with specialized onion hoe to reduce the effect of competition and to maintain weed free environment at 4 and 8 weeks after transplanting.

Manure application

Poultry manure at the rates of 0, 20 t/ha, 25 t/ha, and 30 t/ha respectively were incorporated into the soil at land preparation as proposed.

Data Collection

Soil samples and organic manure analysis

Soil samples were randomly taken from different spots across the experimental field at 0-15cm and 15-30cm prior to planting using Auger. At each depth, samples were taken from ten points on a diagonal transect of the experimental field. Samples from each site and depth were bulked, mixed, air dried and analyzed at the laboratory of Soil Science Department, Faculty of Agriculture, University of Maiduguri. A composite soil sample was formed, air-dried, sieved through 2 mm sieve and was used for physical and chemical analysis. (Table 1. The initial physical and chemical characteristics of soil of the study area).

Plant height (cm)

Plant height were first measured at four weeks after transplanting (WAT) and then at every two weeks until harvest. Five plants were randomly selected from the stands in the plots and tagged for data collection. The height was measured from ground level to the apex of the terminal bud using meter tape. The mean plant height was thereafter, determined and recorded.

Number of leaves per plant

The numbers of leaves from five randomly selected plants from each plot were counted at 4 WAT and at every two weeks until harvest. The mean number of leaves per plant was thereafter, determined and recorded for each plot.

Bulb diameter (cm)

This were obtained by up-rooting three randomly selected plants per plot and measured using pair of Vernier calipers, this were done at 6th weeks after transplanting and continued at every 2week interval. The mean bulb diameter was thereafter determined and recorded.

Individual fresh bulb weight (g)

This were obtained by weighing twenty freshly harvested onion bulbs from each net plot after detaching the leaves at harvest using a sensitive weighing balance, average weight was thereafter determined and data obtained were recorded.

Individual cured bulb weight (g)

This were obtained by weighing twenty randomly harvested onion bulbs after curing for two weeks using a sensitive balance and average determined. Data were recorded as cured bulb weight in gramme.

Percentage of marketable and non-marketable bulb (%)

The randomly selected twenty (20) cured bulbs from each plot were sorted out. Bulbs from each plot were counted and divided by the total number of bulbs and thereafter multiplied by 100 which represent the percent of marketable or non-marketable bulb (Andre, 1991)

Percentage missing stands at harvest

This was determined by dividing the number of missing stand by the expected total number of stand per plot and multiplying by 100.

Cost Benefit Analysis

In each location cost benefit assessment was done after selling and the economic assessment was based on the bulb yield obtained. Partial budgets involving the analysis of variable input costs and benefits were drawn for all the treatments. Items considered were the gross return (₦/ha) calculated as yield of onion (kg/ha) multiplied by market price (₦/ha), total cost (₦/ha) of all inputs and labour used.

Gross profit = Gross Revenue — Gross Cost

Statistical Analysis
Data collected were subjected to Statistical Analysis of Variance (ANOVA) using the Statistix 8.0 Statistical Package, the means were separated using New Duncan's Multiple Range Test (NDMRT) as outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSIONS

Fresh bulb yield (t/ha)

Table 1 indicates the effect of poultry manure and irrigation interval on fresh bulb yield of onion for 2016/2017 and 2017/2018 dry seasons and the years combined. Fresh bulb yields significantly ($p>0.05$) responded to poultry manure rates in the both season and two years combined. The result revealed that increase in poultry in poultry manure rate from 0 – 30kg/ha significantly increased bulb yield in both seasons and the combined. The lowest fresh bulb yield was obtained from the control treatment where no poultry was applied. Jitendra *et al.* (1991) reported that higher yield was obtained by the application of higher farm yard manure. The result is also in agreement with Sing and Dhankar (1998). Irrigation interval had significant ($p>0.05$) on fresh bulb yield of onion in the both seasons and the combined. In both trials and the combined, 6 days irrigation interval gave the highest fresh bulb yield. The interaction between poultry manure and irrigation interval on fresh bulb yield was significant for the both seasons and the combined.

The result in table 1 shows the interactive effect of poultry manure rates and irrigation interval on fresh bulb yield of onion during 2016/2017 and 2017/2018 dry season and the two years combined. There was significant interactive effect between poultry manure rates and irrigation interval for both the seasons and the combined analysis. In the first season, application of 30kg/ha poultry manure level and 6 days irrigation interval produce the highest fresh bulb yield while the least was obtained with the control treatment. The same trend was obtained in the second season and the combined analysis.

Table 1: Effect of different levels of poultry manure and irrigation interval on fresh bulb yield (t/ha) during 2016/2017 and 2017/2018 dry seasons and the two years combined at Sudan Savanah of Borno State

	2016/2017	2017/2018	Combined
Treatment			
Poultry Manure			
0 kg/ha	6.6^{d}	5.7^{d}	6.2^{d}
20 kg/ha	11.8^{c}	10.5^{c}	11.2^{c}
25 kg/ha	17.5^{b}	15.9^{b}	16.7^{b}
30 kg/ha	19.9^{a}	18.3^{a}	19.1^{a}
Significance	*	*	*

SE ±	0.1277	0.1742	0.2821
Irrigation interval			
2 day	12.8[c]	11.3[c]	12.1[c]
4 day	13.8[b]	12.6[b]	13.2[b]
6 day	15.3[a]	13.9[a]	14.6[a]
Significance	*	*	*
SE ±	0.1106	0.1508	0.2443
Interaction PM x I I	*	*	*

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT)., II = Irrigation Interval

* = Significant at 5% probability level, WAP = Weeks after planting, PM = Poultry Manure

Table 2: Interaction effects of different level of poultry manure and irrigation interval on fresh bulb yield (t/ha) during 2016/2017 and 2017/2018 dry seasons and the two years combine at Sudan Savannah of Borno State

	Fresh bulb yield 2016/2017		
Irrigation Interval	2 days	4 days	6 day
Treatment			
Poultry Manure			
0 kg/ha	5.3[k]	6.3[j]	8.2[i]
20 kg/ha	10.2[h]	12.1[g]	13.3[f]
25 kg/ha	16.4[e]	17.3[d]	18.8[c]
30 kg/ha	19.3[b]	19.6[b]	20.8[a]
SE ±		0.2212*	
	Fresh bulb yield 2017/2018		
0 kg/ha	4.4[i]	5.3h	7.5[g]
20 kg/ha	8.7[f]	11.2[e]	11.7[e]
25 kg/ha	14.6[d]	16.4[c]	16.6[c]

30 kg/ha	17.7[b]	17.6[b]	19.6[a]
SE ±		0.3017*	
	Fresh bulb yield Combined		
0 kg/ha	4.8[h]	5.8[h]	7.8[g]
20 kg/ha	9.5[f]	11.6[e]	12.5[e]
25 kg/ha	15.5[d]	16.6[c]	17.7b[c]
30 kg/ha	18.5[b]	18.6[b]	20.2[a]
SE ±		0.4886*	

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).
* = Significant at 5% probability level.
WAP = Weeks after planting
PM = Poultry Manure
II = Irrigation Interval

Fresh Bulb Weight (g)

Table 3 shows the effect of poultry manure rates and irrigation interval on fresh bulb weight of onion during the 2016/2017 and 2017/2018 dry seasons and the 2 years combined. Significant ($p>0.05$) effect of poultry manure and irrigation interval on fresh bulb weight of onion during the both seasons and the combined was observed. The results revealed that increase in poultry manure rate from 0 – 20 kg/ha and further increase to 25 – 30kg/ha lead to the significant ($p>0.05$) improvement in fresh bulb weight in both seasons and the combined. The highest fresh bulb weight was recorded with the application of 30kg/ha of poultry manure in both seasons and the combined and the least with the control treatment. Varying the periods of irrigation from 2 – 6 days, resulted to a significant ($p>0.05$) increase in fresh bulb yield of onion in the both seasons, but had not significantly ($p<0.05$) influenced the fresh bulb weight in the combined analysis. The increases on fresh bulb weight with corresponding increase in level of poultry manure applied noticed in the results are conformity with Gambo *et al.,* (2008), who reported that an increase in farm yard manure translate to increase in bulb yield of onions.

The interaction between poultry manure and irrigation interval had significant ($p>0.05$) effect on the fresh bulbs weight in both season but negative effect on the combined results.

Table 3: Effect of different levels of poultry manure and irrigation interval on fresh bulb weight (g)during 2016/2017 and 2017/2018 dry seasons and the two years combined at Sudan Savanah of Borno State

	2016/2017	2017/2018	Combined

Treatment			
Poultry Manure			
0 kg/ha	51.8[d]	45.8[d]	48.8[d]
20 kg/ha	60.9[c]	50.8[c]	55.8[c]
25 kg/ha	70.0[b]	61.1[b]	65.5[b]
30 kg/ha	71.1[a]	72.3[a]	71.7[a]
Significance	*	*	*
SE ±	0.2752	0.4860	1.5072
Irrigation interval			
2 day	63.2[b]	56.1[b]	59.6
4 day	62.6[c]	57.9[a]	60.2
6 day	64.5[a]	58.5[a]	61.5
Significance	*	*	*
SE ±	0.2383	0.4209	1.3053
Interaction PM x I I	*	*	NS

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT)., II = Irrigation Interval
* = Significant at 5% probability level., WAP = Weeks after planting, PM = Poultry Manure

Table 4 present the significant ($p>0.05$) effect of poultry manure rates and irrigation interval of fresh bulb weight of onion during the 2016/2017 and 2017/2018 dry season. During the both seasons 30kg/ha poultry manure rates in combination with 6 days irrigation interval recorded the highest fresh bulb weight whereas the lowest was observed with the control treatment

Table 4: Interaction effects of different level of poultry manure and irrigation interval on fresh bulb weight (g) during 2016/2017 and 2017/2018 dry seasons at Sudan Savannah of Borno State

	Fresh bulb weight 2016/2017		
Irrigation Interval	2 days	4 days	6 day
Treatment			

Poultry Manure

0 kg/ha	49.4[i]	50.4[h]	55.4[g]
20 kg/ha	60.7[j]	60.7[f]	61.2[f]
25 kg/ha	71.9[ab]	69.0[e]	69.3[de]
30 kg/ha	70.9[bc]	70.1[cd]	72.1[a]
SE ±		0.4767*	
	Fresh bulb weight 2017/2018		
0 kg/ha	47.5[h]	45.7[i]	44.2[i]
20 kg/ha	50.5[g]	52.4[f]	49.4[g]
25 kg/ha	58.6[e]	61.5[d]	63.1[d]
30 kg/ha	68.0[c]	72.0[b]	77.0[a]
SE ±		0.8418*	

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).
* = Significant at 5% probability level.
WAP = Weeks after planting
PM = Poultry Manure
II = Irrigation Interval

Cured Bulb weight (g)

The result in Table 5 shows the effect of different levels of poultry manure and irrigation interval on cured bulb weight of onion for 2016/2017 and 2017/2017 dry seasons and the two years combined analysis. Poultry manure rates and irrigation interval has significantly ($p>0.05$) affected the cured bulb weight of onion in the both seasons and the two years combined. Increasing poultry manure rate from 0 – 30kg/ha had resulted in a corresponding increase in cured bulb weight of onion in both season and as well as the combined analysis. According to Rana and Sharma (1994) reported that dry bulbs weight per plant and other growth and yield parameters show a positive correlation with the frequency of irrigation, also Jones and Man (1963) reported that delay in irrigation results in lower onion bulb yields. Irrigation interval was not significantly ($p<0.05$) influenced the cured bulb weight of onion during the first season and the combined analysis but, had significant ($p>0.05$) effect on cured bulb weight in the second season. The interaction between poultry manure and irrigation interval on cured bulb weight was significant ($p>0.05$) only during the 2017/2018 dry season.

Table 6 shows the interactive effect of poultry manure rates and irrigation interval on cured bulb weight of onion during 2017/2018 dry season. Significant ($p>0.05$) interactive

effect was observed on cured bulb weight where 30kg/ha poultry manure rate with 6 days irrigation interval produced the highest (71.8g) cured bulb weight and the least (38.9g) was noticed with the control treatment in combination with 6 days irrigation interval.

Table 4: Effect of different levels of poultry manure and irrigation interval on cured bulb weight (g) during 2016/2017 and 2017/2018 dry seasons and the two years combined at Sudan Savanah of Borno State

	2016/2017	2017/2018	Combined
Treatment			
Poultry Manure			
0 kg/ha	46.4[c]	40.5[d]	43.4[d]
20 kg/ha	55.7[b]	45.4[c]	50.5[c]
25 kg/ha	64.7[a]	55.8[b]	60.2[b]
30 kg/ha	65.7[a]	67.1[a]	66.4[a]
Significance	*	*	*
SE ±	0.9053	0.4899	1.5371
Irrigation interval			
2 day	57.4	50.8[b]	54.1
4 day	58.2	52.6[a]	55.4
6 day	58.7	53.2[a]	55.9
Significance	NS	*	NS
SE ±	0.7840	0.4243	1.3312
Interaction PM x I I	NS	*	NS

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).
* = Significant at 5% probability level.
WAP = Weeks after planting
PM = Poultry Manure
II = Irrigation Interval

Table 5: Interaction effects of different level of poultry manure and irrigation interval on cured bulb weight (g) during 2017/2018 dry season at Sudan Savannah of Borno State

	Cured bulb weight 2017/2018		
Irrigation Interval	2 days	4 days	6 day
Treatment			
Poultry Manure			
0 kg/ha	42.1^{h}	40.4^{c}	38.9^{i}
20 kg/ha	45.1^{g}	47.1^{f}	44.1^{g}
25 kg/ha	53.2^{e}	56.2^{d}	57.9^{d}
30 kg/ha	62.7^{c}	66.7^{b}	71.8^{a}
SE ±		0.8486*	

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).
* = Significant at 5% probability level.
WAP = Weeks after planting
PM = Poultry Manure
II = Irrigation Interval

Bulb diameter (cm)

Effect of different levels of poultry manure and irrigation interval on bulb diameter of onion during 2016/2017 and 2017/2018 dry seasons and the two years combined were represented in table 6. Bulb diameter of onion was significantly ($p>0.05$) influenced by the application of poultry manure rates during the 2016/2017, but was not significantly ($p<0.05$) affected by poultry manure levels during the second trial and the combined, poultry manure rate of 30kg/ha produced the largest bulb diameter in the second trial, while the least bulb diameter was recorded with the control treatment. The trend was the same with the combined analysis. The positive response of onion bulb diameter to organic poultry manure obtained in the study is in conformity with the findings of Dalatu *et al*., (2018), where higher bulb diameter was recorded due to higher level of organic fertilizer in his research on influence of agriboom and bionim organic fertilizer rates on growth and yield parameters of onion in Sokoto Nigeria. Bulb diameter was not significantly ($p>0.05$) influenced by irrigation interval in the both seasons and the combined.

Table 6: Effect of different levels of poultry manure and irrigation interval on bulb diameter (cm) of onions during 2016/2017 and 2017/2018 dry seasons and the two years combined at Sudan Savanah of Borno_State

	2016/2017	2017/2018	Combined
Treatment			

Poultry Manure			
0 kg/ha	5.2	5.6[c]	5.4[b]
20 kg/ha	5.5	5.5[c]	5.5[b]
25 kg/ha	7.6	7.0[b]	7.3[ab]
30 kg/ha	6.5	8.5[a]	7.5[a]
Significance	NS	*	*
SE ±	0.8395	0.2728	2.9151
Irrigation interval			
2 day	6.6	6.7	6.6
4 day	6.8	6.6	6.7
6 day	6.4	6.6	6.5
Significance	NS	NS	NS
SE ±	5.0571	0.2362	2.5246
Interaction PM x I I	NS	NS	NS

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).
* = Significant at 5% probability level.
WAP = Weeks after planting
PM = Poultry Manure
II = Irrigation Interval.

Percentage marketable weight (%)

Table 7 indicates the effect of poultry manure rates and irrigation interval on percentage marketable weight of onion during the 2016/2017 and 2017/2018 dry seasons and the two years combined. Poultry manure rates significantly ($p>0.05$) influenced the percentage marketable weight of onion. In first trial 30kg/ha poultry manure rate produced the highest percentage marketable weight (79%) followed by 25kg/ha of poultry manure level (73.6%) these shows that increasing the rates of poultry manure has corresponding effect on larger percentage marketable weight. Irrigation interval had significantly ($p>0.05$) affected the percentage marketable weight of onion only in the second trial, where 4 days irrigation interval recording higher percentage marketable weight of onion bulb (72%). This was in conformity with work of Mohammed *et al* (2004), who reported that the application of poultry manure at higher dose of 30 kg/ha resulted in higher percentage marketable weight of onions.

The result in table 8 shows the interactive effect of poultry manure rate and irrigation

interval of onion on percentage marketable weight during the second trial (2017/2018). Poultry manure and irrigation interval interaction has significantly affected the percentage marketable weight. Maximum percentage marketable weight (78.6%) was recorded with 30kg/ha poultry manure in combination with 6 days irrigation interval, while the control treatment (0kg/ha) poultry manure and two days irrigation interval gave the least percentage marketable weight (64.5%).

Table 7: Effect of different levels of poultry manure and irrigation interval on percentage marketable weight (%) of onions during 2016/2017 and 2017/2018 dry seasons and the two years combined at Sudan Savanah of Borno State

	2016/2017	2017/2018	Combined
Treatment			
Poultry Manure			
0 kg/ha	64.3[c]	65.1[d]	64.7[d]
20 kg/ha	66.0[c]	67.9[c]	67.0[c]
25 kg/ha	73.6[b]	75.1[b]	74.3[b]
30 kg/ha	79.0[a]	78.3[a]	78.7[a]
Significance	*	*	*
SE ±	1.5565	0.5809	0.8412
Irrigation interval			
2 day	70.7	70.5[b]	70.6
4 day	71.3	72.2[a]	71.7
6 day	70.2	72.1[a]	71.2
Significance	NS	*	NS
SE ±	1.3479	0.5031	0.7285
Interaction PM x I I	NS	*	NS

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).

* = Significant at 5% probability level.

WAP = Weeks after planting

PM = Poultry Manure. II = Irrigation Interval

Table 8: Interaction effects of different level of poultry manure and irrigation interval on percentage marketable weight (%) during 2016/2017 and 2017/2018 dry seasons at Sudan Savannah of Borno State

	2017/2018		
Irrigation Interval	2 days	4 days	6 day
Treatment			
Poultry Manure			
0 kg/ha	64.5^{e}	65.8^{de}	65.0^{e}
20 kg/ha	67.8^{cd}	68.1^{c}	68.0^{c}
25 kg/ha	71.5^{b}	76.8^{a}	76.9^{a}
30 kg/ha	78.2^{a}	78.1^{a}	78.6^{a}
SE ±		1.0062*	

Means followed by similar letter(s) are not significantly different at 5% probability level according to Duncan's Multiple Range Test (DMRT).
* = Significant at 5% probability level.
WAP = Weeks after planting
PM = Poultry Manure
II = Irrigation Interval

CONCLUSION AND RECOMMENDATIONS

From the finding of this research work, it was concluded that poultry manure and irrigation interval had significantly affected growth and yield components of onion in Maiduguri Sudan Savannah during the 2016/2017 and 2017/2018 dry seasons and the combined years. Therefore, application of poultry manure at 30 kg/ha and irrigation interval at 6 days produced the highest effects on all the parameters examined in the Sudan Savannah.

From the finding of the study, the following recommendations could be made.

i. From the results of the experiments, it is recommended that for optimum onion production in Maiduguri Sudan Savannah, a combination of 30 kg/ha poultry manure and 6 days irrigation interval be adopted.
ii. Further study should be carried out to determine the effect of onion to different rates of poultry manure and irrigation interval levels in the study area.

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Substitutional Effect of Inorganic with Organic Fertilizer on the Productivity of Pearl Millet in Sandy Loam Soil

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Abstract: *The problems of low soil fertility resulting from continuous mono-cropping, crop residue removal and limited fertilizer use represent key challenges to produce surplus food for the ever increasing population of Nigeria. An on-station experiment was conducted at the Research and Demonstration Farm of Lake Chad Research Institute in Maiduguri (11^0 54' N, 13^0 05' E), to assess the substitutional effect of inorganic with organic fertilizer on the productivity of pearl millet in sandy loam soil. The experimental factors considered in this studies are organic and inorganic fertilizer. The organic (NPK) were at five level, rated (0, 60:30:30, 45:30:30, 30:30:30 and 15:30:30 kg/ha) and inorganic Farm Yard Manure (FYM) were rated at four level (0, 7.5, 5.0, 2.5 t/ha) respectively. These factors were combined and replicated three times to form a total of 60 treatments, that were laid in a Randomized Complete Block Design (RCBD). Nevertheless, the statistical analysis (ANOVA) revealed that T_{18} (7.5t FYM + $N_{15}P_{30}K_{30}$) gave the longest panicle length than all other treatment experimented. The highest grain yield values of 1038.5 - 2000.0 kg/ha, was remarkably observed with T_{11} (2.5t FYM + $N_{60}P_{30}K_{30}$) and the lowest growth and yield attributes were observed mostly within the control plot.*

Keywords: *Drainage, Organic fertilizer, Inorganic fertilizer and Pearl millet*

1.0 Introduction

Cereals and legumes are some of the essential and most consumed food by man (www.fao.org/docrep). About 70 % millet are produced in Asia and Africa is grown in West Africa. Major producing countries in Africa include Nigeria, Niger, Burkina Faso, Chad, Mali, Mauritius and Senegal in the West Africa and Sudan and Uganda in the East Africa (Kamble *et al* 2003). Thus the importance of millet to man cannot be over emphasized. Pearl millet is a cereal family that is widely grown in semi-arid tropics of Africa and produced in 18.50 hectares by 28 countries covering 30 % of the continent (Obilana, 2007). According to DAFF (2011), global production of millet grains probably exceeds 10 million tonnes a year, to which India contributes nearly half. It also said that, at least 500 million people depend on millet for their lives. Approximately one-third of world millets are grown in Asia and Africa. The pearls millet (*Pennisetum glaucum*), on the other hand, is the commonest species of millet planted for food across Africa and India (Kamble *et al.*, 2003). According to Ikwella (2001), pearls millet is second important only to sorghum as a staple food in Nigeria. There are three types of pearls millet based on the maturity dates (Ikwella, 2000). These are *gero, maiwa* and *dauro*. *Gero* is photoperiod neutral and early maturing (70 -100 days). It is cultivated in the Northern Guinea, Sudan savanna and in the Sahel. *Gero* is grown on about 80 % of the total area under millet and

predominates in Sahel (Ikwella, 2012). Sandy soils are generally low in fertility for agricultural production due to their very low nutrients and organic matter content. The Rainfall pattern in Maiduguri semi-arid region of Nigeria is characterized by limited and undependable rainfall and the rate of moisture loss into the atmosphere through the process of evapotranspiration is high (Abebe, 2012). The soils are generally sandy in nature, poorly structured and inherently low in fertility, organic matter content and water holding capacity (Chiroma, 2004). However, millet does well on such soils, in spite erratic rainfall because of its high tolerance to heat and moisture stress, but the productivity is considerably low. Management of both physical (structure) and chemical (fertility) becomes paramount for attainment of high productivity by farmer living in such environment. Inorganic fertilizers provide rapid replenishment for crop sustenance, while organic fertilizers in addition to nutrient supply also contribute to soil structure improvement. The use of organic fertilizers in millet field is very common with the farmers, as such this project aims at finding a suitable rate of organic fertilizer that will substitute the inorganic fertilizer rate. There is therefore the need to evaluate the effect of inorganic with organic fertilizer on the productivity of pearl millet in sandy loam soil, in other to determine the most effective and optimum substitution rate of inorganic and organic fertilizer on growth and yield of Pearl millet

2.0 Materials and Methods

Experimental Sites

An on-station experiment was conducted at the Research and Demonstration Farm of Lake Chad Research Institute in Maiduguri (11^0 54' N, 13^0 05' E), to assess the substitutional effect of inorganic with organic fertilizer on the productivity of pearl millet in sandy loam soil.

2.1 Treatment and Experimental Design

The experimental factors considered in this studies are organic and inorganic fertilizer. The organic (NPK) were at five level, rated (0, 60:30:30, 45:30:30, 30:30:30 and 15:30:30 kg/ha) and inorganic Farm Yard Manure (FYM) were rated at four level (0, 7.5, 5.0, 2.5 t/ha) respectively. These factors were combined and replicated three times to form a total of 60 treatments that were laid in a Randomized Complete Block Design (RCBD).

2.2 Agronomic Practice

The experimental site was disc-harrowed and marked-out into plots of 5.0 m x 4.5 m in size. The organic fertilizer was procured from Maiduguri livestock market and applied two weeks before sowing. The inorganic fertilizers were applied at planting and the N-requirement was made-up using urea (46%). Millet (Super SOSAT) was sown in the plots at a row spacing of 0.75 m apart and 0.5 m between stands. All other cultural practices for millet production were observed.

3.0 Results and Discussion

Table 1 shows the effect of inorganic with organic fertilizers on the establishment, plant height at 3, 6 and 9 weeks after sowing (WAS), panicle length and grain yield of millet. The result did not show significant ($P<0.05$) difference in the effect of NPK level and FYM on establishment which ranged from 80.0 - 100%. In contrast, growth of millet at all the three periods differed significantly ($P<0.05$). Plant height at 3, 6 and 9 WAS significantly differed from 8.0 - 14.3 cm, 62.7 - 120.0 cm and 196.7 - 274.0 cm, and the best growth consistently occurred in T_5 ($N_{60}P_{30}K_{30}$). Panicle length differed significantly among the different fertilizer treatments, which ranged from 23.2 - 29.9 cm. The longest panicle was obtained from T_{18} (7.5t FYM + $N_{15}P_{30}K_{30}$), followed by T_5 ($N_{60}P_{30}K_{30}$) and T_1 (7.5t FYM). Grain yield in the different fertilizer treatments significantly varied from 1038.5 - 2000.0 kg/ha, with the highest from T_{11} (2.5t FYM + $N_{60}P_{30}K_{30}$) and the lowest from T_4 (Control). Application of T_{11} (2.5t FYM + $N_{60}P_{30}K_{30}$) gave significantly higher yield than all other treatments,

followed by T_{18} (7.5t FYM + $N_{45}P_{30}K_{30}$) and T_{19} (5.0t FYM + $N_{45}P_{30}K_{30}$) with similar effects, and significantly higher yield than the remaining treatments. Grain yield obtained with the combine application of T_{11} (2.5t FYM + $N_{60}P_{30}K_{30}$) was also significantly higher than those fertilized with single sources. However, the effects of T_9 (7.5t FYM + $N_{60}P_{30}K_{30}$), T_8 (5.0t FYM + $N_{60}P_{30}K_{30}$) and T_{14} (2.5t FYM + $N_{45}P_{30}K_{30}$) on yield did not differ significantly, as the case also was among T_1 (7.5t FYM), T_2 (5.0t FYM), T_3 (2.5t FYM), T_6 ($N_{45}P_{30}K_{30}$) and the T_4 (Control).

Table 1: The effects of the different levels of organic and inorganic fertilizers on the establishment, plant height at 3, 6 and 9 weeks after sowing (WAS), panicle length and grain yield of millet

Treatments	Establishment (%)	Plant height (cm)			Days to 50% heading	Panicle length (cm)	Grain yield (kg/ha)
		3 WAS	6 WAS	9 WAS			
T_1 -7.5 t/ha	100^{a}	13.3^{ab}	88.3^{b-f}	216.0^{e-h}	57.7^{gh}	28.2^{b}	1038.5^{jk}
T_2 -5.0 t/ha	97.7^{a}	11.0^{b-f}	79.3^{c-h}	220.0^{efg}	56.0^{jk}	25.5^{ef}	1041.5^{jk}
T_3 -2.5 t/ha	97.0^{a}	10.0^{d-g}	66.7^{gh}	211.0^{fgh}	62.7^{b}	24.5^{f}	977.8^{kl}
T_4-control	97.3^{a}	8.0^{g}	72.7^{f-h}	196.7^{h}	58.3^{efg}	23.2^{g}	841.5^{m}
T_5-$N_{60}P_{30}K_{30}$	96.7^{a}	14.3a	120.3^{a}	274.0^{a}	54.3^{m}	29.6^{a}	1577.8^{d}
T_6-$N_{45}P_{30}K_{30}$	96.7^{a}	11.7^{b-d}	77.7^{d-h}	238.7^{b-e}	55.7^{kl}	27.4^{bcd}	1044.4^{jk}
T_7-$N_{30}P_{30}K_{30}$	96.7^{a}	13.0^{a-c}	83.3^{b-g}	215.0^{fgh}	56.7^{ij}	26.8^{cd}	900.7^{lm}
T_8-$N_{15}P_{30}K_{30}$	97.7^{a}	12.7^{a-c}	83.7^{b-g}	251.3^{abc}	62.7^{b}	25.0^{f}	866.7^{m}
T_9-$N_{60}P_{30}K_{30}$ +7.5 t/ha	97.7^{a}	11.3^{b-e}	90.0^{b-f}	223.0^{d-g}	59.7^{d}	26.3^{de}	1703.7^{c}
T_{10}-$N_{60}P_{30}K_{30}$ +5.0 t/ha	80.0^{b}	11.0^{b-f}	79.0^{c-h}	225.3^{d-g}	60.7^{c}	27.3^{bcd}	1748.1^{c}
T_{11}-$N_{60}P_{30}K_{30}$ +2.5 t/ha	96.7^{a}	11.7^{b-d}	84.7^{b-g}	226.0^{d-g}	60.0^{c}	27.3^{bcd}	2000.0^{a}
T_{12}-$N_{45}P_{30}K_{30}$ +7.5 t/ha	94.3^{a}	11.3^{b-e}	91.7^{b-e}	244.3^{bcd}	58.0^{fgh}	27.6^{bc}	1918.5^{ab}
T_{13} -$N_{45}P_{30}K_{30}$ +5.0 t/ha	90.0^{ab}	11.1^{b-d}	76.7^{e-h}	225.3^{d-g}	57.3^{hi}	27.1^{bcd}	1844.4^{b}
T_{14}-$N_{45}P_{30}K_{30}$ +2.5 t/ha	95.3^{a}	10.7^{b-g}	62.7^{h}	205.0^{gh}	64.3^{a}	26.6^{cde}	1700.7^{c}
T_{15}-$N_{30}P_{30}K_{30}$ +7.5 t/ha	98.0^{a}	14.3^{a}	96.7^{bc}	259.3^{ab}	58.7^{ef}	26.8^{cd}	1451.9^{e}
T_{16}-$N_{30}P_{30}K_{30}$ +5.0 t/ha	98.3^{a}	12.3^{a-d}	98.3^{b}	261.0^{ab}	55.3^{kl}	26.8^{cd}	1377.8^{ef}
T_{17}-$N_{30}P_{30}K_{30}$ +2.5 t/ha	94.7^{a}	8.7^{fg}	71.7^{f-h}	225.0^{d-g}	55.0^{lm}	26.5^{cde}	1311.0^{fg}
T_{18}-$N_{15}P_{30}K_{30}$ +7.5 t/ha	97.7^{a}	10.7^{c-g}	77.7^{d-h}	228.0^{c-g}	59.0^{de}	29.9^{a}	1240.0^{gh}
T_{19}-$N_{15}P_{30}K_{30}$ +5.0 t/ha	99.7^{a}	11.0^{b-f}	93.3^{b-e}	230.7^{c-f}	55.0^{lm}	24.7^{f}	1163.0^{hi}
T_{20}-$N_{15}P_{30}K_{30}$ +2.5 t/ha	93.0^{a}	9.0^{e-g}	96.3^{b-d}	228.3^{c-f}	56.0^{jk}	24.9^{f}	1103.7^{ij}
Mean	95.8	11.4	84.5	230.2	58.2	26.6	1342.6

SE±	7.51	0.91	6.54	6.08	0.70	0.42	30.42
CV(%)	4.15	13.84	13.41	8.08	0.23	2.70	3.92

Means bearing similar superscript letter(s) under the same parameter in a column are not significantly different at 5% level of probability of the Duncan's Multiple Range Test.

3.2 Conclusion

The results showed that T_{11} (2.5t FYM + $N_{60}P_{30}K_{30}$) which gave significantly higher yield than all other treatments, followed by T_{18} (7.5t FYM + $N_{45}P_{30}K_{30}$) and T_{19} (5.0t FYM + $N_{45}P_{30}K_{30}$) and have been recommended for use by farmers.

3.3 Recommendations

It is recommended that further studies should be carried out on other soil type, climatic region and millet varieties adopting this approach with a view to re- validating the outcome of this research.

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Performance of Growing Yankasa Rams Fed Graded Levels of *Ficus Sycomorus* Leaf Meal (FSLM) in Semi-Arid Zone of Borno State

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Abstract: *The experiment was conducted at Ramat polytechnic Maiduguri teaching and research farm to investigate the performance of growing Yankasa rams fed diet containing graded levels of Ficus sycomorus leaves meal (FSLM) at 5, 10, and 15% representing treatment B, C, and D respectively. Treatment A served as control with 0% inclusion FSLM. Sixteen entire males Yankasa rams with initial average weight of 24kg were used for the experiment. The rams were quarantined for two weeks during which they were fed basal diet and subsequently fed test diets. The experimental animals were allotted into four experimental treatments with four animals per treatment in complete randomized design (CRD). Results obtained revealed that incorporation of FSLM in the diets of growing Yankasa rams up to 15% gave impressive output. Treatment D (15% inclusions) recorded the highest mean for final body weight. Diet with higher Inclusion level of FSLM at (15% inclusion) recorded significantly higher (P<0.05) value in terms of feed intake (139.57g), Average daily gain (0.31g) and feed conversion ratio (6.47). It was concluded that inclusion of Ficus sycomorus leaf meal up to 15% in the diet of rams improves performance. It is therefore recommended that (FSLM) at 15% inclusion in the diets of growing sheep should be adhered.*

Keywords: *Ficus sycomorus, performance, rams*

Introduction

Competition between man and his animals for human food supplies makes it difficult to provide energy and protein supplementation for livestock. Thus during the long dry season when pasture starts to dry off animals loss the weight gain. During the raining season when good quality pasture are available. As the dry season progresses, the pasture remain rarely available, and where they exist, they are often of low quality (Ajiji and Nyako, 2013). Wilson (2001) estimated that as much as 15% of the animal body weight attained at the end of the previous raining season could be lost during the following dry season. The problem is more acute in north western Nigeria especially in the semi-arid zone where the bulk of the ruminant livestock are found. In view of this, it is paramount to look for alternative source of feed ingredients in other to optimize Animal performance. But inadequate knowledge of most of non-conventional feedstuff and their suitability as feed has led to the slow pace in the alternative feed resource in livestock rations. However the advantage of using non-conventional feeding stuffs that is readily available cheaper and not competed for as food for man.

Sheep and goat are meat producing animals that require simple management as compared to poultry and other classes of livestock. Sheep's are economical converter of browse, grasses concentrates and crop residues into profitable products (meat and wool). Inadequate nutrition is one of the major problems facing ruminant's animal production in Nigeria (Sultan *et al*., 2009).

Ficus Sycomorus tree are hardy and can provide year–round fodder to be used as a supplement in lean periods. With proper management and propagation techniques, this fodder can be a viable feed resource to supplement small Ruminants feeding. It also serves as soil erosion control and sand-dunes fixation and riverbank stabilization. A *Ficus* leaf is a rich protein source (crude protein CP; 35-38%) and the protein in the leaf is relatively balance in its amino acid and mineral profiles (Njidda and Ikhimiaya 2010). The use of *Ficus* leaves could help improve ruminant's livestock production.

In Nigeria, there is a low animal protein intake due to escalating cost of feed ingredients like cotton seed cake which in turns affect the cost of Ruminants production. Hence the need for other alternative feed ingredient is necessary; Ficus (*Ficus Sycomorus*) is one of such alternative feed for Ruminants and its abundance and is available all year round within the local environment for this could be an encouragement for Ruminants production (Aseigu and Anugwa, 2005). The objective of this study was to assess the growth performance of yankasa rams fed *Ficus sycomorus* leaf meal in semi-arid zone of Nigeria.

Key words: ruminants, non-convectional feeds, performance

Materials and Methods

Experimental Site

The study was carried out at the Livestock Unit of the Teaching and Research Farm, Department of Animal Production Technology, Ramat Polytechnic, Maiduguri. Maiduguri, the Borno State Capital, is located between latitude 11°5' and 12^0 North, longitude 13°09' E and 14^0 East at an altitude of 354m above sea level (Alaku, 2009). The area has a semi-arid tropical climate with a wide seasonal diurnal range of temperature. The hottest months are April and May with a range between 39.4 and 40.1 ^{0}C under shade (Wikipedia, 2013). There is a long dry season of 7 – 8 months between the months of October to May. The first three (3) months of dry season are characterized by the harmattan wind blowing from the Sahara Desert. During the last 2 – 3 months of the dry season there is hot diurnal temperature and comparatively cooler nights. The average annual rainfall is about 500 mm. The relative humidity is about 45% in August and usually lowers to about 5% in December and January. The vegetation of the area consists of certain grass species that thrive on flat landscape with occasional shrubs and scanty trees. Thus only quick maturing crops like millet, sorghum and cowpea are grown where the soils are suitable. Livestock and poultry rearing is an integral part of the occupation of the people.

Collection and Processing of *Ficus sycomorus* Leaves

The leaf of *Ficus sycomorus* were harvested within the Province of Mahammet Lawan College of Agriculture Maiduguri and its environs. The leaves were air dried on a concrete floor in a well-ventilated Room and later ground into finely particles, Until the Commencement of the feeding Trial.

Experimental Animals, Treatments and Design

Four complete experimental diets A, B, C, and D were formulated, containing 0 (control), 5, 10, 15% *Ficus sycomorus* leaves were used for this study. The Net composition of the experimental diets is shown in Table 1. All the ingredients used except *Ficus* leaves were purchased from the Maiduguri Livestock market. Sixteen yankasa Rams were allotted randomly to the four treatments with four animals per treatment in a complete Randomized design (CRD).

Management of Experimental Animals

Prior to the commencement of the experiment, the experimental Animals were treated against endo-parasite and ecto-parasite using Ivomcetin and Albendazole(R) occurring to the Manufacturers recommendation. Sixteen (16) yankasa Rams with average age of 12 months and weighing 20±kg obtained from Gubio Local government Area of Borno State Livestock Market. The animals were housed in individual pens.

Table 1: Table for the proportion of feed ingredient Diet (%)

Ingredients	(%) A (0%FSLM)	B (5%)	C (10%)	D (15%)
FSLM	0	5	10	15
Maize	8	8	8	8
Groundnut haulms	15	13	10	8
Cowpea husk	15	15	15	16
Maize Bran	27	27	23	19
Cotton seed cake	18	13	15	15
Rice milling waste	15	17	17	17
Bone meal	1	1	1	1
Salt	1	1	1	1
Total	100	100	100	100

Data Collection

Daily records of feed intakes were taken by weighing the feed offered and the leftover the following day in the morning. The daily intake of feed was estimated for each animal by subtracting the feed leftover from the quantity offered to the individual animals. Weight of individual animal was measured at the onset of the trial. Weekly gain is measured by each animal throughout the feeding trial. Weight gain was determined by subtracting the initial weight from the final weight within the feeding period.

Results and Discussions

Proximate Composition of the Experimental Diets

The Proximate Composition of the experimental diets was indicated in Table 2 below. The Results showed that dry matter (DM) values ranged from 92.67 - 94.88%.It could deduced that treatment C (10% *Ficus sycomorus* leaf meal) having the highest dry matter (94.88%) with treatment B (5%FSLM) having the lowest (92.94%) value. The dry matter of the experimental treatment (92 - 94%) were within the values recommended by (Omotosho *et al*., 2015) on the utilization of rice straw ensiled with soybean meal by yankasa rams in the semi arid zone of Nigeria.

The Crude protein level of the experimental treatment ranged from 16.98 - 17.35%. The CP Content was higher in treatment A (0%FSLM) Control with 17.36% and lower in treatment D 16.89%. The values for all the treatment were within the protein requirement ranged (15 to 18% CP) recommended by ARC (1990) for growing sheep. Similarly Purian and Gupta (2001) reported 15-18 CP Levels when he replaced maize with brewers grains in the diets of growing sheep.

The Crude fibre content of the experimental treatments ranged from 12.11 - 14.21%. The CF value were higher in treatment A (14.21%) followed by 13.11% in treatment C and B. While the lowest (12.11%) value was in treatment D. Similarly the CF content reduced slightly from the control treatment A (0%FSLM) to treatment D (15%FSLM) with highest inclusion of *Ficus sycomorus* leaf meal. The CF content obtained in the study met the minimum requirement recommended for ruminants by Banarjee (2010). The values of 12.11 - 14.21 were lower than the values of 32-37% reported by Nayawo (2010).

Ether extract of the experimental treatments ranged from 2.95 - 3.58%. The EE content decline with increasing level of *Ficus sycomorus* leaf meal (FSLM). The values obtained were lower than the values reported by Nayawo (2010) when he replaced rice milling waste with offal in the diets of Kano Brown Goat.

The Ash values ranged from 3.26 - 4.81%. This indicates that the diet has optimal mineral supply. The Ash values were higher in treatment C (10%FSLM) with 4.81% and lower in treatment A (0%FSLM) with 3.21% value.

The NFE (Nitrogen free extract) obtained from this study ranged from 57.99 - 54.26%. This could be deduced that there was optimal amount of fermentable carbohydrate present in the diets to provide energy to the Rams. Observed values were higher than the values reported by Muhammad (2005) when he fed yankasa Rams graded levels of Rice milling waste (RMW) and Soya bean Meal Residue (SBMR) in North western part of Nigeria.

Table 2: Proximate Composition of the Experimental Diets and ***Ficus Sycomorus*** Leaf Meal (FSLM)

PARAMETERS	**T1(0%)**	T2(5%)	T3(10%)	T4(15)
Dry Matter (DM)	92.67	93.13	94.88	93.50
Crude Protein (CP)	17.36	16.98	17.04	16.89
Crude Fibre (CF) 14.21	12.80	13.11	12.11	
Ether Extract (EE)	3.58	2.96	3.29	3.13
Ash	3.26	4.13	4.81	3.38
Nitrogen free extract (NFE)	54.26	56.26	56.63	57.99

Table 3: Growth Performance Indices of Yankasa Rams fed graded levels of *Ficus sycomorus* leaf meal

Parameters	**Treatments**				
	T1	T2	T3	T4	SEM
Initial body weight (kg)	24.500	24.375	24.375	24.500	1.0346
Final body weight (kg)	38.00^{b}	44.250^{a}	44.125^{a}	46.375^{a}	1.5318
Total body weight (kg)	13.50^{b}	20.375^{a}	19.750^{a}	21.875^{a}	1.2635
Average daily gain (g/day)	0.1929^{b}	0.2911^{a}	0.2821^{a}	0.3125^{a}	0.0180
Feed Conversion Ratio	8.1641^{a}	7.9736^{a}	7.9603^{ab}	6.4693^{b}	0.4875
Feed Intake (kg)	109.10^{b}	161.77^{a}	155.73^{a}	139.57^{a}	7.6224

Performance of Yankasa Rams Fed graded Levels of *Ficus Sycomorus* Leaf Meal

The Results for the growth Performance Indices of yankasa Ram fed graded levels of FSLM is presented in Table 3. The results showed that the Initial body weight (24.37 – 24.50kg) did not significantly (P>0.05) between the treatment mean. This shows that no bias among the treatment animals for the Initial body weight.

The Final body weight gain for treatment B (5%FSLM) with 44.25kg was statistically similar to treatment C (10%FSLM) with 44.12kg. Treatment D recorded significantly higher (P<0.05) value with (15% FSLM) inclusion. This indicates that treatment D has higher final body weight gain with (46.37kg); this shows that (15%FSLM) inclusion has the best performance among the treatment animals.

However, the Total body weight gain for treatment D recorded significantly higher (P<0.05) with (15%FSLM) inclusion than treatment B, C and treatment A. It could be deduced that 15% *Ficussycomorus* leaves meal inclusion gave the highest total body weight gain (21.87kg) value.

This experiment also indicate that the Average daily gain (ADG) were significantly (P<0.05) influenced by the experiment treatments with animals on treatment D (15%FSLM) having the highest mean daily gain (0.31g/day) while the lowest mean daily gain was recorded in treatment A (0.19g/day) for Rams receiving 0% FSLM inclusion. The observed highest ADG was recorded in treatment D (0.31g/day) for Rams receiving 15% FSLM. The lower value ADG exhibited by animals on treatment A (control) could be associated with the incidence of diarrhoea which led to loss of weight by animals on the treatment.

The Feed Conversion Ratio (FCR) was significantly higher (P<0.05) in Rams at 15%FSLM inclusion level with (8.16) value. This implies that the efficiency at which the Rams converted feeds for their body weight gain in treatment with 15% inclusion is the lowest, indicating a better feed conversion ratio of the feed.

Results of this experiment indicate an increase in feed intake with increasing levels of *Ficus sycomorus* leaf meal (FSLM) even though treatment A(control) with (0%FSLM) had a lower feed intake compared to treatment D but not significantly different. The increased (P<0.05) feed with increasing levels of *Ficus sycomorus* leaf meal , could be due to the fact that roughages of low quality tend to be eaten more by the animals in order to satisfy their needs for energy and other nutrients (Mc Donald *et al*., 2001). Variation in feed intake between treatment A and D could be as a result of individual animal differences among the experimental animals. One possible explanation for this is that the animals were obtained from different source with possible differences in management system. This could have led to individual animals differences as regards their adaptation to the feeding conditions, even though measures were taken to eliminate these differences at the beginning of the experiment. Payne (2005) and Lynch *et al*. (2007) had earlier reported that individual variation affected the rate of feed intake in sheep and other ruminants.

Conclusion

In Conclusion, the study indicated that *Ficus sycomorus* leaf meal (FSLM) at 15% level in the diets of growing yankasa Rams gave the highest Final body weight gain of 46.37kg, Average daily gain (0.31g) and best Feed Conversion Ratio (6.49) Compared to other

treatments without significantly affecting performance. It is therefore recommended that (FSLM) at 15% inclusion in the diets of growing sheep should be adhered.

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Heamatological and Biochemical Characteristics of Yankasa Rams Fed Graded Levels of *Ficus Sycomorus* Leaf Meal in Semi-Arid Zone of Borno State

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Abstract: *The study was conducted to investigate the Hematological and Biochemical characteristics of Yankasa Rams fed graded levels of Ficus sycomorus Leaf Meal based diet. Sixteen (16) Yankasa Rams with an average weight of 28kg were allotted to four treatments. The treatments evaluated were 0%, 5%, 10% and 15% inclusion levels of the test ingredient in a complete randomized design (CRD). The result reveal no significance difference (P>0.05) in Packed Cell Volume (MCV), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Haemoglobin Concentration (MCHC). However significance difference (P>0.05) were obtained in Haemoglobin, Red Blood Cell and Mean Corpuscular Volume. However all the parameters evaluated were within the normal range values of a healthy sheep. It is concluded that inclusion of Ficus sycomorus leaves in the diet of Yankasa rams had no deleterious effect on the haematological and Biochemical parameters evaluated. It is recommended that further study on the feeding potential of Ficus sycomorus be conducted on other species of livestock to ascertain the feeding value of Ficus sycomorus.*

Keywords: *Ficus sycomorus, Yankasa Rams, Biochemical, Hematology*

Introduction

Background of the Study

The cost of feed ingredients has increased tremendously over the years and this has been a source of worry for livestock producers. The contemporary issue in livestock management is the exorbitant cost of feeding stuffs. This is obviously a matter of concern because of the fact that feeds account for about 60-80% of the recurrent expenditure of intensive animal production system (Onifade, 2002). Astronomical increase in population of Nigeria (140,431, 790 million) (NPC, 2006) is not backed by a commensurate increase in the production of grains and other crops that are also consumed by man. In view of the fact that feeding problems constitute the single largest problem of ruminant animal production in Nigeria, it is important to consider the use of alternative feed ingredients in order to reduce cost of production and optimize profit for improved livestock performance enterprise (Boda, 2003).

These feed ingredient. It is obtained from plants, threes, shrubs and animal by-product. The cost of feed ingredient has increased the shortage of feed has increase particularly during dry season, limit the animal output in most part of the country (Kumar, 2003).

The available feed resources cannot meet the nutritional requirement of animals throughout the year in many parts of the country either due to inadequate supply or quality of the feed. This problem is even more aggravated in arid and semiarid areas giving the erratic and unreliable rainfall pattern. (Herson, 2008).
Low and erratic rainfall severally affects the growth of crop residue available for livestock feeding. Livestock feed resources in Nigeria are mainly natural grazing and crop residues, which are low in energy and protein leading to significant limitation in the production of sheep (Okoli et al, 2002).

As the population ahead of the animal supply there is every need to burst animals supply there is every need to burst animal production through intensive and extensive livestock rearing. Ruminant feed scarcity in the dry season lead to reduce growth of animal and reproductive performance. These problem may be directly associated with lower concentration of nutrient in their diet of semidried region of Borno State.

The objectives of the study were to assess the heamatological indices of Yankasa sheep fed graded levels of *Ficus sycomorus* leaf meal in semi-arid zone of Borno State

Material and Methods

Study Area

The experiment was conducted at Teaching and Research Farm of Ramat Polytechnic. Department of Animal Production Technology Maiduguri, Borno State of Nigeria. Maiduguri is located between latitude 11.5^0 and 12^0 north and longitude 13.5^0 and 14^0 east and attitude of 354m above sea level. The mean relative humidity range from 30% to 45% with minimum in February to May when it drops to as low as 10% in August.

Collection and Processing of Ficus Sycomorus Leaf

The leaves of *Ficus sycomorus* were collected within the province of Mohammed Lawan College of Agriculture Maiduguri and its environs. The leaves were air dried on a concrete floor in a well ventilated room and later ground into finely particles until the commencement of the feeding trial.

Experimental Animals,Treatment and Design

Four complete experimental diet A; B, C, and D were formulated, containing 0 (control) 5, 10, and 15% *Ficus sycomorus* leaf were used for this study. The net composition of the experimental diets is shown in table 1. All the ingredients used except *Ficus sycomorus* leaf were purchased from the Maiduguri livestock market. Sixteen Yankasa rams were allotted randomly to the four treatment diets in a complete randomized design (CRD) with four animals per treatment.

Management of Experimental Animals

Prior to the commencement of the experiment the experimental animals were treated against endo and ecto parasite using ivometic and Albendozole (R) according to the manufacturer's recommendation.

Table 1 for the Proportion of feed Ingredient Diet (%)

Ingredients (%)	A control	B	C	D
Ficus leaves	0	5	10	15
Maize	8	8	8	8
Groundnut haulms	15	13	10	8
Cowpea husk	15	15	15	16
Maize Bran	27	27	23	19
Cotton seed cake	18	13	15	15
Rice milling waste	15	17	17	17
Bone meal	1	1	1	1
Salt	1	1	1	1
Total	100	100	100	100

Data Collection

Blood sample were collected from the jugular vein of apparently 16 healthy sheep of same breed. The blood in the syringe was gently transferred into a plane sample bottles and place in a slanted position at ambient temperature for one (1) hour.Each sample was labeled accordingly. The blood sample was pack and transported to Federal University of Maiduguri for laboratory analysis.

Data Analysis

The data generated was subject to analysis of variance (ANOVA) using general linear model with statistix 10. Least significant difference (LSD) at 5% probability level was used to separate means that showed significance difference between treatments.

Result and Discussion

The result of Haematological characteristic of Yankasa rams fed with graded levels of *Ficus sycomorus* leaf meals is presented in Table 2 below.

Table 2: Heamatogical Characteristic of Yankasa Rams Fed Graded Levels of *Ficus Sycomorus*

	A	B	C	D	SEM
Packed cell volume (%)	0.0029[a]	0.0031[a]	0.0024[a]	0.003[a]	0.0289
Haemoglobin (g/d)	9.600[b]	10.300[a]	8.267[c]	10.000[ab]	0.1364
White blood cell (10^3/mm^3)	8.2100[d]	8.6000[c]	9.000[a]	8.8000[b]	0.0271
Red blood cell (10^6/mm^3)	9.4000[c]	9.2000[d]	9.8000[a]	9.6000[b]	0.0289
Mean corpuscular volume (F[1])	0.3100[a]	0.3367[a]	0.2200[b]	0.3033[ab]	0.0256
Mean corpuscular Haemoglobin (g/di)	337.57[a]	371.33[a]	343.17[a]	339.47[a]	32.388
Mean corpuscular Haemoglobin concentration (G/D1)	3375.9[a]	3380.0[a]	3431.1[a]	2394.9[a]	620.07

a, b, c, & d means within the same row bearing difference superscript differs significantly (P<0.05)

Packed cell volume (%)

The result reveals that the packed cell volume (PCV) showed there were no significant (P>0.05) difference among the treatment means. T_2 (0.031) recorded the highest value and T_3 (0.003) recorded the lowest value. The PCV values were within the range of (0.04-0.08) as reported by (Taway, 2004) which is also in line with the range values of (26.04±32.01) reported by (Latime, *et al*, 2004) who Fed Ensiled maize stover and concentrate supplements without any health hazard as regard.

Haemoglobin (g/d)

The values for the heamaglobin (HB) showed that there were significant (P<0.05) difference among the treatment means. The T_2 (10.300) recorded the highest value, and T_3 (8.267) recorded the lowest value. The HB values range (8.267-10.300) fall within the range value (5.6±0.62) in sheep as reported by (Egbeniiyi, 2000). The HB is good indicator of the physiological status of the animals.

White blood cell (10^3/mm^3)

The values for the white blood cell (WBC) showed that there were significant (P<0.05) difference among the treatment means. The T_3 recorded the highest value (9.00) and T_1 recorded the lowest value (8.21). However all the treatments were fall above the normal range value of (5.80±0.29) as reported by (Yakub, 2001). The values reported in this study were lower than (20.3-0.93) reported by (Isidahomen *et al,* 2011) who Fed Yankasa rams with sorghum stover supplement with graded levels of poultry dropping. White blood cell (WBC) is an indicator of immune response to infections in animals.

Red blood cell (10^6/mm^3)

The values for the Red Blood Cell (RBC) showed that there were significant (P<0.05) difference among the treatment means. The T_3 (9.8000) recorded the highest value and T_2 (9.2000) recorded the lowest value, the RBC fall within the range of (7.80±0.62) in sheep. The values were similar with (5.07-9.01) reported by (Coles, 2004) who Fed chicken with the difference processed of soya bean waste. The red blood cell (RBC) is an indication that the feed was not toxic to the animals.

Mean corpuscular volume (T_1)

The values for the mean corpuscular volume (MCV) showed that there were significant (P<0.05) difference among the treatment means. The T_2 0.3367 recorded the highest value and T_3 (0.2200) recorded the lowest value. All the treatment means are below to the range value (38.00±3.21) as reported by (Compbell, *et al, 2003*). Mean corpuscular volume (MCV) is an indication of the average volume of blood cells.

Mean Corpuscular Haemoglobin (MCHg/d_i)

The values for the mean corpuscular haemoglobin (MCH) showed that there were no significant (P>0.05) difference among the treatment mean. The T_2 (371.33) recorded the highest value T_1 (337.57) recorded the lowest value. The MCH range values recorded were higher than the range values of (13.2±1.04) and (28.8-31.3) reported by (Tambuwal, *et al.,* 2002) and (Isidatimen et *al.*, 2011) respectively. The differences could be due to the environmental factors.

Mean Corpuscular Haemoglobin Concentration (MCHC)

The values for the MCHC showed that there were no significant (P>0.05) difference among the treatment means. The T_3 recorded the highest value and T_4 recorded the lowest value. The MCHC values range (239.9-343.1) were higher than the range value of (2.8±0.44) reported by (Awodi *et al.,* 2005) who Fed sheep with sorghum supplemented with sun-dried poultry dropping diet.MCHC are very important in the diagnosis of anemia.
The result for the biochemical characteristic of Yankasa rams fed graded levels of *Ficus sycomorus* leaf meal is presented in Table 3.

Table 3 Biochemical characteristic Yankasa Rams fed graded levels of Ficus syncomorus

	A	B	C	D	SEM
Direct Dilirubin (md/dl)	0.8000^d	0.9000^c	1.3000^b	2.0000^a	0.0289
Congygatbilirubin	2.2000^d	3.2000^c	4.000^b	4.2000^a	0.0289
Total bilirubin (Mol/L)	59.000^d	60.000^c	64.000^b	68.000^a	0.0289

Albumin (g/l)	29.000^{d}	30.000^{c}	35.000^{a}	34.000^{b}	0.0289
Globubin (g/l)	30.000^{b}	30.000^{b}	29.000^{c}	34.000^{a}	0.0289
Aspenate aminotransferase (lu/l)	77.000^{a}	42.000^{d}	52.000^{b}	51.000^{c}	0.0289
Alamineaminotranscferase (lu/l)	17.000^{b}	12.000^{d}	18.000^{a}	15.000^{c}	0.0289
Glucose (mmol/L)	2.3000^{b}	2.1000^{c}	2.7000^{a}	2.3000^{b}	0.0289
Cholesterol (mmol/L)	1.4000^{d}	2.000^{b}	2.2000^{a}	1.6000^{c}	0.0289

a, b, c, & d means within the same row bearing difference superscript differs significantly ($P<0.05$)

Direct Dilirubin(Md/d_i)

The result for the Direct dilirubin (DB) showed that there were significant ($P<0.05$) difference among the treatment means. The T_4 (2.000) recorded the highest value and T_1 (0.800) recorded the lowest value. The direct dilirubin DB values were fall within the range of (1.50 ± 0.1) and (1.200-3.00) reported by (Ganong, 2005) and (Ramos, *et al*, 2003) respectively.

The values for the conjugated (CT) shows that there were significant ($P<0.05$) difference among the treatment means. The T_4 recorded the highest value and T_1 recorded the lowest value. The conjugated range values are from (2.2000-4.2000) and are slightly lower than the range values of (5.01 ± 0.2) and (4.02-5.06) reported by (Thukwumere *et. al,* 2012) and (Sowande, *et al,* 2008) respectively.

Total bilirubin

The values for the total bilirubin (TB) showed that there were significant ($P<0.05$) difference among the treatment means. T_4 (68.00) recorded the highest value and T_1 (59.00) recorded lowest value. However all the treatment means are statistically difference. The total bilirubin range from (59.000-68.000) were fall within the range value (93.0 ± 0.26) reported by (Merck, 2010) who fed sheep with graded level of rumen content. The values suggested that there is adequate or sufficient protein or good quality protein in the diet.

Albumin (g/l)

The values for the Albumin (ALB) showed that there were significant ($P<0.05$) difference among the treatment means. The T_3 (35.000) recorded the highest value and T_1 (29.000) recorded the lowest value. The albumin values range from (29.000-35.000) were fall within the range value (33.0+1.12) as reported by (Banerjee, 2007) which come in line with work of (Oluremi and Gridhar, 2004) who fed differently processed pearl millet on finishing broilers.

Globulin (g/L)

The values for the glubulin (GLB) showed that there were significant (P<0.05) difference among the treatment means. The T_4 (34,000) recorded the highest value and T_3 (29.000) recorded the lowest value. The values obtained in this study were fall within the range value of (26.00±0.56) as reported by (Borege, 2003). The values indicated that there is no any toxic effect on the *ficus sycomorus* leaves.

Asperiate aminotransferase (lu/L)

The values for the Asperiate aminotransferase (AST) showed that there were significant (P<0.05) difference among the treatment means.T_1 (77.00) recorded the highest value and T_2 (42.00) recorded the lowest value. The values were fall within the range value of (47.0±1.33) as reported by (Ologun, et al, 2006) who Fed sheep with fore-stomach Digesta and poultry litter waste.

Alamine aminotransferase (lu/L)

The values for the Alaminearninotransferase (ALT) showed that there were significant (P<0.05) difference among the treatment means. T_3 recorded the highest value and T_2 recorded the lowest value. The ALT range values of (12.00-18.00) were slightly lower than the range value of (22.0±074) as reported by (Lakpini, *et al,* 2002). The variation could be attributed to the differences in species.

Glucose (Mmol/L)

The values for the Glucose (GC) showed that there were significant (P<0.05) difference among the treatment means. The T_3 (2.7000) recorded the highest value and T_2 (2.1000) recorded the lowers value, while T_1 and T_4 are statistically similarly. The result obtained in this study were fall within the range value (30±1.05) as reported by (Tibbo, *et al,* 2004).

Cholesterol (Mmol/L)

The values for the cholesterol (CHL) showed that there were significant (P<0.05) difference among the treatment means. The T_3 (2.000) recorded the highest value and T_1 (1.4000) recorded the lowest value. The values were similar to the range values of (1.400-2.2000) reported by (Chees brough, 2004) who tested the Effect of Gonadotrophin (Pergona) on haematological, immune leucocyte status and serum metabolites of mature yankasa rams treated for sperm production. The values suggested that there is no any health hazard on the animals.

Conclusion

In conclusion, the results obtained in this study for haematological and biochemical characteristic at the end of the experiment were within the recommended levels, therefore, the test diets did not adversely affect the animals and as such fit for growing rams consumption.

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Efficacy of Camel Urine in the Management of Diabetes Mellitus in Alloxan induced Albino Rats

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Abstract:*There are many anecdotal reports on traditional use of camel urine in the treatment of Diabetes Mellitus (DM). The need therefore arises to validate this claim. The objectives of the study is to; evaluate the effect of camel urine on serum glucose of rats, assess the effect of camel urine on serum lipids of rats and to Compare Different doses of the products on serum glucose and lipids. Thirty-six adult albino rats were used in 4 X 3 factorial experiment involving 4 product treatments and 3 doses. A significant decrease in the blood glucose level in the experimental groups fed camel urine when compared to diabetic untreated (control) group. In treatment group treated with 1.5 ml camel urine there was a significant decrease in glucose compared to control. The result shows that there were significant decrease in TG, TC, LDL-C and VLDL-C compared with the control while the HDL was significantly increased. The results indicate that camel urine possess anti-diabetic effects on alloxan induced rats. This study recommended that awareness should be created on the therapeutic value of camel urine.*

Keywords: *Diabetes mellitus, induced, Camel urine, alloxan, rat*

INTRODUCTION

The camel belongs to the family *camelidae* and divided into two genera: genus *camelus* (the true or old world camels) and genus *lama* (the new world camels). The genus camelus includes two species, the Dromedary, (*Camelus dromedarius)* or one-humped camel and the Bactrian camel (*Camelus bactrianus*) the two humped camel. The Dromedary (*C. dromedarius*) is adapted to hot arid environments and contributes significantly to the food security of the nomadic camel pastoral households (Schwartz & Dioli, 1992). Camelids are ruminating animals and are in proximity to ruminants but are not part of the suborder *Ruminantia*. Differences such as foot anatomy, stomach system and the absence of horns confirm this fact. They belong to the suborder Tylopoda (Werney, 2003).

DM is the fourth leading cause of death in most developed countries, and its prevalence is rising in Nigeria (IDF, 2013). The conventional medications for DM such as Biguanides, Sulfonylureas and Thiazolidinedione are associated with undesirable side effects such as allergic reactions, nausea and vomiting, diarrhea, sexual dysfunction, haemoglobin disorders and lipodystrophy (Oliver and Tellervo 1993). For this reasons cheaper alternatives such as medicinal plants and animal products are sought. Among these alternatives to the conventional drugs are camel urine, for which there are many anecdotal reports and few scientific studies. The need therefore arises to validate this claim.

The aim of the study is to investigate the anti-diabetics effects of camel urine in alloxan induced diabetic rats. The objectives of the study are to; evaluate the effect of camel urine on serum glucose of rats, assess the effect of camel urine on serum lipids of rats and to determine different doses of the product on serum glucose and lipid profiles.

MATERIALS AND METHODS

The study was conducted at the Ramat Polytechnic Teaching and Research Farm, Maiduguri, Borno State of Nigeria. Maiduguri is located between latitude 11^0c and 12^0c longitude 13^0c and 14^0E and on an attitude of 354 above sea level (Alaku, 20005). It falls within the sub-arid zone of West Africa Characterize by short duration of rain fall (3.4 months), which varies from 580mm to 600mm with long dry season (7-8 months). Ambient temperatures are high during the month of April to June and fall within the range 40^0c and above well relative humidity at non-range from 5-45% (Alaku, 2005).

Experimental Animals and their Management

Thirty Six adult albino rats of both sexes weighing between 150 -170 g, were obtained from National Veterinary Research Institute, (NVRI) Vom, and used for the study. The rats were housed in cages in a well-ventilated room with free access to feed (grower mash) and water. The rats were allowed to acclimatize under laboratory condition for a period of two weeks before the commencement of the experiment. Fresh Camel urine was administered to the rats by oral intubation, in doses according to the experimental protocol.

Induction of Diabetes Mellitus

Diabetes mellitus was induced according to Szkudelski (2001), the rats were injected with a single dose of 120mg/kg bw of alloxan monohydrate, in dorsally recumbent position via penial vein. Food and water were given to the animals 30 minutes after the drug administration. A sample of the rat's venous blood was collected 7 days after induction and DM was confirmed by measuring the serum glucose level with the aid of Accu Chek glucometer (mode: AE-350, BY ERMA INC). Rats that had serum glucose level >7.0 mmol/l were considered diabetic.

Experimental layout

The 36 diabetic albino rats were randomly allocated into four treatment groups of nine rats each. In a Complete Ramdomised Design with 4 treatments and each treatments was replicated 3 time with dose levels (0, 0.5. 1.0 and 1.5 ml) were used

Blood collection

Blood samples for monitoring of blood glucose level were taken from the tail. The tail of each of the rats was pricked with lancet and a drop of the blood was collected on the test strip and inserted into the glucometer to read glucose concentration on the screen in mg/dl. Readings were taken before, after the induction and at 28 days post treatment. The first blood collection (pre-induction) was for screening of the animals, while the second collection (post-induction) was for the confirmation of DM. The third collection was for the determination of the effect of treatments.

The serum lipids were measured 28 days after the commencement of the treatments where the animals were fasted overnight and sacrificed. The blood of the animals was collected in plain bottle, centrifuged and the serum separated and kept in labeled sample bottles at 4^{o}C until required for lipid profile analysis.

Data collection

Serum glucose level was measured using glucometer, Total cholesterol (TC), Triglycerides (TG) and High Density Lipoprotein (HDL) were determined using Randox cholesterol kit (mode: CAT/TYP 05075548002, ROCHE INC). Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) were calculated using Friedewald formula (Friedewald *et al.,* 1972).

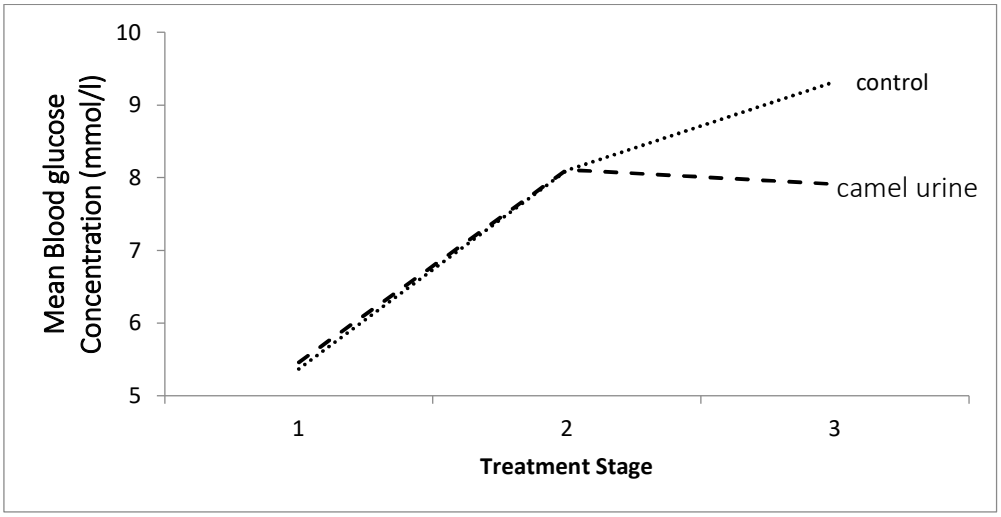
Data analyses

General Linear Model (GLM) univariate procedure was used to determine the effects of the camel urine and dose on serum glucose, TC, TG, HDL, LDL, and VLDL significant means were separated using tukey test.

RESULTS AND DISCUSSIONS

Effect of Camel Urine on Serum Glucose

Before induction all the animals were in non-diabetic state, however, after successful induction there was a sharp increase in blood glucose levels in all the rat groups. With the commencement of treatment there was a steady decline in serum glucose in groups except the control groups. The groups administered camel urine had the lowest concentration of serum glucose, while there was no decline in serum glucose in the control groups (Figure 1).

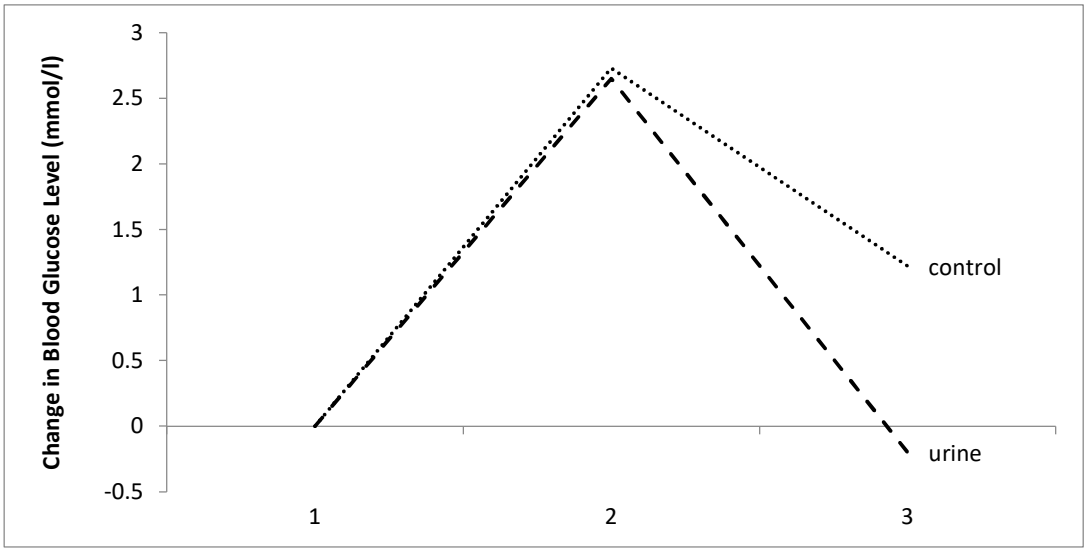


1= Pre- induction, 2= Post- induction before treatment 3= 28 days Post-treatment.

Figure 1 Change in blood glucose level among the various treatments groups

The trend indicated that the camel urine had some hypoglycemic effects that might be due some hypoglycemic factors they contain.

The rate of decline in serum glucose of the control group (Figure 2) was greater in treated groups than in the control group. In all the treated groups, serum glucose fell below pre-induction stage.



1= Pre- induction, 2= Post- induction before treatment 3= 28 days Post-treatment.

Figure 2: Rate of change in serum glucose across the treatment

The trend indicated that the drop in serum glucose in treated group is suggestive of the presence in the products of hypoglycemic factors, which was in fact reported for camel milk by Singh (2001). It is conceivable that this same factor might be present in the urine, in lower concentration.

There was significant difference in serum glucose between control group and groups administered with camel urine. Significant differences also exist among treated groups (Table 1.). Furthermore, the treatments appear to be dose dependent, where significant reduction in serum glucose was recorded with increasing in doses.

Table 1: Blood glucose levels (mmol/l) of albino rats according to treatments and doses

Treatment	**Serum glucose**
Urine	7.91^{b}
Control	9.32^{a}
SE	0.16
Dose (ml)	
1.5	7.44^{c}
1.0	7.88^{b}
0.5	7.96^{b}
0.00	9.32^{a}
SE	0.16
Interaction	NS

abc, means bearing different superscript along the same column within a subset differ (P<0.05); NS not significant

The low concentration of serum glucose in rats administered with camel urine, suggest the likely presence of the insulin-like protein, since it has been established to be present in milk (Singh, 2001), its presence in urine is therefore highly probable.

The lower concentration of serum glucose in treated rats may also be related to the report of Yadav *et al.* (2015) that some plants materials consumed by camel have anti-diabetic effects and the active ingredients are present in the body fluids such as urine and milk.

Effect of Camel milk and urine on Serum Lipids

Rats administered camel urine had significantly lower TG, TC, LDL and VLDL than the control groups. HDL was however higher (P<0.05) in the treated groups. Dose had no effect (P>0.05) on all the lipid parameters among the treated groups. Treatment x Dose interaction was also not significant (Table 2).

Table 2: Serum lipids (mg/dl) in alloxan induced diabetic rats according to treatments and doses

Treatment	**Serum Lipids (mg/dl)**				
	TC	**TG**	**HDL**	**LDL**	**VLDL**

Control	248.33[a]	237.11[a]	15.33[d]	296.11[a]	54.44[a]
Camel urine	168.78[b]	133.0[b]	29.36[c]	168.79[bc]	27.22[b]
S.E	6.68	10.22	2.04	10.50	2.00
Dose (ml)					
1.5	182.33[b]	141.22[b]	177.33[b]	33.67[a]	28.22[b]
1.0	163.89[b]	132.89[b]	160.67[b]	39.78[a]	27.44[b]
5.0	172.67[b]	137.22[b]	169.00[b]	36.78[a]	28.00[b]
0.0	248.33[a]	273.11[a]	296.11[a]	15.33[b]	54.44[a]
S.E	7.45	4.85	9.03	1.90	0.90
Treatment x Dose Interaction	NS	NS	NS	NS	NS

abcd, means bearing different superscripts along the same column within a subset differ (P<0.05)

NS = Not significant

Key: Total cholesterol (TC), Triglycerides (TG), High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL)

Hyperlipidemia is a recognized consequence of diabetes mellitus (Sherma *et al.,* 2003). Thus the higher TC, LDL, VLDL and TG in the control group than in treated groups. The higher lipid value of control group is due to DM, which led to abnormalities in lipid metabolism (Arkkila *et al.,* 2001). The increase in lipids in the control group may be attributed to excess mobilization of fat from the adipose tissue due to the under utilization of the glucose (Krishnakumar *et al*., 2000). It appears that camel milk and urine have hypolipidaemic effects because the treated groups showed significantly lower levels of these lipids (Table 3).

Since insulin has been reported to activate lipoprotein lipase (Arkkila *et al.,* 2001), an enzyme that hydrolyses triglyceride leading to low serum lipids. The presence of insulin-like protein (Singh, 2001) in camel urine will lower lipid components in camel urine treated rats. This supposition is supported by Hull, 2004 and Agrawal *et al.,* (2007b) showing that a high insulin-like factor concentration of camel urine can cause the activation of lipoprotein lipase enzyme.

The HDL level in the treated groups is higher compared to the lower group. This may probably due the presence of some enzymes in camel urine that enhance the reverse cholesterol transport system Al-Numair (2010). In addition the mechanisms by which HDL decreases in diabetes may be due to the impaired metabolism of triglycerides rich lipoprotein with decreased activity of lipoprotein lipase and impaired transfer of materials to the HDL components, in addition to the high level of hepatic lipase among diabetics (Balkis 2009). Finally, insulin resistance may be a direct cause of decrease of HDL concentration (Van Linthout *et al.,* 2010).

A significant increase in LDL and VLDL levels may lead to a significant decrease in HDL levels. The inverse relationship between VLDL and HDL (Boizel 2000) might also explain lower levels of the HDL in the control groups.

The decrease in TC and TG in the treated groups and the increase in HDL in the present study are in agreement with Hassan and Emam (2012), who reported similar findings.

CONCLUSIONS

The following conclusions were drawn from the study.

1. Camel urine reduced serum glucose in rats
2. The hypoglycemic and hyperlipidemic effects of the product is not dose dependent.

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Effects of Some Botanicals on Root Knot Nematode Population and Yield of Tomato (*Solanum Lycopersicum* L.) in Maiduguri, Nigeria

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Abstract: *The experiment was conducted under irrigation during the 2020 dry season to investigate the effects of cauliflower, Beet and cabbage leaves in management of root knot nematode (Meloidogyne spp.) on tomato (Solanum lycopersicum L.). The experiment was carried out in the Teaching and Research Farm of the Department, Agricultural Technology Ramat Polytechnic Maiduguri, Borno State, Nigeria. The experiment was laid out in a Randomized Complete Block Design (RCBD) with six (6) treatments replicated four (4) times each. Data were collected on Shoot height (cm), Root length (cm), Fresh and dry shoot weight (g), Fresh fruits (yield) weight (kg), galling index, initial and final nematode population. All data collected were subjected to analysis of variance (ANOVA) appropriate to Randomized Complete Block Design (RCBD) and means were compared using Least Significant Difference (LSD) at 5% level of significance (Statistix version 8.0). The result obtained from this experiment showed that, beet leaves are effective against plant parasitic nematodes, especially Meloidogyne spp. Compared to cauliflower, and cabbage leaves. Therefore, beet leaves could be used in managing plant parasitic nematode (Meloidogyne spp) as an alternative to synthetic nematicides which have environmental hazard in an ecosystem apart from the cost involved in it, and harmful effects to both human and animals*

Keywords: *Meloidogyne spp, Tomato (Solanum lycopersicum L),Bio fumigant*

INTRODUCTION

Tomato (*Solanum lycopersicum L.*) is one of the most important vegetables worldwide. In 2017, worldwide prodution of tomatoes totaled 170.8 million tons. China, the leading producer of tomatoes accounted for 31% of the total production. India and the United States followed with the second and third highest production of tomatoes in the world. (FAO, 2017). Tomato belongs to the *Solanaceae* family. This family also includes other well-known species, such as potato, tobacco, peppers and eggplant. Tomato has its origin in the South American Andes. The cultivated tomato was brought to Europe by the Spanish conquistadors in the sixteenth century and later introduced from Europe to southern and eastern Asia, Africa and the Middle East. More recently, wild tomato has been distributed into other parts of South America and Mexico. Common names for the tomato are: tomate (Spain, France), tomato (Indonesia), faanke'e (China), tomato (Nigeria), tomatl (Nahuatl), jitomate(Mexico), pomodoro (Italy), nyanya (Swahili) (Walling, 2016).

Tomato is an annual plant, which can reach a height of over two meters (2m). They keep growing after flowering. This feature is called indeterminate. However, under tropical

conditions, roots knot nematodes, attacks will stop growth. The plants generally have more foliage. This will keep the temperature lower within the crop and the fruits grow in the shade of the leaves. Because they are covered, the sun does not damage the fruits and they ripen more slowly. Slower ripening and a high leaf/fruit ratio improve the taste of the fruits and in particular the sweetness (Aziz, *et. al*., 2015).

In Nigeria, tomato is one of the most important vegetable crops. It is a good condiment in most diets and very cheap source of vitamins A, C and E. They contain large quantity of water, calcium and Niacin, all of which are very important in the metabolic activities of man. (Mourvaki, *et. al.,* 2015). Tomatoes are planted at an estimated rate of 85% each year and produced more in dry season. It is cultivated as a major commercial crop in Nigeria, though it's cultivation is not without limitation, and one of it is damage (infestation) caused by plant-parasitic nematodes, particularly root-knot nematodes (*Meloidogyne spp.*). This has become the major limiting factor to profitable tomato production (Allen, 2018).

Nematodes are very small worms living in the soil that feed on plant roots. Due to their small size (only a few millimeters long), it is not possible to see them with the naked eye unless with the aid of microscope. Some nematodes feed from the outside of plants, others enter the plant. All feed on the plant's sap, which can reduce the plant's productive capacity. Even greater damage can occur if viruses or fungi (pathogens) enter the plant as a result of the injuries caused by the nematodes, and then proceed to make the plant sick, and eventually die (Umar *et. al*., 2014). Root-knot nematodes are of major importance pest in tomato cultivation. Three common types of root-knot nematodes are: *Meloidogyne incognita*, *M. javanica* and *M. arenaria.*The affected plants show symptoms like stunted growth, yellowing of the leaves, wilting, and collapse of individual plants, swelling or gall on the roots. All root knot galls damage the vascular tissues of roots and thus interfere with the normal movement of water and nutrient throughout the plants. Nematodes generally are regarded as silent enemies, they cause yield losses of about 30% in tomato in the tropics (Olson, 2016).

Nematodes infestation and transmission can occur in many ways: via infected plant material, tools, rainwater and irrigation water, strong winds (which carry infested soil particles), and contaminated soil carried on shoes, or animal feet. Nematodes will survive in soil as long as it stays moist (Umar *et. al*., 2014). The use of plant extracts is one of the methods for nematodes control. They are cheap, easy to apply, produce no pollution hazards and have the capacity to improve the soil health (Simone, 2018).

MATERIALS AND METHODS

The experiment was conducted in the Teaching and Research Farm of the Department Agricultural Technology Ramat Polytechnic Maiduguri, Borno State, Nigeria. Maiduguri is located at latitude 11º51'N and longitude 13º15'E, it was on the Semi-Arid Zone, characterized by short raining season of 3 – 4 months (June-September) with an annual rainfall varying from 300mm to 650mm. Ambient temperature of 34 – 40ºC and above in the month of April and May, relative humidity ranges from 30 – 50 % with a minimum in February – March when it drops to about 10 % and maximum of 90 % in August. The experiment was laid out in a Randomized Complete Block Design (RCBD) with five (5) treatments replicated four (4) times each. The field measuring 25 x 20 meter was harrowed to

a fine tilth. Each experimental plot measured 4 × 4m with 1 m alley left between each replication and 0.5 m alley left between plots. Irrigation water was pumped through plastic pipes to convey it from the dam to the experimental plots.

Determination of Nematode Population and Extraction Technique

The initial (Pi) and final nematodes population will be determined by taking three core samples soil with a soil auger to a depth of 20 cm in a zigzag pattern from each experimental plot, mixed together thoroughly, bulked and labeled. The soil samples collected from each plot (250 cm^3) will be analysed in the laboratory to determine the plant parasitic nematode population.

The White Head and Hemming, (1965) method will be used in the extraction of nematodes from the soil samples. Two layers of tissue paper will be placed in a netted plastic basket which will be spread thinly over the surface of the plastic tray. The infested soil sample will be spread thinly over the surface of the tissue paper. Water will be poured gently in to the plastic tray until the soil sample becomes moist. Care will be taken not to over saturate the soil. The trays with moist soil samples will be left over for 24 hours. The active stage of the nematodes swim from the moist soil slowly down through the tissue paper into the tray containing water and settled at the bottom. The suspension with nematodes will be collected into 200mls beaker and the nematodes will be allowed to settle for a couple of hours. The excess water in the beaker will be poured off leaving about 50mls suspension with the nematodes. Three (3) aliquots of 5mls each was pipette from the suspension after agitation and each will be poured separately into a counting dish. The nematodes will be counted in each dish under stereomicroscope and the mean numbers recorded.

The following nematode investigation will be carried out:

i. The initial population (Pi) before application of the treatments will be determined for each experimental plot.
ii. Final nematode population (Pf) in the soil after harvest will be also determined for each experimental plot.
iii. Reproduction factor (RF); this will be determined by dividing the final population (Pf) by the initial population (Pi), that is; RF= Pf/Pi
iv. Change in nematode population: this will be determined using the formula below:

$$\frac{Pf - Pi}{Pi} \times 100$$

Where Pi ɔde population per 250cm^3
Pf= Final nematode population per 250cm^3

Measurements of Plant Parameters

Nine (9) plants per plot will be randomly selected for determination of growth and yield parameters. The parameters that will be measured include;

- Shoot height (cm): shoot height will be measured using measuring tape.
- Root length (cm): root lengths will be measured using threat and ruler.
- Fresh and dry shoot weight and fresh and dry root weights will be measured using sensitive electronic weighing balance.

- Fresh fruits (yield) weight (kg) per plot: fresh fruit weight will be determined using a weighing scale.
- Number of galls on roots: To assess the extent of galling on the roots each treatment, nine (9) samples from each plot will be selected randomly and tagged. These will be carefully uprooted at the end of the experiment. The roots of the uprooted plants will be washed in clean water to remove soil and dirt. The roots will be examined for galls using hand lens. The number of the galls found will be counted and indexed according to the indexing scale of Ibrahim and Lewis, (1985).

Galling Index Scale

0. 1-2 galls (completely resistant)
1. 3-10galls (moderately resistant)
3. 11-30 galls (resistant)
4. 31- 100 galls (slightly resistant)
5. More than 100 galls (susceptible).

RESULTS AND DISCUSSIONS

Table 1: Effects of Carbofuran, Cauliflower, Beet, and Cabbage fresh leaves on total population of root knot nematodes (*Meloidogyne spp.)* on tomato plant

Treatments	Initial Population (Pi)	Final Population (Pf)	% Change In Population	Reproduction Factor (RF) (Pf/Pi)
Cauliflower leaves 100g/stand	95	45	-111.1	0.4
Beet leaves 100g/stand	91	30	-203.3	0.3
Cabbage leaves100g/stand	88	41	-114.6	0.4
Carbofuran 2g a.i3G/stand	87	24	-262.5	0.2
Control	93	108	13.8	1.1

Values are means of three replicates.

Key

Percentage (%) change in population = $\frac{Pf - Pi}{Pi} \times 100$

+ = increase in population

– = Decease in population

Effects of Cauliflower, Beet, Cabbage leaves and Carbofuran on total population of root knot nematodes (*Meloidogyne spp.)* on tomato plant.

Table 1 shows effect examined on nematode population in the soil after the treatments. From the result obtained (table 1), it is shown that significance difference was observed in soil nematode population with all treatments at initial and final nematodes population. The highest number of nematode population (108) was recorded under control plot and the least number of nematode populations (24) was recorded under carbofuran, followed by plot treated with Beet (30), Cabbage (41) and Cauliflower leaves (45). Percentage changes in population were also recorded. Carbofuran had the highest decrease percentage in population (-262.5), followed by plot treated with Beet (-203.3), Cabbage (-114.6) and Cauliflower leaves (-111.1), While the increase percentage in population (+13.8) was observed under untreated (control) plot. Furthermore, Reproductive Factor (RF) were also recorded, Carbofuran had 0.27, Cauliflower0.47, Beet 0.32, Cabbage leaves 0.46 and Control 1.16. Reduction in the nematode population was recorded and this was attributed to the production of namaticidal compound during the breakdown of organic materials incorporated in the soil as observed by khan *et al*., (2013). Many of *Brassicaceous* plant residues contain high quantities of sulfur compounds called glucosinolates (GLSs) which can be converted (into soil during bio-decomposition) to isothiocyanates and other related compounds by enzymatic hydrolysis occurred by the endogenous myrosinase. Isothiocyanates are highly toxic to plant-parasitic nematodes, many plant pathogens and insects. Other phytochemical constituents found in brassicaceous plants such as phenols and ascorbic acids, may compliment the activity of GLSs (Zasada and Ferris, 2004; Antonious *et. al*., 2009 and Avato *et. al*., 2013). Therefore, the nematicidal activity of cauliflower, cabbage and beet leaf in the current study was attributed to presence of GLSs and their derivatives which control the effect of nematodes in the soil.

Table 2: Effects of Carbofuran, Cauliflower, Beet, and Cabbage fresh leaves on plant height (cm), fresh and dry shoot weight (g)

Treatments	Plant height (cm)	Fresh shoot weight (g)	Dry shoot weight (g)
Cauliflower leaves 100g/stand	44.3^{b}	123.0^{b}	54.6^{b}
Beet leaves 100g/stand	56.0^{a}	159.0^{a}	73.0^{a}
Cabbage leaves100g/stand	42.0^{b}	111.3^{b}	50.3^{bc}
Carbofuran 2g a.i3G/stand	60.0^{a}	175.6^{a}	82.0^{a}
Control	41.0^{b}	85.0 ^{c}	41.3^{c}
SE±	4.1	9.1	4.7

Values are means of three replicates.
Number in the column with the same letter has no significant difference.

Effects of Carbofuran, Cauliflower, Beet, and Cabbage fresh leaves on plant height (cm), fresh and dry shoot weight (g). Table 2 shows the effect of plants height (cm), Beet leaf and carbofuran had significant difference among the treatments (P≤ 0.05) effect on plant height (Table2). The result revealed that tallest plants (60.0 cm) were recorded under plot treated with carbofuran, followed by beet leaves (56.0 cm), Cauliflower leaf 44.3 cm and cabbage leaf with 42.0 cm. While the shortest plants height was recorded under control, which was recorded as 41.0 cm.

Beet leaf and carbofuran had significant difference among the treatments (P≤ 0.05) on fresh shoot weight (g). And there is also a significant difference between the control and other treatments (Table2). However, highest fresh shoot weight was registered under carbofuran with 175.6 g, followed by beat leaf with 159.0 g, Cauliflower leaf with 123.0 g and cabbage leaf with 111.3 g. The lowest fresh shoot weight was recorded under untreated plot (control) with 85.0 g.

There is no significant difference between treatments with beet leaves and carbofuran, but significant difference exist among the other treatments (P≤ 0.05) in dry shoot weight (Table2). The highest dry shoot weight was recorded under carbofuran with 82.0 g, followed by the beat leaf with 73.0 g, Cauliflower leaf with 54.6 g and cabbage leaf with 50.3 g respectively. While the lowest dry shoot weight was registered under control with 41.3 g.

Table 3: Effects of Carbofuran, Cauliflower, Beet, and Cabbage fresh leaves on Root length (cm), fresh and dry root weight (g) and number of galls in roots

Treatments	Root length (cm)	Fresh root weight (g)	Dry root weight (g)	Root galls index
Cauliflower leaves 100g/stand	22.6^{c}	62.3^{c}	48.0^{b}	19.3^{b}
Beet leaves 100g/stand	26.6^{ab}	73.6^{ab}	63.6^{a}	13.0^{c}
Cabbage leaves100g/stand	23.0^{bc}	63.3^{bc}	56.3^{ab}	18.6^{b}
Carbofuran 2g a.i3G/stand	27.3^{a}	78.0^{a}	66.0^{a}	08.3^{d}
Control	23.3^{bc}	60.0^{c}	50.3^{b}	27.0^{a}
SE±	1.6	4.9	5.4	1.0

Values are means of three replicates.
Number in the column with the same letter has no significant difference.

Table 3 shows the effects of Carbofuran, Cauliflower, Beet, and Cabbage fresh leaves on Root length (cm), fresh and dry root weight (g) and number of galls in roots. There is no significant difference between cabbage leaf and the control, but there is significant difference among the other treatments (P≤ 0.05) on root length (Table 3). However, the longest root length was observed under carbofuran with 27.3 cm, followed by the beat leaf with 26.6 cm,

and Cauliflower leaf with 22.6 cm. The shortest roots length was observed under the cabbage leaf with 23.0 cm and control with 23.3 cm. While according to (Liman *et. al.,* 2010), the same pattern of improved growth was also observed by the root length of tomato with the used of different organic amendments.

The result shows no significant difference between cauliflower and control, but significant difference exists among the other treatment (P≤ 0.05) on fresh root weight (Table 3). However, the highest number of weight was observed under carbofuran with 78.0 g, followed by the beet leaves with73.6 g, and cabbage leaves with 63.3 g. The least number of weights was registered under control with 60.0 g and cauliflower leaf with 62.3 g.

The effect of the treatments on dry root weight (g), the result obtained shows that there is no significant difference between the beet leaf and carbofuran, but there was a significant difference between them (beet leaf and carbofuran) and the other treatments (P≤ 0.05) on dry root weight (Table 3). However, the highest weight was recorded under carbofuran with 66.0 g, and then followed by beet leaf with 63.6 g, cabbage leaf with 56.3 g and control with 50.3 g respectively. The lowest weight was recorded under Cauliflower leaf with 48.0 g.

Significant difference between all the treatments on root galls was observed (Table 3). The untreated plot (control) gives the highest number of root galls (27.0) than the treated plots. Plot treated with carbofuran gives the lowest number of root galls with 8.3, followed by beet leaf with 13.0. Liman *et. al.,* (2010) reported that significant variation in the extent of root galling in tomato treated with different plant the leaves extracts. All the extracts displayed significantly lower number of galls over the untreated control.

Table 4: Effects of Carbofuran, Cauliflower, Beet, and Cabbage fresh leaves on fresh fruits yield weight (kg)

Treatments	Yield weight (kg)
Cauliflower leaves 100g/stand	11.3^{c}
Beet leaves 100g/stand	13.6^{b}
Cabbage leaves100g/stand	11.0^{c}
Carbofuran 2g a.i3G/stand	16.0^{a}
Control	8.0^{d}
SE±	0.8

Values are means of three replicates.
Number in the column with the same letter has no significant difference.

Effects of Carbofuran, Cauliflower, Beet, and Cabbage fresh leaves fresh fruits yield weight (kg). Significant difference was observed (P≤ 0.05) on increases in yield to all treatments, compared to untreated plot (control) (table 4). The result obtained shows that plot treated with carbofuran produced the highest fresh fruit weight (16.0 kg) and then followed by the plot treated with beet leaves with 13.6 k g, Cauliflower with 11.3 kg, Cabbage with11.0 kg and the least number of fruit weight was produced by control with 8.0 k g. The observed

behaviour of tomato fruit yield in the experiment was in line with the report of Dantata *et. al*., (2011). Found that, growth and yield of tomato was response to application of different plant leaves.

Discussion

The result obtained from this experiment showed that, beet leaves are effective against plant parasitic nematodes, especially *Meloidogyne spp.* Compared to cauliflower, and cabbage leaves. Therefore, beet leaves could be used in managing plant parasitic nematode (*Meloidogyne spp*) as an alternative to synthetic nematicides which have environmental hazard in an ecosystem apart from the cost involved in it, and harmful effects to both human and animals (Khan *et al*., (2013) Reported that, many of *Brassicaceous* plant residues contain high quantities of sulfur compounds called glucosinolates (GLSs) which can be converted (into soil during bio-decomposition) to isothiocyanates and other related compounds by enzymatic hydrolysis occurred by the endogenous myrosinase. Isothiocyanates are highly toxic to plant-parasitic nematodes, many plant pathogens and insects. Other phytochemical constituents found in brassicaceous plants such as phenols and ascorbic acids, may compliment the activity of GLSs. Therefore, the nematicidal activity of cauliflower, cabbage and beet leaf in the current study was attributed to presence of GLSs and their derivatives which control the effect of nematodes in the soil.

While according to (Liman *et. al.,* 2010), the same pattern of improved growth was also observed by the root length of tomato with the used of different organic amendments. Similarly, Liman *et. al.,* (2010) reported that significant variation in the extent of root galling in tomato treated with different plant the leaves extracts. All the extracts displayed significantly lower number of galls over the untreated control. The observed behaviour of tomato fruit yield in the experiment was in line with the report of Dantata *et. al*., (2011). Found that, growth and yield of tomato was response to application of different plant leaves.

In Conclusion, The result obtained from this experiment showed that, beet leaves are effective against plant parasitic nematodes, especially *Meloidogyne spp.* Compared to cauliflower, and cabbage leaves. Therefore, beet leaves could be used in managing plant parasitic nematode (*Meloidogyne spp*) as an alternative to synthetic nematicides which have environmental hazard in an ecosystem apart from the cost involved in it, and harmful effects to both human and animals.

Recommendation

Based on the above findings of the study, it was recommended that, farmers should adopt the using of plants bio fumigants (beet leaves) to serve as a means of controlling plants parasitic nematodes (*Meloidogyne spp*) in the soil. Bio-fumigants are affordable, environmentally friendly and easy to handle by the farmers, as well as less or no toxicity to both human and animals.

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The Effects of Varying Forms of Sickle Senna (*Cassia Tora)* on the Growth and Performance of Sorghum in Northern Sahel Savannah of Nigeria

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Abstract: *The research was carried out at the screen house of the Ramat's Research and Teaching farm, Ramat Polytechnic Maiduguri to evaluate the different varieties of sorghum grown under two soil type as a way of reducing overreliance on inorganic fertilizer. Hence, estimating a better form of soil towards bumper farming practice grown on top and subsoils of Northern Sahel Savanna. The specified growth parameters were plant height, stem girth, leaf number, leaf area, leaf width, and leaf length all at 4, 6 and 8 WAP. There was a significant effect of different forms of Cassia tora when the specified growth parameters were analyzed using ANOVA. The result of this study showed that freshly crushed (FC) and crushed, dried and ground (CDG) forms of the amendment material were significantly different from the control and chopped, dried and burnt (CDB).*

Keywords: *Cassia Tora, Green Manure, Sorghum, ICSVIII, Fara Fara, Northern Sahel Savanna*

Introduction

The needs to use renewable forms of energy and reduce the cost of fertilizing crop have revived the use of organic fertilizer worldwide. *Cassia tora* (sub-family: Caesalpinioideae; Family: Leguminosae/Fabaceae) is a small shrub which grows up in warm moist soil throughout the tropical parts of Asian and African countries. It is known by different names in different places like wise Foetid *Cassia tora*, Sickle Senna, Wild Senna, Sickle Pod, Coffee Pod, Tovara, Chakvad, Ring-worm Plant. *Cassia tora* as one of the freely available weed biomasses can be utilized for manuring purpose which helps the poor farmers in weed control, soil and crop improvement. Incorporating of *Cassia tora* into the soil adds nutrients to the soil thereby improving water retention, aeration, structure, texture, permeability and fertility of the soil as these factors that influence crop growth and development.

The cost of in-organic fertilizer is hazardous to the farmer and the general public whose sources food is from those in-organically produced crops. The general problem of the synthetic materials to the ecosystem also needs to be addressed in-order to safeguard the globe from the harmful effect of these chemicals. Organic farming is one of the important management practices that can tackle these problems.

In developing countries like Nigeria, the population growth rate is so high that improved technologies including rational use of fertilisers must be employed to meet the food

requirement of the people (Beyenesh and Nigussie., 2018). Improved soil fertility through the application of fertilisers is an essential factor enabling the world to feed the billions of people that are added to its population (Brady and Weil, 1999).

Apart from the high cost of in-organic fertilizer, its health hazard on the farmer and the general public, when only inorganic fertilisers are used in highly weathered soils of the tropics like the one we have here in Maiduguri, poor physical structure and nutrient retention characteristics would adversely affect crop growth. Declining soil fertility is a major production constraint in Africa, especially in Nigeria, and it is becoming increasingly critical to secure sustainable soil productivity. The negative effects of the synthetic materials to the ecosystem need to be addressed effectively in-order to safeguard the environment from the harmful effect of these chemicals. Organic farming is one of the important management practices that can tackle these problems. At the end of this research *Cassia tora* which has been a weed all over the study area can be use alternatively as a source of nutrients to the soil, and of course this weed plant can be a major control to soil acidity which occurs by frequent use of in-organic nitrogenous fertilizers.

The research targets the evaluation of different varieties of sorghum grown under two soil type as a way of reducing overreliance on inorganic fertilizer. Hence, estimating a better form of soil towards bumper farming practice.

Methodology

Experimental site:

The experiment will be conducted at the Teaching and Research Farm of Ramat Polytechnic, Maiduguri latitude 11º 50” 35.40 N and longitude 13º 07” 45.05 E using sorghum variety popularly known as fara-fara.

Experimental Design and Treatments:

The experiment will be laid out in a Completely Randomized Block Design (CRBD) with three replications and 5 treatments. The treatments will consist of 4 forms of *Cassia tora* namely: chopped, dried and ground (CDG); Chopped, dried and burnt (CDB); freshly crushed and dried (FCD), freshly crushed (FC) and sorghum variety as second factor (T1= ICSVIII; and T2= fara fara) soil type as the third factor (S1= topsoil; and S2= subsoil). Which gives a total of 4x2x2+16 treatments replicated 3 x to have a total of 48 experimental units.

Sorghum seeds was planted when the rain is fully established as being practiced by the farmers in the area. Five to 10 seeds were planted per hole of 3cm to 5cm depth dug using a hoe. The seedlings were later thinned to two plants per stand one week after germination as recommended (Usman et al., 2017) number of days to germination, while growth parameters assesment of plant height, leaf area index, stem girth, leaf width, leaf length and leaf number. All data collected will be subjected to Analysis of Varience (ANOVA) using PROC GLM of the Statistical Analysis System (SAS, 2003). Duncan’s multiple range test at $P<0.05$ will be use to separate the means.

Table 1. Physicochemical properties of the soil and green manure under study area

	Value		Cassia tora	
Parameters	**Top Soil**	**Sub Soil**	**Parameters (%)**	**Value**
pH (H_2O)	6.2	5.7	N	2.07
Organic Matter (%)	0.56	0.46	C	3.46
Total N (%)	0.06	0.03	C:N	1.64
Available P (ppm)	26	16	K	1.31
Exchangeable Bases (cmol/kg)			P	0.44
K	0.10	0.04	Ca	3.13
Na	0.06	0.04	Na	0.02
Mg	0.3	0.04	Crude Protein	16.6
Ca	1.6	1.3	Crude Fibre	16.6
Particle Size (%)			Ash	15.3
Sand	68.01	78.01	Dry Matter	93
Silt	22.00	12.00		
Clay	10.00	10.00		
Textural Class (USDA)	Sandy Loam	Sandy		

RESULTS AND DISCUSSION

Table 1 displays the soil properties with pre-planting analysis of the top and subsoil used indicated that the topsoil is more fertile than the subsoil which was collected from 30-46 cm below the soil surface,

A. Effects of different forms of Cassia tora, variation and soil type on growth performance of sorghum plant

The analysis (ANOVA) on the data collected at 4, 6 and 8 WAP shows a significant main effect of Cassia tora forms, variety and soil type, with variety having no significant effect for plant height at 4 and 8 WAP, leaf area at 8 WAP and leaf number at 4, 6, 8 WAP.

There was no significant ($p<0.05$) interaction effect between the three factors for this experiment as shown in Table 2.

B. Effect of Cassia tora forms on the growth of sorghum plant

Freshly crushed form of Cassia tora (FC) was statistically significant ($p<0.05$) from other forms of green manure, with the highest mean value of 67.71, 99.91, 121.44 for plant height at 4, 6 and 8 WAP correspondingly, however with higher mean value than crushed, dried and ground (CDG) they were still not significantly different from one another statistically at 6 and 8 WAP with a mean value of 98.21 and 119.33 respectively, and the lowest

The control treatment with 28.99, 52.30 and 78.66 at 4, 6 and 8 WAP was recorded as the means as presented in Table 3.

The same procedure was experienced for stem girth were freshly crushed form of Cassia tora has the highest mean value of stem girth with 6.10, 9.76, and 11.31 at 4, 6 and 8 WAP respectively, while the control treatment recorded the lowest mean value of 5.20, 6.05 and 4.68 at 4, 6 and 8 WAP respectively. The freshly crushed form was significantly better ($p<0.05$) statistically than other treatments with the exception of crush, dried and ground (CDG) at 6 WAP for stem girth, though with

a lower mean value (9.65) than that of freshly crushed (9.76), still were not significantly different from one another as presented in Table 3.

For the leaf length, the freshly crushed form also had the highest mean value of 42.63, 67.73 and 75.64 at 4, 6 and 8 WAP respectively, while the lowest mean value was recorded for the control treatment with a mean value of 20.14, 33.04, and 24.40 in that order as presented in Table 3. It can also be noted that crushed, dried and ground (CDG) form though with lower mean value than the freshly crushed, they still didn't differ significantly ($p<0.05$) from one another at 4, 6 and 8 WAP.

Comparable trend was observed for leaf width, where freshly crushed form of Cassia tora has the highest mean value of leaf width with a mean value of 4.24, 6.68, and 7.16 at 4, 6 and 8 WAP respectively, while the lowest mean value was recorded for the control treatment with a mean value of 1.90, 3.24, and 3.74 at 4, 6 and 8 WAP in that order, CDG having a lower mean value at 6 and 8 WAP (6.48 and 6.99), but still not significantly different from the freshly crushed form of the green manure.

Freshly crushed and CDG were significantly better statistically than the control and CDB (crushed, dried and burnt). The highest mean value was recorded for freshly crushed treatment with a mean value of 137.76, 340.22 and 407.22 at 4, 6 and 8 WAP, while the control treatment has the lowest mean value of 29.78, 82.44 and 120.19 at 4, 6 and 8 WAP respectively.

There was also a significant main effect of Cassia tora form on leaf number with freshly crushed having the highest mean value of 7.44, 9.69 and 11.62 at 4, 6 and 8 WAP and significantly different from the control treatment and CDB treatment at 6 WAP, with the control having the least mean value of 5.56, 7.81 and 6.69 at 4, 6 and 8 WAP respectively as presented in Table 3.

A. Effect of Variety on the Growth of Sorghum Plant

The improved sorghum variety (ISCV111) performed significantly better statistically ($p<0.05$) than the local variety (fara fara) across the growth parameters analyzed as presented in Table 3. ICSV111 has higher mean value for plant height with a mean value of 53.15, 90.34 and 113.16 at 4, 6 and 8 WAP in that order, though not significantly different from fara fara at 4 WAP, the fara fara has a mean value of 52.86, 83.82 and 104.93 at 4, 6 and 8 WAP respectively.

Similar trend was observed for stem girth, leaf length, leaf width and leaf area, but leaf area at 8 WAP the two varieties were not significantly different from one another though with ICSV111 having higher mean value of 301.21 while fara fara had a mean value of 298.12.

The two varieties didn't differ significantly ($p<0.05$) from one another for leaf number at 4, 6 and 8 WAP even though ICSV111 had higher mean value of 6.75, 8.90 and 11.00 at 4, 6 and 8 WAP respectively, while fara fara has a mean value of 6.65, 8.80 and 10.73 at 4, 6 and 8 WAP respectively as presented in Table 3.

B. Effect of Soil Type on Growth of Sorghum Plant

Topsoil (T1) perform significantly better statistically ($p<0.05$) than subsoil (T2) across all the parameters measured and analyzed as presented in Table 3. The topsoil has higher mean value for plant height with a mean value of 52.93, 90.12 and 111.83 at 4, 6 and 8 WAP respectively, while subsoil has a mean value of 45.70, 84.04 and 106.26 at 4, 6 and 8 WAP in that order.

The similar trend was observed in other parameters (stem girth, leaf length, leaf width, leaf area and leaf number), all with topsoil being significantly better statistically than subsoil at 4, 6 and 8 WAP as shown in Table 3.

Table 2. A two-way ANOVA table showing mean values of sorghum plant height (cm), girth (mm), leaf length (cm), leaf width (cm), leaf area (cm^2) and leaf number at different growth stages,

Treatments	Plant Height			Stem Girth			Leaf length			Leaf Width			Leaf Area			Leaf number		
	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8	4	6	8
C	**	**	**	ss	tt	ss	ss	ss	ss	ss	ss	ss	ss	ss	ss	as	ss	ss
V	ns	s*	ns	*	s	ss	s	ss	s	ss	ss	s	s	s	ns	ns	ns	ns
S	ss	ss	ss	**	**	s*	s*	s	s	ss	ss	ss	ss	ss	ss	ss	ss	ss
Interactions																		
Cx V	ns	ns	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CxS	ns	ns	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
V x S	ns	ns	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CxVxS	ns	ns	ns	ns	ns	ns	Ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV	7.32	4.01	6.30	11.48	8.51	10.76	8.13	10.24	9.61	7.92	12.82	11.78	9.30	7.86	8.97	12.77	11.85	10.06

NB: C= Cass/a *low* forms; V= Variety; S= Soil Type; CV= Coefficient of Variation; ns= not significant, *=significant at <0.05 level; **= significant at <0.01 level

Table 3. Mam effects of *Cassia tora* forms, variety and soil type on sorghum plant height (cm), girth (mm), leaf length (cm), leaf width (cm), leaf area (cm^2 ■) and leaf number at different growth stages.

Treatments	Plant Height			Stem Girth			Leaf length			Leaf Width			Leaf Area			Leaf number		
	4	6	8	4	6	8	4	6	3	4	6	8	4	6	3	4	6	3
Cassia t org Forms (S) LSD	3.19	4.88	6.86	0.38	0.52	0.63	4.06	3.27	3.55	0.43	0.39	0.38	24.04	32.15	36.05	0.81	0.84	0.88
C_1 (control)	28.99d	52.30c	78.66c	2.84d	5.20c	6.05d	20.14c	33.04c	42.40c	1.90c	3.24c	3.74c	29.78c	82.44c	120.19c	5.56c	7.81c	9.69b
C_2(CDG)	55.86b	98.21a	119.33a	5.60b	9.65a	10.47b	40.15a	65.12a	72.47a	3.78b	6.48a	6.99a	115.64ab	317.88a	381.38a	7.31a	9.44a	11.50a
C_3(CDB)	47.73 c	91.26b	109.78b	4.76c	8.94b	9.82c	35.93b	58.38b	67.82b	3.39b	5.89b	6.43b	96.41b	261.04b	329.39b	6.33a	8.75bc	10.94a
C_4(FC)	67.71a	99.91a	121.44a	6.10a	9.76a	11.31a	42.63 a	67.73a	75.64a	4.24a	6.68a	7.16a	137.76a	340.22a	407.22a	7.44a	9.69a	11.62a
Variety (V) LSD	1.43	2.18	3.07	0.17	0.23	0.28	1.82	1.46	1.59	0.19	0.18	0.17	10.76	14.38	16.13	0.36	0.38	0.39
ViOCSVIll)	53.15a	90.34a	113.16a	5.30a	3.84a	9.93a	38.80a	59.88a	68.00a	3.72a	5.93a	6.44a	114.68a	279.53a	301.21a	6.75a	8.90a	11.00a
V_2(Fara Fara)	52.86a	83.32b	104.93b	4.52b	8.32b	9.29b	31.82b	54.85b	63.17b	3.03 b	5.46b	5.99b	78.26b	237.93b	298.12a	6.65a	8.80a	10.73 a
Soil Type (S) LSD	1.43	2.18	3.07	0.17	0.23	0.28	1.82	1.46	1.59	0.19	0.18	0.17	10.76	14.38	16.13	0.36	0.38	0.39
Si (Top Soil)	52.93a	90.12a	111.83a	5.28a	8.87a	10.00a	37.71a	59.48a	67.75a	3.60a	5.90a	6.42a	108.31a	274.72a	337.40a	7.13 a	9.23 a	11.23a
S_2 (Sub Soil)	45.70b	84.04b	106.26b	4.54b	8.29b	9.22b	32.91b	55.25b	63.93b	3.15b	5.49b	6.01b	84.63b	242.74b	301.94b	6.28b	8.43 b	10.50b

NB: Means with the same letter with in same column of either of the treatments are not significantly different; CDG (Crushed, Dried and Ground); CDB (Crushed, Dried and Burnt); FC (Freshly Crushed); LSD (Least Sign ificantDjffe rent

DISCUSSION

The performance of the test crop (Sorghum) was significantly affected by the application of different forms of Cassia tora, freshly crushed (green manure) improved the growth performance of sorghum, which is related to the assertions by Bhuma et al. (2001) who reported that green manures have some growth promoting capability apart from its nutrient content (which is low compared to inorganic fertilizes), and the results obtained were in accordance to the findings of Chamle (2007) who reported leafy green manure having the capability of improving the growth performance of Spinach, due to better uptake of nutrients from the soil. According to Mathaura (2010), green manure can lead to increase in the growth of root, stem and leaf which will result in better crop yield. Similarly, the green manure inoculated field has an improved soil structure, which can be a reason for better crop development (Rao et al., 2011).

The improved sorghum variety (ICSV111) did better than the local variety (fara fara) and that can be due attributed to the growth and yield contractions of the local varieties dated back 1970s as a result of African drought, that made researchers to develop a drought- resistant variety which has higher growth performance potentials and ICSV111 comes into existence from that efforts (Dendy 1994) an improved variety is always expected to have better growth potentials than a local variety (Arunah et al., 2006).

Topsoil contains more nutrients than the subsoil as presented in Table 1. Though the subsoil also did better with application of green manure, but still the gap in nutrient content of the two soil types become a reason the topsoil did significantly better statistically ($p<0.05$) as stated by Agbede et al., 2008).

CONCLUSION

Green form of Cassia tora (freshly crushed) can improve the growth performance of sorghum plant in marginal soils, either with an improved variety or a local variety of the crop, they all responded well to the application of the green manure more than the control and other treatments. The improved variety (ICSV111) can be used in substitute to the local variety (fara fara).

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Growth Performance of Rabbits Fed with Different Level of M.Balsamina (Balsam Apple)

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Abstract: *The effect of graded levels of Mormodica balsamina inclusion in the diets of rabbits on growth, haematological, biochemical indices and carcass characteristics of rabbits was determined. Four diets were formulated, comprising treatment 1(control), 2, 3 and 4 at 0%, 2.5%, 5% and 7.5% levels of M. balsamina respectively. Thirty six adult rabbits of mixed breeds were used for the experiment and were allotted to the four treatments (1, 2, 3, and 4) with three rabbits per replicate and twelve rabbits per treatment in a randomized complete block design. The data generated was subjected to analysis of variance (ANOVA). Where significant differences exist, least significant difference (LSD) was used to compare the means. The trial lasted for 12 weeks. The growth performance of the rabbits was not significant across the treatment, except for the final weight and feed conversion ratio being higher in treatment 4. Effects of the diets on haematology and serum chemistry shows that M. balsamina inclusions at these levels had no harmful effect on red blood cell counts, white blood cell counts, packed cell volume and haemoglobin. All the parameters differed significantly (P<0.05) with the exception of mean corpuscular haemoglobin which show a significant difference among treatments. The cholesterol, creatinine and the blood urea levels were significantly varied. The carcass evaluated showed significant difference in the weight of the liver and the lungs which may indicate the slight anti-nutritional effect of the M. balsamina on the physiology of the rabbits.*

Keywords: *Breed, Diet, Growth, Performance and Rabbit*

1.0 INTRODUCTION

1.1 Background to the Study

The animal protein content of a typical Nigerian diet is about 17% of the total protein requirement, which is lower than 60% in the United Kingdom and 71% in New Zealand (World Bank, 2001). In Nigeria, consumption of animal protein remains low at about 6.0-8.4g/head/day which is far below the 13.5g per day recommended by the WHO (Egbunike, 1997). Pagot (1992) predicted a decline in protein intake to 5.3g per head per day by the year 2010 which would be the lowest in the world. The myriad attempt aimed at solving low protein intake and poverty alleviation by Nigerian government still remains a mirage (Nworgu and Hammed, 2009).

The reasons behind this inadequate intake of animal proteins includes short supply of animal products due to poverty, general economic recession and low level of production of

the indigenous breeds of animals (Ogunbosoye and Babayemi, 2010). In order to maximize food production and meet protein requirements in Nigeria, viable options need to be explored and evaluated (Owen *et al*., 2008). Among such alternatives is the use of livestock species such as rabbit that have great potential for improved production (Owen *et al*., 2008)

Improved rabbit production can help in boosting the protein supply in Nigeria. Animal protein production from cattle, sheep and goat require much capital as compared to rabbit which has small body size and short gestation interval. Fast-growing animals such as rabbits possess a number of features that might be of advantage to the small holder subsistence – type integrated farming especially in developing countries. The potentials and attributes of rabbit which makes it unique among farm animals include, high growth rate, high efficiency of conversion, short gestation period, and high prolificacy, low cost of production, high quality (meat which includes low fat, sodium, and cholesterol levels). Rabbit meat has a high protein level (about 20.8%) and its consumption is bereft of cultural and religious biases (Biobaku and Oguntona, 1997), it also has excellent quality attributes (Jibir *et al.,* 2014).

Increasing demand and subsequent high cost of conventional animal feed ingredients coupled with increase in human population has created the need for sustainable alternatives, particularly natural feed resources (Onwuka *et al.,* 1989; Abubakar and Mohamed, 1992; Osagie, 1998; Tian *et al.,* 1998). The use of forages and other agricultural by-products such as *Tridax precumbens* (Taiwo *et al*., 2005) Moringa (*Moringa oleifera*) (Odeyinka *et al*., 2008), Acacia (*Acasia nilotica*) (Abdu *et al*., 2011), composite cassava meal (Ukachukwu *et al*., 2011), and *Commelina benghalensis*, *Leucerna leucocephala, Boerhavia diffusa, Impomia triloba* (Yakubu *et al*., 2012) have been documented.

The physiology of farm animals is affected by several factors, one of which is nutrition (Ajao *et al.,* 2013). Nutritional status of an individual is dependent on dietary intake and effectiveness of metabolic processes. These can be determined by combinations of chemical, anthropometric, biochemical or dietary methods (Bamishaiye *et al.,* 2009). Feed is an important aspect of livestock production. The importance of feed supplementation in animal production has increased in the last few years (Sharifi *et al.,* 2011). Increase in meat production can be achieved through proper nutrition and inclusion of feed ingredients at normal or required levels (Etim and Oguike, 2010). According to Schalm *et al.* (1975), the blood pictures of animals might be influenced by certain factors one of which is nutrition. Addass *et al.* (2012) also posited that nutrition affects blood values of animals. Processing of feed could have effect on haematological parameters of farm animals (Aya *et al.,* 2013). Dietary content affect the blood profile of healthy animals as reported by (Odunsi *et al.,*1999; Yeong, 1999; Iheukwumere and Herbert, 2002; and Kortuglu *et al.,* 2005).

Isaac *et al.* (2013) stated that haematological components which consists of red blood cells, white blood cells or leucocytes, Mean Corpuscular Haemoglobin and Mean Corpuscular Haemoglobin Concentration are valuable in monitoring feed toxicity, especially, with feed constituents that affect the blood as well as the health status of farm animals. Aro and Akinmoegun (2012) and Aro *et al.* (2013) reported that haematological parameters like haematocrit value, haemoglobin concentration, white blood cell count and red blood cell count are used in routine screening for the health and physiological status of livestock and even humans. Aderemi (2004) reported that haematological traits especially Packed Cell Volume (PCV) and Haemoglobin (Hb) are correlated with the nutritional status of the animal.

Isaac *et al.* (2013) stated that RBC is involved in transport of oxygen and absorbed nutrient. Blood viscosities are however, also affected by nutrition, especially, when processed agro-industrial wastes are taken into consideration. Livestock blood, for instance, may be subjected to hyperviscosity syndrome consequent on the feed they consume which may ultimately affect other blood values including haematocrit and erythrocyte sedimentation rate (Rosencranz and Bogen, 2006; Aro *et al.,* 2013).

M. balsamina L is commonly known as African pumpkin (or African cucumber), Balsam apple (or balsam pear) and locally called "Garahuni" (Hausa language), (Roger, 2007). It is a very good source of seventeen essential amino acids (Hassan and Umar, 2006). The plant is a perennial herb with soft stems and tendrils that climbs up shrubs, boundary fields and fences. The green leaves are deeply palmately 5-7 lobes about 12cm long with toothed and stalked margine. *M. balsamina* produces spindle shaped fruits (dark green when unripe and bright to deep orange when ripe). The seeds are embedded into a sweet edible red fleshy pulp testing like watermelon (Welman, 2004).

1.2 Problem Statement

Rabbit production is a veritable way of alleviating animal protein deficiency in Nigeria (Ajala and Balogun, 2004), but kitten mortality and poor performance are among the factors leading to lower productivity. One of the ways of mortality reduction and enhanced productivity is the use of feed additives such as *M. balsamina.* It is used in humans where it is believed to help mothers to regenerate lost blood during parturition and to purify breast milk. Roodt, (1998); Bandiera et al., (2001) has reported the medicinal value of *M. balsamina*, but despite this, the plant has not been given due research attention in terms of its effect on the performance of rabbits. However the test ingredient being relatively unknown, there is a need to test for possible toxicity, for which it is necessary to carry out heamatological screening.

1.3 Justification

In recent years, natural compounds produced by micro-organisms (probiotics, bacteriocins), plants and their extracts have received increased attention as potential alternatives for growth promoters in several animals, due to their antimicrobial activity (Lewis *et al*., 2003; Laukova *et al*. 2006; Marcin *et al*. 2006; Simonova *et al*. 2008). While most of the studies deal with the moderating effects of the environment, feeds, genetic, and biological (age and weight) factors as well as those of technological (pre slaughter, transportation, processing) conditions on rabbit carcass and meat quality (Dalle Zotte 2002), the results concerning the influence of natural substances (probiotics) or herbal plants on rabbit performance and blood chemistry have not yet been reported, except the oxidative stability of muscle tissues in rabbits (Botsoglou *et al,.* 2004).

Many feed products are fed to rabbits usually without recourse to their health and physiological implications on the animals. The commonest parameter for measuring these implications

2.0 MATERIALS AND METHODS

2.1 Location of Experiment

The experiment was conducted at the Animal Farm of department of Animal science, College of Agriculture, Umaru Ali Shinkafi Polytechnic Sokoto. Sokoto state is located in the North-western part of Nigeria between (latitude 13º1m N and longtitude 5º15m E). The state has a maximum temperature of 41ºC and minimum of 13ºC in April and January respectively (Mamman *et al*., 2000). Sokoto State is characterized by alternating rainy and dry seasons.

The annual rainfall is about 700mm per annum, and an altitude of 350m above sea level, (OJanuga, 2004). The harmmattan season stretches from November to March, when there is dry and laden wind accompanied with dust (SEPP, 2006).

Sokoto has two main seasons; the dry season, which last from October to May/June, and the rainy season that last from June to September/October. Sokoto state has abundant of livestock resources, because the climate is more suitable for livestock production, due to the absence of Tse-tse fly on open grass land (SSGD, 2002). There are numerous species of animals in both wild and domesticated forms in the state. Sokoto state rank second in livestock production in the country, with livestock population of over 8 million (SSGD, 2002).

2.2 Experimental Feed Sources

Experimental ingredients used in this experiment includes: maize, soya bean, wheat offal and salt were purchased from the Sokoto central market. Bone and Blood meal was sourced from the Sokoto metropolitan abbatoir, milled and separately bagged for diet formulation. Fresh *M. balsamina* leaves was sourced from villages around the polytechnic. The plant was dried under the shade in an open air.

2.2.1 Formulation of Experimental Diets

Four experimental diets were formulated and fed as complete diet each (Table 3.1). *M. balsamina* was included at 0, 2.5, 5, and 7.5% inclusion levels. The diets were designated as diet 1, 2, 3, and 4 respectively, in the experiment.

Table 3.1: Gross composition of the experimental diets (%)

	Treatment			
Ingredients %	**1**	**2**	**3**	**4**
M. balsamina	0	2.5	5.0	7.5
Maize	37.6	37.4	36.2	36.1
Cow pea hay	25.0	24.5	27.5	25.0
Soy bean meal	1.3	1.3	1.3	1.3
Blood meal	10.0	9.5	9.5	9.5
Rice offal	12.4	11.2	6.7	6.8
Wheat offal	10.1	10.1	10.4	10.4
Bone meal	2.5	2.5	2.5	2.5
Premix	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Total	**100**	**100**	**100**	**100**
Energy (ME/Kg)	2500.09	2500.40	2500.99	2500.30
CP (%)	17.40	17.12	17.40	17.40
CF (%)	11.90	12.14	13.50	13.07

2.2.2 Chemical Analysis of Experimental Diet alignment

Formulated experimental diets were analyzed for proximate components (crude protein, nitrogen free extract, crude fiber, ether extract, ash, energy and dry matter), as outlined by the Association of Official Analytical Chemists AOAC (2005).

Also, in the course of the experiment the test ingredient, *M. balsamina* was evaluated for toxins such as alkaloids, saponins and tannins content as outlined by AOAC (2005).

2.2.3 Experimental Animals and their Management

All the experimental rabbits were identified, allowed two weeks pre-conditioning period to acclimatize them, and medicated against coccidiosis and mange. They were given prophylactic coccidiostat (Ampro-vitracycline), via drinking water based on manufacture's recommended dose. They were dipped with cinatic powder base on the instruction given by the manufacturer. Daily washing of feeders and drinkers, and disinfecting of the pens were also carried out.

Thirty six adult mixed breed rabbits comprising of Chinchilla, New Zealand white and Dutch with an average weight of 2kg were purchased, constituting 24 does and 12 bucks. The animals were housed in 12 pens containing 2 does and 1 buck each. The pens were made of concrete floor and zinc roofing and were partitioned into 12 pens. One m^2 per rabbit was used, based on Wayne (2009).

The rabbits were fed twice a day (morning and evening). Clean water and experimental diet was provided *ad-libitum*, plastic bowls were used as feeders and drinkers.

Plate 2: Rabbit Housing with Feeders and Drinkers

2.2.4 Experimental Layout

Randomized Complete Block Design (RCBD) was used with four treatments replicated three times with 3 animals per replicate making a total of 36 rabbits.

3.3 Data Collection

The data was collected in three phases, as follows

3.3.1 Phase I

Body weight (in kg) of each rabbit was taken at the beginning of the experiment (day 0). Subsequently, each rabbit was weighed weekly. Feed intake was recorded daily by subtracting the left over from the quantity of feed offered to the animals the previous day. Feed conversion ratio was determined using feed intake and body weight gain.

Feed intake (g/rabbit) =Feed offered (g) – Leftover (g)

Feed conversion ratio (FCR) FCR=DM intake (g)/ live weight gain (g)
Average daily gain (ADG)=(final body weight-initial body weight)/total days of the experiment.

2.3.2 Phase II

2.3.2.1 Haematological Assay

At the end of the experiment, all the males (3 males/ treatment) were humanely slaughtered for collection of 10ml whole blood for haematology, serum chemistry and electrolyte evaluation. Each 10ml blood sample was collected in a labelled ethylene-diamine tetra acetic acid (EDTA) bottle which served as anti-coagulant and a plain tube was covered and centrifuged, the serum decanted and deep-frozen for serum biochemistry and enzymogical analysis. Labeled samples (5ml each) were taken to the Chemical pathology and haematology laboratory, Usmanu Danfodiyo University Teaching Hospital Sokoto, for analysis.

2.3.2.2 Analytical Technique

2.3.3. Blood Chemistry

2.3.3.1 Serum Chemistry

The plasma total protein was measured using biuret reaction according to the procedure of Savory and Sundaman (1968), while albumin was measured by colorimetric estimation using sigma diagnostic kit according to the method described by Reinhold (1953). Globulin was obtained by calculating the difference of total protein and albumin. The serum enzyme, Aspertate aminotransferase (AST), Alanin aminotransferase (ALT) and Alkaline phosphatase (ALP) were determined using a photoelectric colorimeter as described by Duncan *et al*. (1994). Blood urea, nitrogen and creatinine levels were also determined using photoelectric colorimeter as described by Gbore *et al*. (2006). Total cholesterol was also evaluated as described by Baker *et al.* (2007).

2.3.3.2 Serum Electrolytes

Serum sodium and potassium were determined using flame spectro photometry as described by Varley *et al.* (1980), while calcium was determined by flame spsectro photo metric method as described by Trudean and Freier (1967).

Phase III

2.3.4 Carcass Characteristics and Internal Organs Measurements

Three male rabbits from each treatment were randomly selected at the 9th week of the experiment. The rabbits were humanely slaughtered, skinned and eviscerated to obtain the carcass weight. All the internal organs were separated and weighed separetely. Dressing percentage was also determined as follows:

Dressing percentage = Dressed carcass weight (g)/ Slaughter weight (g) × 100

Plate 3: Individual Rabbit Carcasses

2.4 Data Analysis

The data generated were subjected to analysis of variance (ANOVA) using general linear model in SAS, (2002). Least significant difference (LSD) was used in separating the means where significant differences existed among treatments at 5% probability level.

3.0 RESULTS

3.1 Chemical Composition of Experimental Diet

Proximate composition of the experimental diet showed that crude fibre is higher for treatment 4 and 3. The dry matter and nitrogen free extract composition of the diet decreased with increasing level of *M. balsamina.* The value for energy and crude protein were not comparable between the treatments (Table 4.1). Also, the phyto-chemical analysis of the test ingredient (*M. balsamina*) showed that there were some anti-nutritional factor present (Table 4.2).

The initial diet formulation was 0, 5, 10 1nd 15% inclusion levels of *M. balsamina*. In the course of the experiment, problem of abortion was encountered in treatment 3 and 4 at the second week of the experiment, which was attributed to the high level of the test ingredient. The diet was then amended by reducing the levels of the test ingredient to 0, 2.5, 5, and 7.5% inclusion levels.

Table 4.1: Proximate Composition of the Experimental Diets

Parameter	**Treatment**			
	1	**2**	**3**	**4**
Crude protein	17.34	18.06	15.36	16.08
Ether extract	2.86	2.78	4.75	3.39
Moisture	5.00	4.08	5.06	5.50
Fibre	8.03	9.10	10.82	12.88
Ash	9.85	9.95	10.95	8.35
Dry matter	95.00	95.92	94.94	94.50
Nitrogen free extract	56.92	56.03	53.06	53.80
Energy kcal/kg	2867.73	2856.67	2813.97	2755.26

Table 4.2: Phyto-chemical Components of *M. balsamina*

Parameter	**Results**
Flavonoids	-
Tannins	+
Saponin	+
Glycoside	+
Cardiac Glycoside	-
Steroid	+
Alkaloids	+
Saponin glycoside	+
Anthraquines	-
Phytate	4.65mg%
Oxalate	5.4mg%
Cyanide	0.06mg%
Tannins	1.89mg/ml
Nitrite	1.3ug/ml

3.1 Growth Performance of Rabbit Fed Graded Levels of *M. balsamina*

Results (Table 4.3) indicated no significant difference (P>0.05%) between treatments in initial body weight, live weight gain, feed conversion ratio and the final body weight. But, there was significant difference in average daily gain with treatment 4 having the higher value (P<0.05%) and low value for feed intake.

Table 4.3: Growth Performance of Rabbits Fed Graded Levels of *M. balsamina*

	Treatments				
Parameter	1	2	3	4	SEM
Feed intake (g/day)	228.56^{a}	215.70^{ab}	193.35^{b}	186.14^{b}	10.77
Initial body weight (Kg)	2.93	2.93	2.90	2.90	0.09
Final body weight (Kg)	3.17	3.23	3.43	3.73	0.13
Weight gain (g)	233.33	300.00	533.33	833.33	168.91
Average daily gain (g/day)	2.77^{a}	3.57^{a}	6.35^{b}	9.92^{c}	2.01
Feed conversion ratio	16.25	9.40	5.01	6.73	3.56

4.4 Carcass Characteristics and Some Organ Weight of Rabbits Fed Graded Levels of *M. balsamina*

Results (Table 4.7) indicated no significant difference between the treatments in terms of live weight, carcass weight, dressing %, weight of kidney, small and large intestine ($P<0.05$). However, weight of liver and heart are significantly higher for animals fed diets containing high levels of *Mormodica balsamina L.*($P<0.05$), (Table 4.7).

Table 4.7: Carcass Characteristics of Rabbits Fed Graded Levels of *M. balsamina*

Parameter	Treatment				
	1	2	3	4	SEM
Live weight (kg)	1.533	1.467	1.500	1.6	0.64
Carcass weight (kg)	0.833	0.850	0.800	0.853	0.62
Dressing %	54.31	57.88	53.34	53.70	1.8
Kidney (g)	9.43	9.80	9.77	10.20	0.61
Liver (g)	34.97^{b}	44.00^{a}	34.27^{b}	40.67^{a}	1.38
Lungs (g)	9.77^{b}	12.13^{a}	10.30^{b}	7.90^{c}	0.26
Heart (g)	3.53^{b}	3.57^{b}	3.8^{b}	4.40^{a}	0.13
Small intestine (cm)	210.00	215.33	214.33	209.67	4.21
Large intestine (cm)	89.00	91.17	88.50	90.00	3.12

a, b, c means values with different superscripts in a row denotes significant ($P<0.05$) difference between means within the same rows. n=number of sample

4.0 DISCUSSION

4.1 Proximate Composition of the Experimental Diet

The results shows variations among the experimental diets. The CP and energy in the diet were formulated to be iso-proteineous, and iso-caloric, so as to balance the requirements for rabbits but some variations were observed when analysed in the laboratory. This could be due to method of analysis and sampling error. The experimental diets were within the optimal crude protein level of 15-20% as recommended (Sheldon and Williams, 2000). The crude fibres of the treatment diets were higher than that of the control group but all the diets fall within the range of 6%-16% as recommended (Sheldon and Williams, 2000). The high fibre content obtained for treatment 4 (12.88%) could be due to high fibre content of *M. balsamina,* as observed by Hassan and Umar, (2006). The fibre content is also within the required level for rabbits.

4.2 Growth Performance of Rabbits Fed Graded Levels of *M. balsamina*

The non- significant difference in feed intake, weight gain, average daily gain and feed conversion ratio might be a good indication of better utilization of *M. balsamina* by the experimental animals. The average daily weight gain reported in this study was higher than those reported by Elamin and Yousif (2011). The feed intake of the rabbits further explain the trend of the growth performance, in that the test ingredient which is bitter has the ability to stimulate appetite by reacting with enzyme ptyline right from the mouth resulting to better feed conversion ratio and higher weight gain with lower feed intake as indicated by Yusuf *et al*., 2012. Higher weight gain reported across the treatments showed a better acceptability of the diets.

4.4 Serum Chemistry of Rabbits Fed Graded Levels of *M. balsamina*

The values obtained in this study for total protein and albumin were higher in treatment 1 (control) and was decreasing with increasing level of *M. balsamina*. This could be due to the increasing fiber levels in the diet leading to lower digestibility of nutrients. Abnormal serum albumin usually indicates an alteration of normal systematic protein utilization, (Apata, 1990) and low dietary protein intake, (Onifade and Tewe, 1993). The cholesterol level (28 to 75 g/dl) observed in the present study was in line with the range (20 to 83 g/dl) reported by Njidda *et al.* (2006). HDL and LDL values obtained were also within the range reported by Njidda *et al.* (2006). The urea levels of the serum ranged from 4.53 to 7.9 mmol/l. The values were not within the range (2.50 to 5.80 mmol/l) reported by Njidda and Isidahomen (2011) and 2.60 to 4.90 mmol/l reported by Njidda and Isidahomen (2010) who fed sesame seed meal and grasshopper meal to rabbit in tropical environment. The values were lower compare to that obtained in temperate regions (4.6 to 10.4) reported by Duncan *et al*., (1994). This may indicate a little effect of the anti-nutritive factors on the liver and the health status of the rabbits.

4.6 Carcars Characteristics and some Organ Weight of Rabbits Fed Graded Levels of *M. balsamina*

The carcass values obtained showed an increase weight of the liver in treatment 2 and 4 showing a slight effect of the anti-nutritional factors in *M. balsamina.* The dressing percentage for the rabbits appeared to score higher in treatment 2, though there is no significant difference (<P 0.05%) among all the treatment. The kidney, small intestine, and large intestine were all within the range for normal healthy rabbits as evaluated by Mudunuru *et al.* (2008). The dressing percentage range of 54.31-57.88% reported in this study was lower than the range of 55.30±0.72-67.45±0.43% reported by Idowu *et al*. (2006).

The significantly (P<0.05) higher weights of liver and kidney in treatment 4 observed was expected because treatment 4 contained the highest amount of *M.balsamina*. Bone (1979) reported that, if a feed contain anti-nutritional element, abnormalities in weights of liver and kidney would be observed. The abnormalities will arise because of increased metabolic rate of the organs in an attempt to reduce the toxic elements or to convert the anti-nutritional agents to non-toxic metabolites. The values obtained for relative weight of the heart were similar to the range of 3.90-4.15g reported by Ozung *et al*. (2011).

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

The study was conducted to assess the effects of graded levels of *Mormodica balsamina* inclusion in the diets of growing rabbits on growth performance. Four diets were formulated, namely: Treatment 1(control), 2, 3 and 4 respectively, counting 0%, 2.5%, 5% and 7.5% levels of the plant. Thirty six adult rabbits of mixed breeds were used for the experiment and were allotted to the four treatments (1, 2, 3, and 4) with three rabbits per replicate and twelve rabbits per treatment in a randomized complete block design. The data generated was subjected to analysis of variance (ANOVA). Where significant differences exist, least significant difference (LSD) was used to compare the means. The trial lasted for 12 weeks. The growth performance of the rabbits was not significant across the treatment, except for the final weight and feed conversion ratio being higher in treatment 4. Effects of the diets on haematology and serum chemistry were elicited on the results. The result shows

that *M. balsamina* inclusions at these levels had no adverse effect on red blood cell counts, white blood cell counts, packed cell volume and haemoglobin concentration. All the parameters differ significantly ($P<0.05$) with the exception of mean corpuscular haemoglobin which show a significant difference among treatments. The cholesterol, creatinine and the blood urea levels were significantly varied. The carcass evaluated showed significant difference in the weight of the liver and the lungs which may indicate the slight anti-nutritional effect of the *M. balsamina* on the physiology of the rabbits.

5.2 Conclusion

The study concluded that *M. balsamina* is a herb that is high in amino acids and minerals. The inclusion of *M. balsamina* in the diets of rabbits of up to 7.5% did not significantly alter the haematological parameters studied. However, adult rabbits tolerated the plant for a period of 3 months without significant side effect.

5.3 Recommendation

The study recommended as follows:

1. Levels of *M. balsamina* above 7.5% should be tried in further studies, as this study could not exploit higher levels on the physiology of adult rabbits.
2. Further studies should be conducted to evaluate the effect of *M. balsamina* on gestation, lactation and other physiological functions of rabbits.

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Hematological Characteristics of Cattle Fed Graded Levels of Locust Bean Pulp in Semi Arid Zone of Nigeria

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Abstract: *The experiment was conducted at the teaching and research farm Ramat Polytechnic Maiduguri, Borno, State Nigeria. The experiment was carried out to assess the effect of feeding diets containing graded levels of locust bean pulp on the heamatological and differential blood profiles of feedlot Rahaji bulls. Twelve Rahaji bulls, aged two years and weighing averagely 142 Kg was allotted to four dietary treatments (T1, T2, T3 and T4) in which locust bean pulp was included at 0, 5, 10 and 15% respectively in a Completely Randomized experimental Design. Other feed inputs that was used in formulating the diets include cotton seed cake, brewer dried grain, rice milling waste, cowpea husk, bone ash and table salt. The experimental diets was fed to the bulls for 90 days. The haematological indices that were assessed include White Blood Cells (WBC), Red Blood Cells (RBC), Haemoglobin (HB), Packed Cell Volume (PCV), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), Neutrophils, Lymphocytes, Eosinophils, Monocytes, and Basophils. The result obtained revealed the White Blood Cell (WBC) showed significant difference (P<0.05) between the treatment means. However, all the haematological parameters were within the normal range values. In conclusion, inclusion of locust bean pulp into the diet of cattle up to 15% did not exert any deleterious effects on the haematological profiles and by implication the health of the Rahaji bulls used in this study.*

Keywords: *Heamatology, Rahaji bulls, Locust bean pulp*

INTRODUCTION

In most developing countries, inadequate protein intake, especially that of animal origin has been identified as one of the most important nutritional problems (Feilding, 1991). Animal protein is considered as superior to plant protein as it contains the essential amino acids which are more balanced and readily available to meet human nutritional needs than the plant protein. Although Nigeria is endowed with abundant animal resources and has great potentials to be self-sufficient in livestock production, but remains a net importer of livestock products (Adedipe *et al.,* 1997). The average Nigerian consumes only 3.245g of animal protein per person per-day which is far below recommended value of 34g (FAO 2002).

This low protein intake has been attributed to low level of animal production which led to high cost of animal products. The consequences of this low protein intake are retarded growth, high incidence of kwashiorkor, high rate of child mortality, short life-span and wide spread protein-energy malnutrition. Due to the acute shortage of animal protein in the diet of average Nigerian, there is a pressing need to increase the production of livestock resources (Shaib *et al*., 1997).

Nutrition has been an indispensable aspect of livestock production. Meeting the nutritional needs as well as the requirements of livestock, conventional and established feedstuffs have been implicitly utilized in feeding livestock. Although plethora of research findings on the excellent performance of these conventional feedstuffs fed to livestock have been extensively documented but competition between man and livestock for cereals and cereal product has made these ingredients uneconomical for continuous use as livestock feed. In order to reduce cost of feed which constitutes a significant fraction of total cost of production, focus has been on the search for cheaper and readily available feedstuffs with little or no competition with man's dietary demands (FAO 1999)

The cost of feed ingredients has increased tremendously over the years and this has been a source of worry for livestock producers. The contemporary issue in livestock management is the exorbitant cost of feeding stuffs. This is obviously a matter of concern because of the fact that feeds account for about 60-80% of the recurrent expenditure of intensive animal production system (Adisa and Badmos 2009). Astronomical increase in population of Nigeria (140, 431, 790 million) (NLPD 1992) is not backed by a commensurate increase in the production of grains and other crops that are also consumed by man. In view of the fact that feeding problems constitute the single largest problem of ruminant animal production in Nigeria, it is important to consider the use of alternative feed ingredients in order to reduce cost of production and optimize profit for improved livestock performance enterprise (Abubakar and Garba, 2004).

The available feed resources cannot meet the nutritional requirement of animals throughout the year in many parts of the country either due to inadequate supply or quality of the feed. This problem is even more aggravated in arid and semiarid areas giving the erratic and unreliable rainfall pattern. (Benard *et al*., 2010).

Low and erratic rainfall severally affects the growth of crop residue available for livestock feeding. Livestock feed resources in Nigeria are mainly natural grazing and crop residues, which are low in energy and protein leading to significant limitation in the production of livestock (Okoli et al, 20012).

Some of the factors contributing to the increasing cost of feed are under-production of various ingredients used in feed formulation, high inflation rates and competition in consumption of these ingredients by other animal species including man. There is also increase in human population which further worsens the situation because of the pressure placed on the available land for grazing, grains and other crops that are consumed by man. And without a commensurate increase with that of human population and inappropriate employment of technology for improved production (Dayo *et al*., 2009). These problems have resulted to poor nutrition of animals leading to loss of weight, lower resistance to disease, reduced fertility of adult animal, retarded growth of young animals and death among others, which together bring about the low level of performance by the ruminant animals, especially in the semi-arid zone of Nigeria. It has therefore become necessary to look for alternative sources of feed ingredients in order to optimize the animal performance in the northern part of the Country (Maigandi, 2001). The objective of the study was to assess the heamatological characteristics of Rahaji cattle fed graded levels of locust bean pulp in semi-arid zone of Nigeria.

MATERIALS METHODS

Experimental Site

This study was conducted at the Teaching and Research Farm of the Department of Animal Production Technology Ramat Polytechnic, Maiduguri, Nigeria. Maiduguri the capital city of Borno State is located on latitude 11^{0}51'N, longitude 13^{0}09'E and at an altitude of 354m above sea level. Maiduguri has very short rainy season (3-4 months) with about 645.9 mm/annum and a long dry

season of about 8-9 months (Jaekel, 1984). The ambient temperature could be as low as 20^0C during the dry cold period and as high as 44^0C during the dry hot period. Relative humidity is 30-45% in August which usually lower to about 5% in December and January. Day length varies from 11-12 hours (Lekan, 1991).

Treatment and Experimental Design
Four complete experimental diets A, B, C, and D will be formulated; containing 0 (control), 5, 10 and 15% locust bean pulp was used for this research. All the ingredients used except locust bean pulp was purchased from the Maiduguri livestock market. The twelve bulls were allotted randomly to the three treatment diets in a completely randomized design (CRD) with four replicates each.

Experimental Animals and their Management
Twelve (12) Rahaji bulls with average age of 24 months and weighing 150kg were obtained from the Maiduguri livestock Market. The Animals were quarantined for a period of two weeks in the Teaching and Research Farm of Ramat Polytechnic, Maiduguri. The Animals were dewormed against endo-parasite with Albendazole suspension at 25mg/kg which was administered orally. The animals were also sprayed against ecto-parasite with the application of cypermethrin. Also Oxytetracycline (a broad-spectrum antibiotic) long acting base at 1m/10kg body weight and multivitamin injection was given at 1ml/10kg body weight for three days to reduce stress.

Experimental Feed Sources
Feed Ingredients that were used in the experiment include; locust bean pulp, cotton seed cake, Rice milling waste, cowpea husk, wheat offal, groundnut haulms, salt and bone meal. All the ingredients were purchased from Maiduguri Livestock Market.

Management of Feeding Pens
Experimental Animals were housed individually in feeding pen and managed intensively for the period of 12 weeks. The feeding pens were cleaned and disinfected a week before the arrival of the animals and commencement of the experiment. The feed and water trough were cleaned every morning before feeding. The experimental animals were fed with experimental diets and watered *ad libitum* daily for 12 weeks.

Blood Sample Collection
At the end of the feeding trial, blood samples were collected from the Jugular vein of three randomly selected animals from each of the treatments (Coles, 1986). Blood sample collection was done early in the morning before feeding and 3ml of the blood sample were collected from each animal. The blood sample were placed in ethylene diamine tetra-acetic acid (EDTA) (anti-coagulant) bottle to prevent coagulation for heamatological studies. The collected samples were labelled and taken to the Laboratory for the evaluation of haematological characteristics.

Haematological Assay

Whole blood samples in EDTA bottles were analyzed for hemoglobin (Hb) content and Packed cell volume (PCV) using cyanmethaemoglobin and microhematocrit methods respectively (Coles, 1989). Erythrocyte and leucocytes counts were determined by haematocytometry as described by Jain (1986). Total white blood cell (WBC) count were determined by using the count made in a haemocytometer using the WBC diluting fluid. Differential leucocytes count were made by counting the different types of WBC from Geimsa stained slides (Coles, 1989). Calculation of the Erythrocyte indices including Mean Corpuscular Volume (MCV), Mean Corpuscular Heamoglobin (MCH) and Mean Corpuscular Heamoglobin Concentration (MCHC) were derived from the values obtained from

Red Blood Cells (RBC), Heamoglobin Concentration and PCV values according to the procedures described by Jain (1986)

Data Collection
Data were collected on haematology and differential blood count of Rahaji cattle fed graded levels of locust bean pulp.

Data Analysis
The data generated were subjected to Analysis of Variance (ANOVA) using general linear model with Statistix-10. Least significant difference (LSD) at 5% probability level were used to separate means that showed significance difference between treatments.

RESULTS AND DISCUSSIONS

Haematological Profile and differential Blood Counts for Rahaji Cattle Fed Graded Levels of Locust bean pulp

Parameters	Treatments			
	A	**B**	**C**	**SEM**
Haematology				
Packed cell volume (PCV %)	30.60	30.30	29.50	1.39
Haemoglobin (Hb g/dl)	12.05	11.80	11.32	0.70
Red blood cell (RBC $X10^{12}$)	8.60	8.25	8.45	0.36
White blood cell (WBC $X10^{9}$/L)	14.20^{a}	13.00^{a}	12.00^{b}	0.32
Mean corpuscular haemoglobin (MCH pg)	12.50	12.95	13.00	0.65
Mean corpuscular volume (MCV fi)	36.00	34.50	35.00	1.36
Mean corpuscular haemoglobin concentration (MCHC g/dl).	35.35	37.00	36.70	0.45
Differential blood counts (%)				
Neutrophils	48.07	46.03	47.50	0.63
Eosinophil	6.90	6.93	6.83	0.12
Lymphocytes	41.07	42.57	43.43	0.47
Monocytes	1.43	1.36	1.27	0.16
Basophils	0	0	0	0

a, b, mean values with different superscripts denote significant ($P<0.05$) differences between means within the same rows.

Haematological characteristics of Rahaji bulls fed diets containing graded levels of locust bean pulp

The haematological characteristics of the Rahajii bulls are shown in table 1. The result revealed that the white blood cells showed significant difference ($P<0.05$) between the treatments means; the other parameters were statistically similar ($P>0.05$). All the haematological parameters fell within the reference range values (RAR, 2009). The values of lymphocytes showed numerical increase as the level of inclusion of locust bean pulp in the diets increased while the white blood cells, haemoglobin, packed cell volume, mean corpuscular volume, eosinophils, monocytes and basophils showed the reverse.

Significant difference in WBC count was explained as possible presence of foreign organisms introduced into the bodies of the animals that would have necessitated increase in WBC count so as to fight the invasion. This effect could not however be attributed to the locust bean pulp introduction since the high WBC levels were also noticed in T1 that had no locust bean pulp inclusion. The non-significance in the haemoglobin and PCV values show that inclusion of locust bean pulp aided production of enough red blood cells and transport of oxygen to tissues of the bulls for oxidation of food for energy release necessary for preventing anaemia and aiding absorption of nutrients (Isaac *et al.,* 2013; Kubkomawa *et al.,* 2015). The normal lymphocytes count showed that inclusion of locust bean pulp in the diets did not encourage introduction of any infection while the low neutrophils count portrayed absence of any potential inflammatory process (Isaac *et al.,* 2013). The level of eosinophils also showed that locust bean pulp as a feed input did not introduce any allergic substances that the body would have reacted to. Similarity in monocytes count showed that locust bean pulp inclusion did not introduce harmful organisms in the body or increased dead body cells that needed to be removed. Similarity in leucocytes showed absence of any negative effect on immune system of the bulls. In general it can be summarized that the varying levels of locust bean pulp inclusion in the diets in this study did not have any detrimental effect on the haematological parameters of the bulls.(Mbanasor *et al.,* 2003).

Conclusion

In conclusion, the dietary inclusion of locust bean pulp did not exert any deleterious effects on the haematological profiles and by implication the health of the beef Rahaji bulls used in this study.

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