AJFAND ONLINE
Volume 10 No. 11
November 2010
ISSN 1684 5374
Peer Reviewed
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

GROWTH AND HAEMATOLOGICAL RESPONSE OF GROWING RABBITS TO DIETS CONTAINING GRADED LEVELS OF SUN DRIED BOVINE RUMEN CONTENT

Okpanachi U, Aribido S O and I S Daikwo

Ucheleg Okpanachi

Corresponding author email: ucheleg@yahoo.com

C/o Chapel of Restoration, K S U, P.O.Box 241, Anyigba, Kogi State, Nigeria

ABSTRACT

The growth and haematological response of growing rabbits to diets containing graded levels of Sun dried Bovine Rumen Content (SBRC) was studied for a period of ten weeks. The rumen content was collected from Nsukka abattoirs and dried in sun, ground and stored in sacks. The Composition of SBRC used in this study is given as: 31.90% crude fibre; 7.95% moisture content; 0.75% ether extract; 16.20% Ash; 25.70% nitrogen free extract; 13.56 crude protein and energy of 4220 kcal/kg. Five treatments coded as T1 (control diet), T2, T3, T4 and T5 were used. The levels of inclusion of SBRC in T1 (control diet), T2, T3, T4 and T5 were 0%, 10%, 20%, 30% and 40%, respectively. Parameters observed were average daily and weekly feed intake, average daily and weekly water intake, average initial body weight, average weekly and daily body weight gain, feed cost per 1000g feed, feed cost per 1000g gain, feed conversion ratio, dressing percentage, weight of internal organs and haematological parameters. Generally, SBRC diets performed better than the control group. However, only weekly feed and water intakes were significantly different ($p < 0.01$). Numerically, the rabbits on T5 recorded the best water and feed intake, body weight gain; feed cost per 1000g feed, weight of internal organs and White Blood Cell count (WBC), while those on T4 had the best feed cost per kg gain and Feed Conversion Ratio (FCR). The best Packed Cell Volume (PCV) and Red Blood Cell count (RBC) were obtained with the rabbits fed T3 diet, while T1 had the best dressing percentage. No mortality occurred. The study indicated that SBRC could feed rabbits at 40% level of inclusion, thus providing a cheaper source of feeding and also help reduce environmental pollution. However, T4 with 30% SBRC is recommended, since rabbits on this diet had the best feed cost per 1000g gain (N/1000g) and feed conversion ratio.

Key words: Anaemia, Digesta, Immunosuppressed, Rabbits, growth

INTRODUCTION

The need to improve rabbit production in Nigeria to increase supplies of animal protein is clear, due to the high cost of chicken and beef. Also, the animal protein shortage facing Nigeria cannot be solved by large animals with their slow production cycle. Animals like rabbits, with very short gestation periods and production cycles, can help this protein shortage problem. Rabbits can be produced on forages alone, although production can improve by adding other feed supplements. The need to explore other less common, but potential, sources of animal protein such as rabbits has been supported [1]. Recently, there has been increased awareness in rabbit production. The advantages projected include the high reproductive rate, rapid maturity, high genetic potential, efficient feed utilization, limited competition with humans for food and high quality nutritious meat [2]. Rabbits have been introduced into West Africa as farm animals of economic value. They are low in fat, succulent, nicely flavored and provide a palatable change to chicken and other meats [3, 4]. It is also reported that rabbit meat plays an important role in preventing vascular disease due to its extremely low cholesterol and sodium levels [4]. This makes rabbit meat a good source of animal protein for coronary heart patients and people on low sodium diets. Rabbit meat also has no religious taboos about its consumption [4].

Rabbits can thrive on non-conventional feed stuffs and forages [4, 5]. Rabbits are being maintained solely on all forage diets with encouraging weight gains [6]. However, these investigators used temperate forages, which are known to have, on the average, higher crude protein and lower fibre contents, and has higher nutritive value than tropical forages [7, 8]. Their utilization of large forage diet was shown to be limited, since fibre digestion is post-gastric in the caecum [9]. Although the rabbit requirement for crude fibre is very high— about 14-25% when compared with other monogastiric animals— it is reported that the feeding of concentrate increases feed consumption and crude fibre digestion [10, 11]. Feed accounts for the dominant input in animal production, ranging from 60-70% of the total cost of production [12]. Similarly, feed ingredient accounts for over 90% of compound feed industry. Therefore, the relationship between feed ingredient and animal product output is both direct and obvious. Conventional feedstuffs are very expensive and scarce, the crippling realities that are characteristic of the economics of developing countries [13, 14, 15]. Conventional ingredients face stiff competition with channels in the food chain, which command a higher priority and can pay higher prices than the compound feed industry.

Nigerians are amongst the lowest consumers of animal protein in Africa, despite their numerous natural and human resources [16]. The average per capita protein daily intake is below the minimum stipulated by FAO [17]. The estimated daily protein intake in North America, Western and Eastern Europe has been put at 66g, 39g and 35g per person, respectively, while in Africa, and indeed Nigeria, the figure stands at 11g per head per day [18]. Regrettably, animal products contribute 15 to 20% of the total protein intake of Nigerians [19]. Animal protein contains essential amino acids, which are more balanced and readily available to meet human nutritional needs than plant protein [20]. In an attempt to search for alternative sources of animal protein feedstuffs, there is an urgent need to explore the potentials of non-conventional protein sources that do not compete with human food consumption.

One such alternative feedstuff, which is not only cheap but also locally available, and does not attract competition in consumption between humans and livestock, is the bovine rumen content. The rumen is a unique organ. Its content (rumen content or digesta) is heterogenous. It is made up of digested feed at different stages of degradation, saliva (making up the rumen liquor) micro-organisms and the products of their metabolic activities such as proteins, peptides, amino acids, lipids, vitamins and Volatile Fatty Acids (VFA). The rumen contains one of the most varied and dense microbial populations in nature [21]. Microbial population of rumen is made up of bacteria and protozoa with more than 200 species of bacteria and 20 species of protozoa identified [22]. The strained rumen liquor consists of 1 billion bacteria and 1 million protozoa per milliliter but this is not uniform, since considerable numbers of protozoa and bacteria are associated with the solid digesta [21]. The mean concentration of microorganisms in the solid matrix (digesta) is far grater than that found in the free suspension [22].

The crude protein range of 9-20% had been reported for rumen content [23]. The composition of rumen content is 92.83% Dry matter; 17.13% crude protein; 7.49% ash; 2.81% ether extract; 24.58% crude fibre; 40.82% Nitrogen free extract and 2278.50 Kcal/kg as the estimated metabolically energy [24]. The availability of the rumen content in the abattoir could be a good source of protein in livestock feed if it is properly processed and harnessed [24]. It has been reported that rumen content contains no anti-physiological factors [25]. Investigations revealed the composition and potentials of rumen content and blood–rumen content mixture as good sources of protein in monogastric ration [25]. The need to carry out this research came as a result of the high cost of protein feed stuff such as fishmeal, groundnut cake and soybean meal for animals. Also, the high competition existing between man and animals for these feedstuffs creates the need to maximize the economic efficiency of conventional feeds. This can be achieved by reducing the quantity of expensive feedstuffs substituting them with non-conventional feedstuff like sun-dried bovine rumen content (SBRC), thus greatly reducing production cost. In addition, the way this bovine rumen content is being trampled, wasted and left to cause environmental pollution calls for more research on it. Finally, higher levels of SBRC up to 40% have not been reached, according to the literature available on the use of SBRC in the diets of livestock generally, and rabbits in particular.

The general objective of this study was to evaluate the effect of feeding sun-dried bovine rumen content (SBRC) on the general performance of growing rabbits. It is envisaged that the results obtained from this research will help solve the food and nutritional problems faced by Africa and Nigeria in particular. It is also expected that from this research, useful suggestions will emerge that could be encouraging to both small- and large-scale farmers.

AJFAND ONLINE
Volume 10 No. 11
November 2010
ISSN 1684 5374
Peer Reviewed
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

MATERIALS AND METHOD

Fresh Bovine Rumen Content was collected from Nsukka abattoir and sun dried during the Harmattan period until the desired moisture content of 7.95% was reached. It was then crushed in a hammer mill. The experiment was conducted at the grass cutter unit of the Department of Animal Science, University of Nigeria, Nsukka. A total of twenty rabbits of different crossbreeds with an initial average weight of 0.88kg were used for this study. The rabbits were randomly transferred to a cage, with one rabbit in each cell. SBRC was used to compound five (5) different diets at the following inclusion rates 0% (T1) which is the control diet, 10% (T2), 20 (T3), 30% (T4) and 40% (T5). Each of the treatments had four rabbits. The experiment lasted for ten weeks. The rabbit were de- wormed with Pirazine (containing piperazine citrate as its active ingredient). Routine management such as cleaning of drinkers, feeders and the cages was done. Experimental diets and water were provided to the rabbits *ad libitum*. Proximate analysis of SBRC and the experimental diets were conducted in accordance with the methods of analysis by AOAC [26].

Five isocaloric and isonitrogenous based experimental diets were formulated by varying the proportions of maize (8.9 % crude protein), soybean meal (40% crude protein), groundnut cake (45 % crude protein), rice offal (6% crude protein) and sun dried bovine rumen content (17.13% crude protein), while the proportions of palm oil, salt, vitamin/mineral premix and bone meal were held constant. The composition of the experimental diets is shown in Table 1. The parameters measured during the study were: feed intake, water intake, body weight gain, feed cost per kg feed, feed cost per kg gain, feed conversion ratio, life weight, dressed weight, dressing percentage, weight of internal organs and haematological parameters. The cost of producing 1kg of each feed (feed cost N/kg) was determined by using current prices of the feedstuffs. Feed consumption was measured daily by giving the rabbits a weighted quantity of the feed each day and weighing the remnant the next day to know the actual quantity the rabbits ate. Water intake was determined by supplying a known volume of water each morning, using a calibrated beaker, and the volume left on the following morning, measured noting the volume lost due to evaporation. Evaporation loss was determined by placing a known volume of water in a drinker (same as those used in supplying water to the rabbits) within an inaccessible passage of the rabbit house. The difference in the volume of water observed the following morning and the original volume left in the passage was recorded as the volume evaporated. Weight gain of the rabbits was determined weekly by finding the average weight gain of the rabbits per treatment for the week and subtracting it from that of the previous week. Feed Conversion Ratio (FCR) was determined by calculating the ratio of the total feed consumed in kilogrammes and total weight gained in kilogrammes per treatment. Feed cost per kg gain was obtained from the product of Feed Conversion Ratio and cost of feed per kg. Carcass evaluation (Dressing percentage and weight of internal organs) and haematological parameters were done using two rabbits from each treatment. The selected rabbits were fasted for 24 hours prior to slaughter and provided only water, after which they were weighed and slaughtered. The slaughtered rabbits were roasted and the internal organs removed and weighed to get the carcass

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

AJFAND ONLINE
Volume 10 No. 11
November 2010
ISSN 1684 5374
Peer Reviewed
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

weight. Dressing percentage was calculated by working the percentage of the ratio of the carcass weight to the live weight. Internal organs were weighed using the electronic weighing scale to obtain more accurate values.

For the Haematological parameters, blood was collected from the ear vein of the rabbits after applying xyaline to the ear to help collect the blood. The blood samples were taken to the laboratory in anticoagulant tubes for analysis. Red Blood Cells (RBC) and White Blood Cell (WBC) were counted by Neubauer's improved haemocytometer. Packed Cell Volume (PCV) was calculated using standard formula described by Dacie and Lewis [27].

The data collected were subjected to Analysis of Variance (ANOVA), and Duncan's Multiple Range Test was used to separate the significant means, both contained in SPSS for Windows 2003.

RESULTS

The results of this experiment are shown in Tables 2, 3 and 4 Composition of SBRC used in this study is given as: 31.90% crude fibre; 7.95% moisture content; 0.75% ether extract; 16.20% Ash; 25.70% nitrogen free extract; 13.56% crude protein and energy of 4220 kcal/kg. In comparing the composition of SBRC in past studies with this current study, crude protein (17.13%), ether extract (2.81%), and nitrogen free extract (40.82%) reported by [24] are higher than those in this current study. Also, 7.49% ash, 24.58% crude fibre and 2278.58 kcal/kg energy reported by Adeniji and Balogun [24] are lower than those in this current study. However, 13.56% crude protein in this current study falls within the range of 9-20% crude protein for SBRC as reported by Dairo *et al.*, [23]. Significant differences ($p<0.01$) were noticed in weekly feed intake and water consumption only. In Table two, average daily feed intake increased as the dietary content of energy in the feed reduced for all the treatments except treatments three and five. This relationship between average daily feed intake and dietary energy content was however not significant ($p> 0.05$).The results of feed intake and water intake had the same trend with the rabbits on T1 (control diet) having the lowest daily feed and water intakes (61.19±3.29g) and (130.49±10.42ml) and those on T5 (40% SBRC) having the highest daily feed and water intakes (79.91±6.94g) and (188.15±29.23ml), respectively. The results from this current research showed that T4 (30% SBRC) had the best feed cost per kg gain of N365.11 and best Feed Conversion Ratio of 7.10. However, both feed cost per kg gain and Feed Conversion Ratio were not significant ($p>0.05$). Feed cost per kg feed was lowest (N 47.04) for the diet in T5 (40% SBRC) and highest (N63.57) for the control diet T1 (0% SBRC). Average daily and weekly body weight gain were observed to be best for the rabbits on T5 (40%SBRC) with daily and weekly weight gains of 10.08 and 70.60g, respectively. From Tables 2, 3 and 4, it was observed that the rabbits on T5 (40% SBRC) had the highest values for all other parameters apart from dressing percentage, PCV and RBC. None of these parameters was, however, significant ($p>0.05$). This result agrees with the study carried out by Esonu *et al* [28], but disagrees with the findings of Adeniji and Balogun [24]. Dressing percentage was

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

best (66.87%) for the rabbits in T1 as compared to 63.80%, 65.71%, 62.24% and 64.59% for T2 ,T3, T4and T5, respectively. Results on the haematological parameters of the rabbit's shows a general increase in PCV, RBC and WBC of those rabbits fed with diet containing SBRC.

DISCUSSION

The increase in average daily feed intake shows that rabbits eat to satisfy their energy requirements. The same trend for feed intake and water intake observed for most of the treatments as shown in Table two shows that the lower the feed intake, the lower the volume of water the rabbits drank. The increased feed intake of the rabbits on the diets containing SBRC is understandable since SBRC contains high fibre, which tends to increase the total fibre content of the diet and dilute other nutrients. This result agrees with earlier reports from [14]. The best Average daily and weekly body weight gain for the rabbits on T5 (40%SBRC) with daily and weekly weight gains of 10.08 and 70.60g, respectively means that SBRC containing diets in this study can produce as much weight gain as the control diet. The general increase in PCV, RBC and WBC of those rabbits fed with diet containing SBRC seem to mean that SBRC helped in boosting the immune system of the rabbits. This present study disagrees with the work of Omitoyin [29], in which poultry litter diets reduced the haematological parameters of fish and caused anaemia and the reduction of immune system of the fishes. Blood is a good indicator to determine the health of an organism [30]. It also acts as pathological reflector of the whole body; hence hematological parameters are important in diagnosing the functional status of exposed animal to toxicants [30]. It is proposed that SBRC in feeds can be used to manage rabbits that are immunosuppressed and anaemic. This is because of the drastic increase in PCV and total RBC count as well as increased WBC count stimulated by the feeds containing SBRC.

CONCLUSION

It is clear from the results obtained from this experiment that SBRC can be incorporated into diets for growing rabbits up to 40% level, since it met the growth performance and hematological and carcass requirements of the rabbits and had no adverse effects on them. T4 with 30% SBRC is, however, recommended since the rabbits on this diet had the best feed cost per kg gain (N/1000g) and feed conversion ratio,

Out of all the data generated from this experiment, only weekly feed intake and weekly water consumption were significant ($p<0.01$). It is, however, possible that inclusion of SBRC higher than 40% level considered in this experiment could have resulted in different effects on the performance of the rabbits. This, therefore, indicates that more research may be needed on the use of this by-product in rabbit diets.

AJFAND ONLINE
Volume 10 No. 11
November 2010
ISSN 1684 5374
Peer Reviewed
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

Table 1: Experimental diet

	Levels of Inclusion of SBRC (%)				
Ingredients	**0**	**10**	**20**	**30**	**40**
MAIZE	43.05	38.23	33.41	28.62	23.78
RICE OFFAL	23.17	20.58	18.00	15.40	12.82
GNC*	17.35	15.53	13.71	11.89	10.08
SBM*	7.43	6.66	5.88	5.09	4.32
SBRC*	0.00	10.00	20.00	30.00	40.00
PALMOIL	5.00	5.00	5.00	5.00	5.00
SALT	0.25	0.25	0.25	0.25	0.25
VMP*	0.25	0.25	0.25	0.25	0.25
BONEMEAL	3.50	3.50	3.50	3.50	3.50
TOTAL	100.00	100.00	100.00	100.00	100.00
calculated analysis					
CP(%)	16.00	16.00	16.00	16.00	16.00
Energy(kcal/kg)	2,848.49	2,811.38	2774.16	2637.60	2,700.06

GNC*: Groundnut cake SBRC*: Sun dried bovine rumen content

SBM*: Soybean meal VMP*: Vitamin/ mineral premix

Table 2: Effect of the experimental diet on the growth response of rabbits

	Treatments					
Parameters	1	2	3	4	5	**SEM**
Average weekly water consumption (ml)	913.42±38.16^{a}	1012.72±68.13^{a}	989.19±49.29^{a}	1283.08±127.58^{b}	1317.06±70.58^{b}	36.28**
Average weekly feed consumption (g)	428.33±14.79^{a}	458.69±12.70^{ab}	447.89±14.04^{ab}	475.53±14.18^{b}	559.39±17.06^{c}	7.30**
Average weekly weight gain (g)	65.80±0.01	53.30±0.01	60.00±0.01	67.80±0.01	70.60±0.01	0.0032$^{N.S}$
Average daily weight gain (g)	9.41±2.13	7.62±0.51	8.57±0.39	9.68±0.83	10.08±2.18	0.61$^{N.S}$
Average daily water consumption (ml)	130.49±10.42	144.68±23.43	141.32±13.45	183.30±57.91	188.15±29.23	13.73$^{N.S}$
Average daily feed consumption (g)	61.19±3.29	65.53±3.94	63.99±3.74	67.93±4.03	79.91±6.94	2.35$^{N.S}$
Feed cost/kg gain (N/1000g)	466.13±87.53	527.25±69.22	415.37±32.70	365.11±19.97	399.96±44.97	25.92$^{N.S}$
Feed conversion ratio	7.33±1.38	8.84±1.16	7.53±0.59	7.10±0.39	8.50±0.96	0.41$^{N.S}$
Feed cost/kg feed (N/1000g)	63.57	59.66	55.18	51.46	47.04	-

Means with different superscript on the same role differ significantly at 1% ($p<0.01$); N.S-not significant

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

Table 3: Effects of the different treatments on the carcass characteristics and organs of rabbits

	Treatments					
Parameters	1	2	3	4	5	**SEM**
Live weight (g)	1240±0.19	1160±0.06	1370±0.02	1450±0.19	1700±0.34	0.09 $^{N.S}$
Dressed weight (g)	840±0.17	740±0.10	900±0.00	900±0.10	1110±0.26	0.06 $^{N.S}$
Dressing percentage (%)	67.74±3.06	63.80±5.62	65.70±0.96	62.07±1.26	65.29±2.09	1.16 $^{N.S}$
Liver weight (g)	28.50±4.60	26.20±0.50	33.65±3.25	37.20±4.20	42.85±12.35	2.91 $^{N.S}$
Spleen weight (g)	0.09±0.50	0.50±0.30	0.65±0.05	0.90±0.20	0.90±0.50	0.13 $^{N.S}$
Kidneys weight (g)	6.85±0.75	5.90±1.10	8.05±0.85	7.95±1.45	8.60±1.20	0.49 $^{N.S}$
Lung weight (g)	4.20±0.50	5.95±0.95	6.25±0.15	5.95±0.35	9.65±2.45	0.72 $^{N.S}$
Weight of stomach, intestine, and ingesta (SII) (g)	272.55±45.55	224.90±45.20	257.25±1.75	293.75±48.05	311.05±57.85	17.77 $^{N.S}$
Heart weight (g)	2.40±0.20	2.65±0.65	3.20±0.50	3.45±0.05	3.60±0.50	0.21 $^{N.S}$

N.S-not significant

AJFAND ONLINE
ISSN 1684 5374
Volume 10 No. 11
November 2010
Peer Reviewed
AFRICAN JOURNAL OF FOOD AGRICULTURE NUTRITION AND DEVELOPMENT

Table 4: Effects of the different treatments on the haematological profile of rabbits

	Treatments					
Parameters	1	2	3	4	5	**SEM**
PCV (%)	29.00±1.00	37.50±1.50	38.00±2.00	36.00±2.00	36.00±5.00	1.41 $^{N.S}$
RBC/X10^6	4.84±0.17	6.25±0.27	6.34±0.33	5.92±0.44	5.98±0.83	0.24 $^{N.S}$
WBC/NM^3	8650.00±1050.00	8025.00±125.00	8925.00±1125.00	9050.00±1750.00	11225.00±75.00	501.79 $^{N.S}$

N.S-not significant

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

REFERENCES

1. **Bamgbose A M, Akinlabi H, Oboh S O, Aruna M B, Ikhimioya, Oteku I T, Igene F U and C S O Otoikhain** Replacement Value of Copra Meal for Soybean Meal in Weaner Rabbit Diets. *Proc. 9th Annual conc. Anim. Sci. Ass. Of Nig. (ASAN)* 2004: 26-27.

2. **Cheeke P R, Grobner M A and N M Patton** Fibre Digestion and Utilization in Rabbits. *J. Appl. Rabbit Res.* 1986; **9(1):** 25-30.

3. **Owen J E** Rabbit Production in Tropical Developing Countries: A Review. *Tropic Sci.* 1976; **18(4)**: 203 – 210.

4. **Aduku A O and J O Olukosi** Rabbit Management in the Tropics. Living Book Series. G. U. Publications, Abuja, Nigeria. 1990: 5-20.

5. **Omole T A** The Effect of Level of Dietary Protein on Growth and Reproductive Performances in Rabbits. *J. Appl. Rabbit Res*. 1982; **5**: 83 – 88.

6. **Perez R and J J San Sebastain** *Cuban Agric. Rev. Journal*.1970; **4**: 201–204.

7. **Oyennga V A** Nigeria's Feed and Feeding-stuffs, their Chemistry and Nutritive value Ibadan University Press. Ibadan. 1968. pp 99.

8. **Miltroy R J** Introduction to Tropical Grass Land Husbandry. 2nd edition. Oxford Univ. Press,1972.

9. **Davidson W J and D Spreadbury** Nutrition of New Zealand White. *Proc. Soc.*1975; **24**: 75-83.

10. **Adegbola J A, Tibi E U and D C Adogwa** Feed Intake and Digestibility in Rabbits and All Forage Plus Concentrate and All Concentrate Diet. *J Anim. Prod. Res.*1985; **5(2):** 15-16.

11. **Butcher C, Bryabt M J and E Owen** Effect of Metabolizable Energy Concentration on Performance and Digestibility in Growing Rabbits. *Trop. Anim. Prod.* 1981; **6**: 93-100.

12. **Nworgu F C, Adebowale E A, Oredin O A and A Oni** Prospects and Economic of Broiler Production Using Two Plant Protein Sources. *Trop. J. Anim. Sci.* 1999; **2(1):** 159 – 166.

13. **Esonu BO, Iheukwumere F C, Iwuji T C, Akanu N and O H Nwugo** Evaluation of *Microdesmis puberula* Leaf Meal as Feed Ingredient in Broiler Starter Diets. *Nig. J. Anim. Prod.* 2001; **30**: 3-9.

14. **Esonu B O, Iheukwumere F C, Emenalom O O, Uchegbu M C and E B Etuk** Performance Nutrient Utilization of The Organ Characteristics of Broiler Finisher Fed *Microdesmis puberula* Leaf Meal. *Livest. Res. Rural Dev*.2002; **14**: 15. (http//:www.cipar.org.co/irrd14/6/eson146.htm).

15. **Esonu B O, Azubuike J C, Emenalom O O, Etuk E B, Okoli I C, Ukwu H O and C S Nneji** Effect of Enzyme Supplementation on the Performance of Broiler Finisher Fed *Microdesmis peberula* Leaf Meal. *Int. J. Poult. Sci.* 2004; **3**: 112 – 114.

16. **Egbunike G N** What is Animal Science and How can Nigeria Get Out of Malnourishment? **In**: Ologhobo A D, Iyayi E A, Adesehinwa A O K and A M Bamgbose (Eds). Livestock Products. *Proc. 2nd Ann. Confr. Anim. Sci. Assoc. of Nig*. 1997: 16-17.

17. **FAO.** Food and Agricultural Organization Annual Report. Rome. Italy, 1988.

18. **Lamorde A G** Animal Health and Production in Nigeria. An Agenda for the Future. Paper Presented at the 1st Monthly Technical Seminar. Nat. Inst. For oceanography and marine Research. Lagos, 1991.

19. **Federal Republic of Nigeria**. "Federal Republic of Nigeria Position Paper". In: Shalb B, Adedipe N O Aliju and M M Jir (Eds). Integrated Agricultural Production in Nigeria: Strategies and Mechanisms for Food Security. Proc. of the National Workshop on Nigeria's Position at the World Food Summit, 1996: 11–74.

19. **Oyenuga V A** "Agriculture in the Current Development 1970 – 1994 Livestock Plan". Proc. of Agricultural Society of Nigerian, 1971; **8**: 15 – 20.

20. **McDonald P, Edwards R A, Greenhalgh J F D and C A Morgan** Animal Nutrition India 6th ed, Pearson Education Plc. Ltd Publishers, 2002.

21. **Czerkawski J W** Introduction to Rumen Studies 4th ed, Pergamon Press, 1986.

22. **White E P and I Wadak** Evaluation of Rumen Content on the Growth Performance of Weaner Rabbits. Proc. 7th Ann. Conf. Anim. Sci Ass. Of Nig, 2002: 143 – 146.

23. **Dairo F A S, Aina O O and A R Asafa** Performance Evaluation of Growing Rabbits Fed Varying Levels of Rumen Content and Blood Rumen Content Mixture, *Nig. J. Anim. Prod.* 2005; **32(1)**: 67-72.

24. **Adeniji A A and O O Balogun** Utilization of Flavour Treated Blood-Rumen Content Mixture in the Diets of Laying Hens, *Nig. J. Anim. Prod.* 2002; **29(1)**: 34-39.

26. **AOAC** Official Methods of Analysis of AOAC, 15th Edition. Association of Official Analytical Chemists, Washington D.C. USA, 1990.

27. **Dacie SIV and SM LEWIS** Practical haematology (7^{th} edition) J and A Churchill Ltd. Livingston, London, Melbourne and New York, 1991.

28. **Esonu B O, Ogbonna U D, Anyanuwn G A, Emenalom O O, Uchegbu M C, Etuk E B and A B I Udedibie** Evaluation of Performance, Organs Characteristics and Economic Analysis of Broiler Finisher Fed Dried Rumen Digesta, *Inter. J. Poult. Sci.* 2006; **5(12**): 1116 – 1118.

29. **Omitoyin B O** Hematological Changes in the Blood of *Clarias gariepinus* (Burchell, 1822). Juveniles Fed Poultry Litter. *Livest Res. Rural Dev*. 2006; **18(11):** 200.

30. **Joshi P K, Bose M and D Harish** Changes in Certain Haematological Parameters in a Siluroid Catfish *Clarias batrachus* (Linn) Exposed to Cadmium Chloride. *Pollution Resources.*2002; **2(2):** 129 – 131.