

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

Maryam Bello Ali

Department of Agricultural extension and management, college of Agriculture, Umaru Ali Shinkafi polytechnic, Sokoto. Maryam M. Mikail,

Department of Animal science, Usman Danfodiyo University, Sokoto

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 antinutritional 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 agroindustrial 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 13°1m N and longtitude 5°15m E). The state has a maximum temperature of 41°C and minimum of 13°C 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.

		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

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

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 m² 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)

journals@arcnjournals.org manuscriptiarcj@gmail.com

manuscriptiarci@amail.co

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 spectro 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) \times 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.

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 4.1: Proximate Composition of the Experimental Diets

journals@arcnjournals.org

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/m
Nitrite	1.3ug/ml

Table 4.2: Phyto-chemical Components of M. balsamina

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.

		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	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°	2.01
Feed conversion ratio	16.25	9.40	5.01	6.73	3.56

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

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. Duisuminu						
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°	0.26	
Heart (g)	3.53 ^b	3.57 ^b	3.8 ^b	$4.40^{\rm a}$	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	

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

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 $55.30\pm0.72-67.45\pm0.43\%$ 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.

REFERENCES

- Abdu, S. B, H. Bako, M. R. Hassan, G. E. Jackthan, S. M. Yashim, H. Y. Adamu and Abdurrashid, M. (2011). Effects of Charcoal Inclusion on the Performance of Growing Rabbits Fed Acasia (Acasia nilotica) Pod Meal Based Diets. Nigerian Journal of Animal Science. 13:133-141
- Aboul-Ela, S. S., El-Hindawy, M. M., Sulkamy, M. T. and Khalil, F. S. (2010). Amino-acid Requirements of Growing Rabbits in Hot Climates. 1st Prediction of Quantitative Needs. 2nd International Conference on Rabbit Production in Hot Climates. Cahiers-Option-Mediterran. 41:67-74.
- Abubakar, M. M. and Mohammed, A. (1992). Utilization of Slaughter House By-product for Sustainable Livestock Production in Nigeria, In J. A. T. Ojo (ed). Mobilizing Finance for Natural Resource Conservation in Nigeria. Natural Resources Conservation Council, Abuja.
- Addass, P. A., David, D. I., Edward, A., Zira, K. E. and Midak, A. (2012). Effect of Age, Sex and Management System on some Haematological Parameters of Intensively and Semi-intensively Kept Chicken in Mubi, Adamawa State, Nigeria. *Iranian Journal* of Applied Animal Science, 2(3):277-282.
- Aderemi, F. A. (2004). Effects of Replacement of Wheat Bran with Cassava Root Sieviate Supplemented or Unsupplemented with Enzyme on the Haematology and Serum Biochemistry of Pullet Chicks. *Tropical Journal of Animal Science*, 7:147-153.
- Aduku, A. O. and Olukosi, J. O. (1990). *Rabbit Management in the Tropics*. Living Books Series, G U Publication. Abuja, FCT. Nigeria.
- Aganga, A. A. and Tshwenyane, S.O. (2003). Feeding Values and Anti-nutritive Factors of Forage Tree Legumes. *Pakistan Journal Nutrition* 2 (3): 170-177.
- Ahamefule, F. A., Obua, B. E., Ukweni, I. A., Oguike, M. A. and Amaka, R. A. (2008). Haematological and Biochemical Profile of Weaner Rabbits Fed Raw or Processed

Pigeon Pea Seed Meal Based Diets. *African Journal of Agriculture and Research*. 3: 315-319

- Ahmed, M. K., Bargue, A. R., Nawaz, H. and Siddiqui, R. H. (1994). Effect of Varying Energy and Protein Levels on the Haematology of Japanese Quail. *Pakistan Veterinary Journal*. 14(4): 200-202.
- Ajala, M.K. and Balogun, J.K. (2004): Economic of Rabbit Production in Zaria, Kaduna State, *Tropical Journal of Animal Science*. 7(1): 1-10.
- Ajao, B. H., Ola, S. I., Adameji, O. V. and Kolawole, R. F. (2013). The Relationship of Ambient Temperature and Relative Humidity of Thermo Respiratory Function of Greater Grasscutter. Proceedings Of the 18th Annual Conference of Animal Science Association of Nigeria.held at Ibadan 3rd-6th June, pp92.
- Akande K. E. (2015). The Requirements of Protein and Amino Acid in Rabbits Nutrition and Production. A Review: *Case Studies Journal*. ISSN (2305-5097) vol 4 (4). www.casestudiesjournal.com.
- Akinmutimi, A.H (2004). Evaluation of Sword Bean (Canavalia gladiate) as an Alternative Feed Resources for Broiler Chickens. phd thesis Micheal Okpara university of Agriculture, Umudike Nigeria.4.
- Amy, E. H. (2010). Nutritional Requirements for Rabbits. Shur-Gain, Nutreco, Canada Inc.
- AOAC (2005). Association of Official Analytical Chemist. Official Methods of Analysis (18th Ed). Vol 1 Arlington. Virginia. USA 1094pp
- Apata, D. F. (1990). Biochemical, Nutritional and Toxicological assessment of some Tropical Legumes and Seeds. phd Thesis, University of Ibadan. Nigeria. 247pp.
- Aro, S. O. and Akinmoegun, M. B. (2012). Haematology and Red Blood Cell Osmotic Stability of Pigs Fed Graded Levels of Fermented Cassava Peel Based Diets. Proceedings of the 17th Annual Conference of Animal Science Association of Nigeria (ASAN), 152-153pp.
- Aro, S. O., Ogunwale, F. F. and Falade, O. A. (2013). Blood Viscosity of Finisher Cockerel Fed Dietary Inclusions of Fermented Cassava Tuber Wastes. Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria, 74-77pp.
- Aya, V. E., Ayanwale, B. A., Ijaiya, A. T. and Aremu, A. (2013). Haematological and Serum Biochemistry Indices of Broiler Chickens Fed Rumen Filtrate Fermented Palm Karnel Meal Based Diet. Proc. of the 18th Annual Conf. of Anim. Sci. Assoc. of Nig., 329p.
- Baker, J. F., Silverton, R. E. and C. J. Pallister (2007). Introduction to Medical Laboratory Techniques. 5th Edition. London Butterworth and Co-publishers Ltd. 540-621pp.
- Bamishaije, E., Muhammad, N. and Bamishaiye, O. (2009). Haematological parameters of Albino Rats Fed on Tiger Nuts (*Cyperuss esculentus*) Tuber Oil Meat Based Diet. *The International Journal of Nutrition and Wellness*, 10(1):
- Bandeira, S. O., F. Gaspa and F. Paggot., (2001) African Ethanobotany and Health Care: Emphasis on Mozambique. *Pharmacceutical Biology*, 39:70-73pp.
- Banerjee, G. C. (2007). *A Text Book of Animal Husbandry*. 8th Edition. Published by Raju primlani for Oxford & TBH Publishing Co. Pvt. Ltd. New Delhi. 1079p.
- Bawala, T. O., Akpan, U., Ogunnowo, A. O., Fasae, O. A. and Sogunle, O. M. (2007). Influence of Mg Supplementation on the Haematological Indices of Young West African Dwarf (WAD) Goats. Proceedings of the 32nd Annual Conference of NSAP, 76-78pp.

- Bernardini, M., Dal Bosco, A., Castellini, C. and Miggiano, G. (1996) Dietary Vitamin E Supplementation in Rabbit: Antioxidant Capacity and Meat Quality. In: Lebas, F. (ed.) Proceedings of the 6th World Rabbit Congress, Toulouse. Association Française de Cuniculture, Lempdes, 137-140pp.
- Biggs, W. C (2010). Blood Tests Explained with Interpretation. Amarilla Medical Specialist. Retreived from <u>www.amarila.com/howto on 05/09/2014</u>.
- Biobaku, W.O. and Oguntona, E.B. (1997): The Effects of Feeding Multi Nutrient Mini Blocks and Pelleted Diet on the Growth of Rabbits. *Nigerian Journal of Animal Production*, 24(2): 147-149.
- Bolaji, O. S. (2005). *Animal Welfare Veterinary Science*. (Handbook). Ibadan: Evans Publishers 77p.
- Bone, F.J. (1979). Anatomy and Physiology of Farm Animals. 2nd Edn. Reston Publishing Comp, IncVirginia, USA, 560p.
- Botsoglou N.A., Florou-Paneri P., Christaki E., Giannenas I., Spais A.B. (2004): Performance of Rabbits and Oxidative Stability of Muscle Tissues as Affected by Dietary Supplementation with Oregano Essential Oil. *Archives for Animal Nutrition*, 58: 209–218pp.
- Burke, J. (1994). Clinical Care and Medicine of Pet Rabbit. In: Proceedings of the Michigan Veterinary Conference. 49-77pp.
- Burton, J. L. and Erskine, R. J. (2003). Immunity and Mastitis. Some New ideas for an Old Disease. Veterinary Clinic of North America, Food Animal practices.19:1-45pp.
- Campbell, J. R. and Lasley, J. F. (1975). *The Science of Animal that Serve Man.* 2nd ed. McGraw Hill Book Company, New York, USA: 200-222pp.
- Cheeke, P. R. (1986). Potentials of Rabbit Production in Tropical in and Subtropical Agricultural Systems. *Journal of Animal Science*, 63:1581-1586.
- Church, J. P., Judd, J. T., Young, C. W., Kebay, J. L. and Kim. W. W. (1984). Relationships among Diet Constituents and Specific Serum Clinical Components of Subjects Eating Self-selected Diets. *African Journal of Clinical Nutrition*, 40:1338-1344.
- Cohens, S. and Burns R. C. (2002). Pathways of the Pulp, 8th Edition. St. Louis: Mosby, Inc.465p
- Coles, E. H. (1989). Veterinary Clinical Pathology. 4th Edition. W. B. Saunders Co. USA. 130-148pp.
- Dalle Zotte A. (2002): Perception of Rabbit Meat Quality and Major Factors Influencing the Rabbit Carcass and Meat Quality. *Livestock Production Science*, 75: 11–32.
- Dalle Zotte A. and Gisella P. (2014). Rabbit Growth Performance, Carcass Traits and Hind Leg Bone Characteristics as Affected by the Sire Breed, Season, Parity Order and Sex in an Organic Production System. *Animal Science Paper and Reports* Vol. 32(2) 143-159.
- Daramola, J. O., Adeloye, A. A., Fatoba, T. A. and Soladoye, A. O. (2005). Haematological and Serum Biochemical Parameters of West African Dwarf Goats. *Livestock Research for Rural Development*, 17(8). http://www.irrd.org17/8/clara/17095.htm
- De Blas, C. and Wiseman, J. (2003). *The Nutrition of the Rabbit*. CABI Publishing, Oxon, UK. 98p

- De Larco, J. E., Wuertz, B. R. and Furcht L. T. (2004). "The Potential Roles of Nuetrophils in Promoting the Metastatic Phenotypes of Tumors Releasing Interleukin-8". *Clinical Cancer Research* 10(15):895-900.
- Doyle, O. (2006). William Hewson the Father of Haematology. British Journal of Haematology 133:375-381
- Dukes, H. H. (1955). *The Physiology of Domestic Animals*. 7th Edition. Bailers Tindall and Co. London. 98p
- Duncan, J. R., Prasse, K. W. and Mahaffey, E. A. (1994). *Veterinary laboratory, medicine* (clinical Pathology). Iowa State University Press: Ames. 94-96pp.
- Edwards, S. W. (1994). *Biochemistry and Physiology of Neutrophils*. Cambridge University Press. 6pp.
- Egbo, M. L., Doma, U. D. and Lacdacks, A. B. (2001). Characteristics of Small Scale Rabbit Production and Management in Bauchi. Proceedings of the 26th Annual Conference of Nigerian Society for Animal Production (NSAP), 18-21st March, 2001. Ahmadu Bello University, Zaria, pp 160 - 162.
- Egbunike, G.N. (1997): What is Animal Science? And how can Nigeria get out of malnutrition. In: Livestock Products. Ologhobo, A.D., Iyayi E.A., Adesehinwa A.O.K and Bamgbose A.M. (eds). Proc. 2nd Annual Conference of Animal Science Association of Nigeria. Held at Airport Hotel, Ikeja Lagos on the 16th -17th September.
- Eheba, E. T. E., Omoikhojie, S. O., Bangbose, A. M., Druna, M. B., Isidhahomen, C. E. (2008). Haematology and Serum Biochemistry of Weaner Rabbits Fed Cooked Bambara Groundnut Meal as Replacement for Soybeans Meal. Proc. of 33rd Annual Conference of Nigeria Society for Animal Production, 192-196pp.
- Elamin K.M, and Yousif I. A. (2011). Evaluation of Litter Traits in Sudanese Rabbits. Livestock Research for Rural Development. pp. 25-30.
- El-Sayiad, G. A., Habbeb, A. A., and Maghawry, A. M. (1994). A Note on the Effects of Breed, Stage of Lactation and Pregnancy Status on Milk Composition of Rabbits. *Animal Production* 58, pp153-157.
- Esonu, B. O., Emenalom, O. O., Udedibie, A. B. I., Berbert, U., Ekpor, C. F., Okoli, E. C. and Iheukwumere, F. C. (2001). Performance and Chemistry of Weaner Pigs Fed Raw Mucuna Bean (Velvet bean) meal. Tropical Animal Production and Investment., 4:49-54.
- Etim, N. N. (2010). Physiological and Reproductive Responses of Rabbit Does to Aspilia africana. M.Sc. Thesis. Department of Animal Breeding and Physiology, Michael Okpara University of Agriculture, Umudike, Abia State, Nig. 14pp.
- Etim, N. N. and Oguike, M. A. (2010). Egg production of the domestic fowl (*Gallus gallus*): Implications for Food Security. Proceedings of the 35th Annual Conference of the Nigerian Society for Animal Production (NSAP), 660pp.
- Ewuola, E. O, and G. N. Egbunike (2008). Haematological and Serum Biochemical Response of Growing Rabbit Bucks Fed Dietary Fumonisin B. *African Journal of Biotechnology*. Vol 7, pp 4304-4309.
- Ewuola, E. O., Sokunbi, A. O., Alaba, O., Omotoso, J. O. and Omoniyi, A. B. (2010). Haematology and Serum Biochemistry of Weaned Rabbits Fed Dietary Prebiotics and Probiotics. Proc. of the 35th Annual Conf. of the Nig. Soc. for Anim. Prod., 147.

- Ezea, J. (2004). Effects of Graded Levels of Toasted Lina Bean (*Phaeous lunatus*) meal in Weaner Rabbit Diet. B. Agric. Project. College of Animal Science and Health. Michael Okpara University of Agriculture, Umuahia.
- Gbore, F. A., J. T. Ogunlade, E. O. Ewuola (2006). Effects of Dietary Fumonisin on Organ Characteristics and some Serum Biochemical Parameters of Bucks. *Moor Journal of Agricultural. Research.* 7, 28-34.
- Gidenee, T. and Fourtun-Lamothe, L. (2006). Feeding Strategy for Young Rabbits Around weaning: A review of Digestive Capacity and Nutritional Need. *Journal of Animal Science* 75:169-184.
- Gidenne, T. (2000). Recent Advances in Rabbit Nutrition: Emphasis on Fibre Requirement. A Review. *World Rabbit Science*. Vol. 8(1), 23-32
- Gilbert, R. Y., Grohn, P. M. and D. Hoffman. (1993). The Effect of Parity on Peripartum Neutrophil Function in Dairy Cows. *Vet Immunol. Immunopath.* 36: 75-82.
- Hackbath, H., Buron, K. and Schimansley, G. (1983) Strain Differences in Inbred Rats: Influence of Strain and Diet on Haematological Traits. *Laboratory Animals*. 17: 7 – 12.
- Hann, L. M. & Smith, O. P. (2006). Pediatric Haematology. Wiley-blackwell. 763pp.
- Harkness, J. E. and Wagner, J. E. (1989). *The Biology and Medicine of Rabbit Chemistry*. 17th ed. Lang Medical, Los Altos, California.
- Hasanuzzaman, M., Reza, A., Amin, M. R. and Khatun, R. (2001). Effects of Different Levels of Energy on Growth and Reproductive Performances of Rabbit in Bangladesh. *Bangladesh Journal of Animal Science* 30(1-2): 137-142.
- Hassan L. G. and K. J Umar (2006). Nutritional Value of Balsam Apple (Momordica balsamina L.) Leaves. Pakistan Journal of Nutrition. 5(6):522-529.
- Hillyer E.V., (1994). Pet Rabbits. The Veterinary Clinics of North America, *Small Animal Practice*, 24(1):25-65.
- Hutchings, A., Scott, A.H. Lewis G. and A.B. Cunningham, (1996). Zulu Medicinal Plants, an Inventory. University of Natal press, Pietermaritzburg.
- Idowu, O. M. O., O. M. Idowu, Jegede, A. V., Alabi, E. E. Adenugba, A. O and Bamgbose A. M. (2006). Performance and Carcass characteristics of Weaner Rabbits Fed Diets Containing Cassava Root Peel and Cassava sievate. *Tropical Journal of Animal Science* 9 (1):81-87.
- Iheukwumere, F. C. and Herbert, U. (2002). Physiological Responses of Broiler chickens to Quantitative Water Restrictions: Haematology and Serum Biochemistry. *Journal of Poultry Science*, 2:117-119.
- Iraqi, M.M., 2003. Estimation and Evaluation of Genetic Parameters for Body weight Traits of New Zealand White Rabbits in Egypt Using Different Multivariate Animal models. *Livestock Research for Rural Development*. 15(6). http://www.cipav.org.co/lrrd/lrrd15/6/iraqi156.htm
- Ironkwe, M. O. (2004). Comparative Performance of Weaner Rabbits Fed Concentrate, Forage and Concentrate Plus Forage. Proceedings of the 9th Annual Conference of Animal Science Association of Nigeria on September 13 - 16, pp. 14 - 16.
- Isaac, L. J., Abah, G., Akpan, B. and Ekaette, I. U. (2013). Haematological Properties of Different Breeds and Sexes of Rabbits. Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria, 24-27.

- Ishikawa, H. (1998). Observations of Lymphocytes Functions in Perinatal Cows & Neonatal calves. *Japan Journal of veterinary sciences*. 49:469-475.
- Iyeghe-Erakpotobor G. T., Aliyu R. and Uguru J. (2006). Evaluation of Concentrate Grass and Legume Combination on Performance and Nutrient Digestibility of Grower Rabbit under Tropical Condition. *African Journal of Biotechnology*. Vol 4(20) pp 2004-2008. www.Academicjournal.org/AJB.
- Jackson, W. P. U. (1990). Origin and Meanings of Names of South African Plant Genera. Ecolab, Botany Dept., University of Cape Town.
- Jain, N. C. (1986). Schalm's Veterinary Haematology. 4th Edition. Philadelphia. U. S. A. Lea and Febiger.
- Jane, B. B. (2010). Haematology. A Core Curriculum.
- Jenkins, J.R. 1999. Feeding Recommendations for the Horse Rabbit: Veterinary Clinics of North America: *Exotic Animal Practice*. Vol. 2 p 143. W.B. Saunders Company, Philadelphia
- Jenkins, K.J., Hidiroglow, M., Mackay, R.R. and Proulx, J.G. (1970) Influence of Selenium and Linoleic acid on the Development of Nutritional Muscular Dystrophy in Beef Calves, Lambs and Rabbits. *Canadian Journal of Animal Science* 50, 137-146.
- Jibir, M., Alli-Balogun, Jibrila, I., Garba, S., M. I. Ribah and Isah, A. M. (2014). Preference Studies on Rabbit Meat Products: A Consumer Approach. In: R.A. Abdullah, G.A. Tayo, A.O. Okubanjo and O.A. Akinsoyinu (Eds.). Positioning Animal Production in the Agricultural Transformation Agenda. Proceedings of the 39th Annual Conference of the Nigerian Society for Animal Production, 16th-19th, March, held at Babcock University, Ilishan Remo, Ogun state, Nigeria. Pp. 502-504.
- Jiya, E. Z., Jiya, A. T. and Akanbi, O. K. (2008). Effect of Replacing Fish Meal with Silk Worm Caterpillar (Anapheinfracta) on the Carcass and Haematological Parameters of Weaned Rabbits. Proceedings of 33rd Annual Conference of Nigerian. Society for Animal Production. 139-141.
- Kashiwazaki, Y., Maede, Y. and Namioka, S. (1985). Transformation of Bovine Peripheral Lymphocytes in the Perinatal Period. *Japan journal of veterinary Science*.47:337-339.
- Kehrli, M. E., Nonnecke, B. J. and Roth, J. A. (1989). Alterations in Lymphocytes Functions during the Peripaturient Period. Amsterdam Journal of Veterinary Research. 50:215-220.
- Keneko, J. J., Harvey, J. W. and Bruss, M. L. (1997). *Clinical Biochemistry of Domestic Animals*. Academic Press. Inc. San Diego, London, Boston, Newyork Sydney.
- Kerti A., Bardos, L., Deli, J and P. Olah (2005). Relationship of Retinol and Carotinoid Metabolism with Caecotrophy in Rabbits. Acta veterinarian Hungarica 53(3) 309-318pp.
- Khan, A. B. M. K. I., Reza, A. and Fouzder, S. K. (2000). Influence of Dietary Protein Levels on Growth and Carcass Characteristics of Domestic Rabbits. *Bangladesh Journal of Animal Science*. 29(1-2): 153-161.
- Khan, M. C., and Scott, L. (2012). *Merck Manual: Haematological Reference Ranges* (12th edition). White House Station, Mercke and Co. Pp 40.
- Klebanoff, S. J. and Clerk, R. A. (1978). The Neutrophils: Function and Clinical Disorders. Elsevier/North-Holland Amsterdam.

- Kortuglu, F., Kortuglu, V., Celik, I., Kececi, I. and Nizamlioglu, M. (2005). Effect of Dietary Boron Supplementation on some Biochemical Parameters, Peripheral Blood Lymphocytes, Splenic Plasma Cells and Bone Characteristics of Broiler Chicks given Diets with Adequate or Inadequate Cholecalferol (Vitamin D) content. *British Poultry Science*, 46:87-96.
- Lamb, G. N. (1981). Manual of Veterinary Techniques. CIBA-CEAGY, Kenya. Pp 96-107.
- Lane, T. J. (1999). *Rabbit Production in Florida*. Fact Sheet VM-51. Cooperative Extension Service, University of Florida. http://hammock.ifas.ufl.edu
- Laukova A., Strompfova V., Skřivanova V., Volek Z., Jindřichova E., Marounek M. (2006): Bacteriocin Producing Strain of *Enterococcus faecium* EK13 with Probiotic Character and its Application. Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria, 169.
- Lawrence-Azua O., Marthins F. and Ugo M. (2013). Performance of Rabbit Fed Graded Levels of Cocoa Bean Pod at Graded Levels of Inclusion. *Journal of Farm Animal Physiology*. Vol 36(5) Pp89-93.
- Le T. H., Nguyen, Q. S., Dinh, V. B., Le, T. B. and Preston, T. R. (1996). Replacing Molasses with Concentrate Blocks and Protein Rich Tree Leaves for Reproduction and Growth in Rabbits. *Livestock Research for Rural Development*. http://www.cipav.co/lrrd8/3/ha83.htm.
- Lei, Q. X., Li, F. C., and H. C. Jiao (2004). Effect of dietary crude protein on Growth performance, Nutrient Utilization, Immunity Index and Protease Activity in Weaner to 2 month old New Zealand Rabbits. Asian-Australian Journal of Animal Science. 17(10):1447-1451.
- Lewis M.R., Rose S.P., MacKenzie A.M., Tucker L.A. (2003): Effects of Dietary Inclusion of Plant Extracts on the Growth Performance of Male Broiler Chickens. *Journal of British Poultry Science*, 44 (Suppl. 1): 43–44.
- Licouis, D. (2006). Domestic Rabbit Enteropathis. Proceedings of the 8th World Rabbit Congress. 7th-12th September. Puebla, Mexico. 385-386.
- Linga S. S., Lukefahr S. D., Lukefahr M. J. (2003). Feeding of *Lablab purpureus* forage with Molasses Blocks or Sugar Cane Stalks to Rabbit Fryers in Subtropical South Texas. *Livestock Production Science* 80, 201-209.
- Loosh, K.R. (1997). *Agricultural Science for West African College*. (2nd Ed.). Lagos: Johnson Publication Ltd.
- Lui S. M. and D. G. Master (2003). Amino-acid Utilization for Wool Production. In amino Acid in Animal Production. 2nd Edition. Ed. JPF D'mello. pp 309-328 (CAB international, London.
- Lukefahr, S. D. (2007). Strategies for the Development of Small- and Medium-scale Rabbit Farming in South-East Asia. *Livestock Research for Rural Development*, 19(9). Retrieved on 16 May 2015 from http://www.lrrd.org/lrrd19/9/luke19138.htm
- Maertens L. (2010). Fats in rabbits Nutrition, A Review: *World Rabbit Science*. Vol 6(3-4) 341-348pp. www.researchgate,net/publication/50841550.
- Mailafia, S, Onakpa M. M and Owoleke O. E. (2010). Problems and Prospects of Rabbit Production in Nigeria – A review. *Bayero Journal of Pure and Applied Sciences*, 3(2): 20–25.

- Malak, A. N. Y. (2000). Effect of dietary protein levels on rabbit's performance. *Egyptian Journal of Rabbit Science*. 10(2): 195-206.
- Mallard, B., J. Dekkers, M., Ireland, K., Leslie, S. Sharif, C., Vankampen, L. and Wagter, B. W. (1998). Alteration in Immune Responsiveness during the Peripartum Period and its Ramification on Diary Cows and Calf Health. *Journal of Dairy Science*. 10(5)585-595.
- Mamman, A. B., Oyebanji, J. O. and S. W. Peters (2000). *Nigeria, A People United, A Future Assured* (survey of States) Vol. 2 Gabumo Publishing Co. Ltd. Calarba, Nigeria.
- Marcin A., Laukova A., Mati R. (2006): Comparison of the Effect of *Enterococcus faecium* and Aromatic Oils from Sage and Oregano on Growth Performance and Diarrhoeal Diseases of Weaned pigs. *Biologia, Bratislava*. 61: 789–95.
- Mateos, G.G. and De Blas, C. (1998) Minerals, Vitamins and Additives. In. De Blas, C and Wiseman, J. (Ed) *The Nutrition of the Rabbit*. CABI Publishing, Oxon, UK, pp. 145-175.
- Maxwell, M. H., Robertson, G. W., Spences and McCongrouodala, C. C. (1990). Composition of Haematological Values in Restricted and *ad libitum* Feed Domesticated fowls. RBC Characteristics. *British Poultry Science*. 60:1474-1484.
- Mbanasor, U. U., Anene, B. M., Chiniezie, A. B., Nnaji, T. O., Eze, J. I. and Ezekwe, A. G. (2003). Haematology of Normal Trypanosome Infected Muturu Cattle in South-Eastern Nigeria. *Nigerian Journal of Animal Production*. 30:236-241.
- Mc Dowell, L. R. (2003). Minerals in Animal and Human Nutrition. 2nd Edition.Elsevier Science, Amsterdam, The Netherlands. 644pp.
- Mitruka, B. M.;and Rawnsley, B. V. (1977). Clinical Biochemical and Haematological Reference Values in Normal Experimental Animals. New York. U.S.A. Inc Masson Publishing, pp 106-112.
- Moreki, J. C. (2007). Commercial rabbit production. Agrinews Magazine, 38(10): 2-12.
- Mudunuru, U. Lukefahr S. D., Nelson, S. D. and D. O. Flores, (2008). Performance of Rabbits Fed *Lablab purpureus* Forage with Molasses Mini-Blocks and Restricted Commercial Pellets. In 9th World Rabbits Congress, June 10-13, Verona, Italy.
 N.R.C. (2001). *Nutrient requirement of Rabbits*. 7th (Ed). Washington DC, USA: National
- N.R.C. (2001). *Nutrient requirement of Rabbits*. 7th (Ed). Washington DC, USA: National Academy Press.
- Nathan, C. (2006). "Neutrophils and immunity: Challenges and opportunities". Nature Reviews. Immunology 6 (March): 17382.doi:10.1038/nri1785.ISSN1474-1733. PMID 16498448.
- Njidda A A and C E Isidahomen, 2010. Hematology, Blood Chemistry and Carcass Characteristics of Growing Rabbits Fed Grasshopper Meal. *Pakistan Veterinary Journal* 30(1): 7 - 12.
- Njidda, A. A., Igwebuike, J. U. and Isidahomen, C. E. (2006). Haematological parameters and carcass characteristics of weaning rabbits fed grade levels of molasses. *Global Journal of Agricultural Science*. 5(7):167-172.
- Njidda, AA. (2011). Evaluation of the Potential Nutritive Value of Browse Forages of Semiarid Region of Nigeria. Ph D Thesis, Department of Animal Science, Ambrose Alli University, Ekpoma Nigeria. 219pp.
- NseAbasi N. E., Glory E. E., Uduak A. and E. A. Edem (2014). Effect of Nutrition on Haematology of Rabbit: A Review. *European Scientific Journal*. 10:3. 413-424pp.

journals@arcnjournals.org manuscriptiarcj@gmail.com

- Nworgu, F. C. (2006). Prospects and Pitfalls of Agricultural Production in Nigeria (1st ed.) Ibadan, Blessed Publication-Nigeria.
- Nworgu, F.C. and Hammed A. M. (2009). Performance of Rabbits Fed *Altermantherna bettzikiana* Supplements. Proceedings of the 34th Annual Conference of Nigerian Society for Animal Production on 15th-18th march, at Uyo. Pp644-646.
- Nwosu, C. C. (1979). Characteristics of Local Chicken of Nigeria and its Potential for Egg and Meat Production. In: Poultry Production in Nigeria. Proceedings. of 1st National Seminar on Poultry Production, Zaria.
- Odeyinka, S.M., Oyedele, O.J. and Odedire, J.A. (2008). Reproductive Performance of Rabbits Fed *Moringa oleifera* as a Replacement for *Centrosema pubsescens*. 9th World Rabbit Congress. June, 10th-13th 2008, Verona-Italy
- Odunsi, A. A., Ojifade, A. A. and Babatunde, G. M. (1999). Response of Broiler Chicks to virginmycin and Dietary Protein Concentration in the Humid Tropics. *Architect. Zootechnology*. 48(183):317-325.
- Ogbu C. C., Ani A. O. and Nwogwugwu P. (2014). Growth Performance, Feed Preference and Cirdicadian Variation in Behavioral Traits of Rabbit Reared Singly and in Groups. *Journal of Animal Production Advances*, 4(8): 488-500pp. ISSN: 2251-7677.
- Ogunbosoye, D. O. and Babyemi, O. J. (2010). Potential Value of Some Non- Legumineous Browse Plants As Dry Feed for Ruminants in Nigeria. *African Journal of Biotechnology*. 9(18): 2720-2726.
- Ojanuga, A. G. (2004). Agroecological Zone Maps of Nigeria. National Special Programme for Food Security, FAO-UNESCO. 124PP.
- Oke, U. K., Herbert, U., Ebuzoeme, C. O. and Nwachukwu, E. N. (2007). Effect of Genotype on the Haematology of Nigerian Local Chickens in a Humid Tropical Environment. Proceedings of 32nd Annual Conference of Nigerian Society for Animal Production held at Ibadan, 3rd-5th Aug. 54pp
- Olabanji, R. O., Farinu, G. O., Akinlade, J. A. and Ojebiyi, O. O. (2007). Growth Performance and Haematological Characteristics of Weaner Rabbits Fed Different Levels of Wild Sunflower (*Tithonia diversifolia* Hems L A. Gray) Leaf Blood Meal Mixture. Proceedings of 32nd Animal Conference of Nigerian Society for Animal Production, 207-209.
- Olafedehan, C. O., Obun, A. M., Yusuf, M. K., Adewumi, O. O. Olafedehan, A. O., Awofolaji,
 A. O. and Adeniji, A. A. (2010). Effects of Residual Cyanide in Processed Cassava
 Peel Meals on Haematological and Biochemical Indices of Growing Rabbits.
 Proceedings of the 35th Annual Conference of the Nigerian Society for Animal
 Production.
- Olayinka, O. A., Mark S. O. and Uzo k. (2010). Haematological Indices of pp212.Rabbit Fed Loofah Gourg (*luffa aegyptiaca*) seed meal at graded levels. *Journal of Farm Animal Physiology*. Vol 34(5). Pp 87-91
- Olowofeso, O. Adejuwon A. J., Ademokoya V. A. and Durosano S. O. (2012). Breeding and Productive Performance of Three Breeds of Rabbits in South-west Nigeria. *Global Journal of Science Frontier Research Bio-tech and Genetics*. 12(5)
- Oluwumi S. (2014). Comparative Study on Rabbits Breeds for Post Weaning Growth Traits in the Humid Tropics of Nigeria. *Journal of Animal Production Advances*. 4(6):442-447.

- Onifade, A. A. and Tewe, O. (1993). Alternative Tropical Energy Feed Sources in Rabbit Diets: Growth Performance Diet Digestibility and Blood Composition. *World Rabbit Science*. 1: 17-24.
- Onwuka C. F. I; Akinsoyinu A. O, and Tewe O. O. (1989). Feed Value of Some Nigerian Browse Plants: Chemical Composition and "In Vitro"Digestibility of Leaves. *East Africa Agriculture and Forestry Journal*, Volume 54 No.3 pp 157-163.
- Onyeyili, P. A., Egwu, G. O., Jibike, G. I., Pepple, O. J. and Gbaegbulan, J. O. (1994). Seasonal Variation in Haematological Indices in the Grey Breasted Guinea Fowl (Numida mealagris Gallata pallatas). Nigerian Journal of Animal Production, 18(2):108-11.
- Osagie A. U (1998). Anti-nutritional Factors; In: Osagie A. U and Eke O. U (eds): Nutrtional Quality of Plant Foods, Post-Harvest Research Unit, Department of Biochemistry, University of Benin.
- Oseni S. O. and Popoola M. A. (2013). Doe Fertility and Weaning Survival Rate of Composite Rabbits as Affected by Thermal Environment in the Humid Tropical climate of South western Nigeria. *International Journal of Bioscience*. 2(3): 113-115. www.ijagbio.com.
- Owen, O. J., Chukuigwe E. C., Amakiri A. O. and Aneibo A. O. (2008). Bamboo Hutches as Replaced for Wire Mesh Cages in Rabbit Production in Nigeria. *Journal of Livestock Research for rural development*, 20(11) 2208. http://www.lrrd.org/publiclrrd/011/owen20177.htm. Assessed on 20th July 2014.
- Ozung, P.O., Bitto, I.I and Ikurior, S.A. (2011).Carcass Yield, Gut Morphology, Reproductive Tracts Morphometry and Some Biochemical Characteristics of Serum in Female Rabbits Fed Cassava Peel Meal. *Continental Journal of Animal and Veterinary Research*. 3(1): 22-23
- Pagot, J. (1992). Animal Production in the Tropics and Sub-tropics, Macmillan Education.
- Penz junior, A. M. and Jacob, D. V. (1991). Protein and Amino-acid Requirements in Diet's for Rabbits. *Nutritional Abstract Review*. (Ser. B): 61 (2).
- PGCV (1990). Post Graduate Committee in Veterinary Science. Rabbits and Rodents Laboratory Animal Science. Proceedings No. 142. PGCVs, University of Sydney, Australia.
- Phillips, D. M. (1995). *Plasma Enzymes in Diagnosis*. In: Clinical Chemistry in Diagnosis and Treatment, 6th Edition. Arnold publisher London. Pp 303-307.
- Poole, T. B. (1987). UFAW Handbook of the Care and Management of Laboratory Animals. 6th ed. Universities Foundation for Animal Welfare, Longman Scientific and Technical, Harlow, UK.
- Price, M. L. and Regier, F. (1982). Rabbit production in the tropics. Echo Technical Note.
- Proverb G. and Quintyne R. (1992). *A guide to Breeding Rabbits*. Caribbean Agricultural Research and Development Institute. Fact sheets order No: AP-F/ 4-80.
- Radostits, O. M., Gays, C. C., Blood, D. C. (1994). Veterinary Medicine: A Textbook of Disease of Cattle, Sheep, Goats, Pigs and Horses. W. B. Saunder (eds.) pp 304.
- Rafiu, T. A., Aderinola, O. A., Akinwumi, A. O., Alabi, T. A. and Shittu, M. D. (2013). Performance and Blood Chemistry of Broiler Chickens Fed *Moringa oleifera* Leaf Meal. Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria, 294.

Ramodisa, J. (2007). Rabbit production. Agrinews Magazine, 38(2): 11.

- RAR (2009). Research Animal Resources. Reference Values of Laboratory Animals: Normal Haematological Values. Retrieved April 20, 2015, from www.ahc.umn.edu/rar/refvalues.html.
- Reilly, J. S. (1993). Euthanasia of Animals used for Scientific Purposes. ANZCCART, Glen Osmond. South Australia, 7(4):
- Reinhold, J. A. (1953). Manual Determination of Serum Protein, Albumin and Globulin Fractions by Buirete Method in Standard Method of Clinical Chemistry. New York Academic Press.

Richardson, V. (2000) Rabbits Health, Husbandry and Diseases, Blackwell Science

- Roberts, M. B. V. (2003). Biology: *A Functional Approach*. 4th Edition. First Indian reprint. Replica Press PVT ltd. P693.
- Roger, B. (2007). Hausa Names for Plant and Trees. 2nd Ed. Cambridge CB1 2AL. UK.
- Roodt, V., 1998. The Shell Field Guide Series: Part II. Common Wild Flowers of the Okavango delta, Medicinal uses and Nutritional Value. Ressel Friedman Book, Halfwen House, South Africa.
- Rosencranz, R. and Bogen, S. A. (2006). Clinical Laboratory Measurement of Serum, Plasma and Blood Viscosity. *American Journal of Clinical Pathology*, 125 (Suppl. 1): 578-586.
- Ruiz-Feria, C. A., and Lukefar, S. D. (1998). Rabbit Growth and Feeding Performance in South Texas. Evaluation of *Dolichos lablab* and *Opuntia stricta* as Local Forages and Effects of Fur Clipping. *Journal of Agriculture and Environment for International Development*. 2(2-9).
- S A S (2002). Statview Statistical Package. (English version 7.0) SAS Incoporated, Newyork.
- Saidj, J. D., Sahli O., AinBazi H. and Tamim S. (2012). Effect of Dietary Energy Content on Reproductive Performance of Local Rabbits Does. World Rabbit Science Association. Proceedings of 10th World Rabbit Congress, Sharm el-Shaikh- Egypt, 537-540
- Salma, U. (2000). Effect of Different Levels of Supplemental Protein on Reproductive Performance of Rabbit Does and their Subsequent Effect on Post Weaned Litter Performance. Msc Thesis, Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh.
- Savory, J. P. H and Sunderman, F. W. (1968). A Buiret Method for the Determination of Protein in Normal Urine. *Clinical Chemist* 14: 1160-1171.
- Schalm, O. W., Jain, N. C. and Caroll, E. J. (1975). *Veterinary haemtology*. 3rd ed. Lea and Fabiger, Philadelphia.
- Schiele, F., Vincent-viry, M., Fournier, B. Starck, M. and Siest, G. (1998). Biological Effect of Eleven Combined Oral contraceptives on Triglicerides, Gammaglutanyltransferase, Alkaline phosphate, Bilirubin and other Biochemical Variables. *Clinical Chemical Lab. Med.* 36(11): 871-878.
- Schiere, J. B. (2004). Agrodok 20 *Backyard Rabbit Farming in the Tropics* (4th Edition). Agromisa Foundation, Wageningen, The Netherlands. 71 pp.
- SEPP (2006). Sokoto Environmental Protection Programme. Metrological Data. Unpublished.

journals@arcnjournals.org

- Sharifi, M. R., Shams-sharg, M., Dastar, B.and Hassini, S. (2011). The Effect of Dietery Protein Levels on Blood Characteristics and Carcass Yield of Japanese Quils (*Cortunix cortunix japonica*). *Italian Journal of Animal Science*. Available at: i0:e4doi:10.4081/ijas.2011.e4.
- Sheldon, W.B. and Williams W.K. 2000. Raising Healthy Rabbits under Primitive Conditions. A Publication of Christains Veterinary Mission, USA.
- Simonova M., Chrastinova Ľ., Strompfova V., Faix Š. Vasilkova Z., Laukova A., Rafay J. (2008): Effect of *Enterococcus faecium* EF2019 Strain and its Bacteriocin in Digestive Tract of Rabbits. *World Rabbit Science*. 7:234-239pp
- Smith K. (2004). Rabbit Production and Nutrition in the tropics. Maccmillan Press. Ghana.
- SSGD (2002). Sokoto State Government Dairy. Ministry of Youth Sport and Culture, Sokoto. Pp1-33.
- Strucklec, M., Dermelj, M, Stibilij, V. and Rajh, I. (1994) The Effect of Selenium Added to Feedstuffs on its Content in Tissues and on Growth of Rabbits. *Krmiva* 36, 117-123.
- Swenson, M. J. (1990). Physiological Properties, Cellular and Chemical Constituents of Blood. *Dukes Physiology of Domestic Animal*. Ed. Cornstock Publishing Associates, Cornell University Press, Ithaca, London, 75-83.
- Taiwo, A. A., Adejuyigbe A. D., Adewale, J. A. Osbotan, J. S. and O. O. David (2005). Performance and Nutrient Digestibility of Weaned Rabbits Fed Forages 11Supplemented with Concentrates. *Nigerian Journal of Animal Production*, 32(1):74-78.
- Taiwo, B.B.A., Ogundipe. I.I. and Ogunsiji O. (1999): Reproductive and Growth Performance Rabbits Raised on Forage Crops. In: Proc. Of the 4th Annual Conference of the Animal Association of Nigeria held in Ibadan, Nigeria, pp 108-109
- Tian, G. Broussard L., and Kang B. T. (1998). The Role of Plants Residues with Different Chemical Compositions in Sustaining Maize Production in Sub-mined Tropical Environment. In: Strategies and Tactics of Sustaining Agriculture in the Tropics (M. A. Badejo and A.O. Togun (Eds) pp 68-84.
- Togun, V. A. and Oseni, B. S. A. (2005). Effect of Low Level Inclusion of Biscuit Dust in Broiler Finisher Diet on Pre-pubertal Growth and Some Haematological Parameters of Unsexed Broilers. *Research Community of Animal Science*. 1(2):10-14.
- Togun, V. A., Oseni, B. S. A., Ogundipe, J. A., Arewa, T. R., Hammed, A. A., Ajonijebu, D. C., Oyeniran, A., Nwosisi, I. and Mustapha, F. (2007). Effects of Chronic Lead Administration on the Haematological Parameters of Rabbit a Preliminary study. Proceedings of the 41st Conference of the Agricultural Society of Nigeria, pp341.
- Trudean, D. F. and E. F. Freier (1967). Determination of Calcium in Urine and Serum by Atomic Absorption Spectrophotometry (AAS). *Clinical Chemistry*. 13. 101-144pp.
- Ukachukwu, S. N., C. C. Ekwe and G. S. Ojeola. (2011). Performance of Weaned Rabbits Fed Graded Levels of Composite Cassava Meal. *Nigerian Journal of Animal Science*. 13:142-153.
- Van Dijk L (2003). Rabbit Production Guidelines for the Malawi Prison Service. Penal Reform International. Lilongwe, Malawi.
- Van Wyk, B. E., Chamberlain, W. and Gericke, N. (2000). *Peoples Plant, A Guide to Useful Plant of Southern Africa.* Briza, Pretoria.

- Varley, H., A. H. Cowenlock, M.Bell (1980). *Practical Clinical Biochemistry*, 5th ed Heimemann. London, 771-799 pp.
- Voss, K. A., Chamberlain, W. J., Bacon W. C., and Noored A. (1993). A Preliminary Investigation on Renal and Hepatic Toxicity in Rats Purified Fimonisin B1. *Natural Toxins*. 1: 222-228.
- Watt J. M. and Breyer-Brandwijk M. G. (1962). *Medicinal and Poisonous Plant of Southern* and Eastern Africa, (2nd Ed). Living Stone, Edinburgh and London.
- Waugh, D. J. and Wilson C. (2008). "The interleukin-8 Pathway Cancer". Clinical Cancer Research. 14(21): 6735-6741
- Wayne N., (2009). Tropical Rabbit Production: *A guide to Raising Rabbit with Few Resources*. Echo Technical Note, 17391 Durrance Road, North Forst Myer, FL 33917, USA.
- Welman, M., 2004. *Momordica balsamina* (L). National Herbarium, Pretoria. www.platkl/momordbalsam.htm. retrieved 20th july 2014.
- Wheater, P. R. and Stevens, A. (2002). Wheaters Basic Histopathology: A Colour Atlas and Text. Edinburg: Churchill Livingstone.
- Witko-Sarsat, V. Rieu, P., Descamps-Lascha, B. Lesavre, P. Halbwachs-mecarelli, L. (2000). "Neutrophils: Molecules, Functions and Pathophysiological Aspect" *Laboratory Investigations*. 80(5): 617-653
- Wolf, P., Schroder, A., Wenger, A. and J. Kamphues (2003). The Nutrition of the Chinchilla as a Companion Animal Basic Data Influence and Dependence. *Journal of Animal. Physiology and Nutrution.* 87 (129-133).
- World Bank (2001). World Development Report 2000/2001 Attacking poverty, Oxford university press, New York, USA. Pp. 335.
- Xiangmei, G. (2008). Rabbit Feed Nutrition Study for Intensive, Large Scale Meat Rabbit Breeding: Mekarn International Workshop (Organic rabbit production based on forages).
- Xiccato G. and Trocino A. (2012). Feed and Energy Intake in Rabbits and Concequences on Farm Global Efficiency. The 6th International Conference on Rabbit Production in Hot Climate, Assuit, Egypt, 1-8.
- Yakubu, B., Yusuf H. B., Raymond, B. S. and M. M.Yahaya (2012). Nutrient Composition of Some Selected Forages Used as Rabbit Feed in Adamawa state, Nigeria. Proceedings of the 17th Annual Conference of Animal Science Association of Nigeria held at the International Conference Center Opposite Radio House, Area 8 Abuja, Nigeria.
- Yeong, S. W. (1999). Effect of Dietary Protein on Growth Performance of Village Chicken. Proceedings of National IRPA Seminar Agric Sector, 2519-2520.
- Yesmin S. (2012). Effect of Methionine Supplementation on the Growth Performance of Rabbit. A thesis submitted to the Department of Animal Nutrition Bangledash Agricultural University Mymensingh.
- Zanaty, G. A. (2000). Determination of Methionine Requirements for Growing New Zealand White rabbits. *Egyptian Journal of Rabbit Science*. 10(1): 175-182.
- Zsolt, S., Zsolt, M., and Zsolt, G. (2011). Nutrition of Rabbits, Kapvar University. Canada.