Performance and economics of production of weaner rabbits fed graded levels of sorghum sprout waste meal-based diets

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Abstract

The effect of feeding varying dietary levels of sorghum sprout waste (SS) as substitutes for maize on performance, carcass and blood indices of rabbits was investigated. Thirty growing rabbits of nine weeks of age were allocated to 5 dietary treatments of 6 rabbits per replicate in a Complete Randomized Design experiment which lasted 56 days. The diets were formulated with 0 (control), 25, 50, 75 and 100% SS as substitutes weight for weight in place of maize. Results show that daily feed intake, cost per kg feed, cost of feed per kg weight gain, carcass, organs, most serological and haematological indices investigated were significantly ($p< 0.05$) affected by dietary treatments. The trends obtained in these parameters across the treatments were not definite and not depict adverse effects on the experimental rabbits. The highest ($p< 0.05$) total protein, albumin, packed cell volume, red blood cells and haemoglobin values were obtained in the experimental rabbits fed 100% SS-based diets. Cost/kg feed reduced ($p< 0.05$) from N69.07 (€0.32), N63.95 (€0.30), N62.88 (€0.29), N59.77 (€0.28) and N55.11 (€0.25) ; and cost of feed/ kg live weight from N582.84 (€2.69), N509.04 (€2.35), N445.30 (€2.06), N433.12 (€2.00) and N403.68 (€1.86) respectively for rabbits fed 0, 25, 50, 75 and 100% SS. Substitution of maize with 100% SS gave the cheapest cost of production of a kg live weight of rabbits with no deleterious effects on carcass and health depicted by normal serological and haematological values; and could be adopted by rabbits farmers to alleviate the problem of high cost of maize.

Keywords: weaned rabbits, health status, sorghum sprout, performance, profitability

Introduction

Animal protein is very essential in human nutrition and there has not been perfect substitute for it. High cost of animal protein sources in Nigeria and most of the developing countries of the world has limited the consumption. Atsu (2002) explained that the animal protein content of most Nigerians was very low and has reached a crisis level. Amagbade (2006) reported that the animal protein consumption of Nigerians is below 10% of World Health Organization recommendation. High cost of conventional feed ingredients particularly maize is an important contributory factor. This calls for the use of unconventional energy feed resources. Sorghum sprout waste (SS) from beer making industry is readily available and cheaper substitute to maize. It is not competed for nutritionally by man and its use in livestock diets helps to make beer making process more environmental friendly by reducing the attendant odour and pollution. Rabbit meat is a good source of animal protein to man. It is a good source of white meat (Bolaji, 2005). Rabbit is a fast growing monogastric herbivore (Adejinmi *et al.,* 2000) favoured because of its high fecundity, short generation interval and ability to utilize forages (Taiwo *et al.,* 2004). This study was carried out to investigate the effects of replacing maize with graded levels of

Sorghum sprout waste (SS) on performance, carcass, serological and haematological parameters of weaned rabbits.

Material and methods

This study was carried out at the Rabbit Unit of the Teaching and Research Farm, Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State, Nigeria. The location lies between 7°16[1] and 7°18[1] North and longitude 5°09[1] and 5°11[1] in the rain forest belt of the tropics. The annual rainfall ranges from 1405-2400 mm and the average monthly temperature of 26.5°C. There were five diets formulated with 0, 25, 50, 75 and 100% replacement of maize with sorghum sprout waste (SS) weight for weight in the diets with each diet represented a treatment. The gross composition of the diets and the determined nutrient composition are presented in Table 1. The diets were pelletized. There were 6 replicates of 6 rabbits of nine weeks of age in each of the treatments. The rabbits were housed one in a unit of the hutch measuring 40 x 60 x 54 cm in dimension. The hutches were raised from the floor and provided with wire screen floor to allow faeces and urine to drop to the cemented floor. The hutches were provided with suitable clay pot drinkers and feeders. The rabbits were weighed at the commencement of the experiment to know their initial weights which was balanced for the average of the treatments. Weight gain and feed intake were determined on weekly basis and thereafter used to calculate the average daily values. The costs of the five diets were computed from the prevailing cost of the ingredients at the time of the experiment. These were then used to calculate the cost of feed consumed per kg live weight gain of the experimental animal. Fifteen rabbits (three rabbits per treatment) were randomly taken at the end of the feeding trial based on the group average weight for carcass analysis. The rabbits were fasted for 12 hours and their live weights recorded. Each of the animals was stunned before slaughtering by cutting the jugular vein with a sharp knife. Carcass weight was taken. The tail, head, pelt, feet and internal organs were removed. The dressing weight was recorded. The head, liver, kidneys, heart, lungs, intestine, feet, spleen, and all other parts were obtained and weighed. The dressed weight was expressed as percentage of carcass weight and organ weight as percentage of live weight of the animals. Blood samples were collected from three animals per treatment for haematological and biochemical analyses at the end of the feeding trial. Blood was collected from each animal into labelled sterile universal bottle containing anti-coagulant ethylene-diamine-tetraacetic acid (EDTA) for the determination of haematological components and into another labelled sterile bottle without EDTA for the determination of serum biochemical components. The samples were taken to the Laboratory for analysis. The packed cell volume (PCV) was determined using the micro-hematocrit technique, the red blood cells (RBC) and white blood cells (WBC) counts using the improved Neubauer hematocytometer method, and haemoglobin (Hb) using the cyanomethemoglobin method described by Kelly (1979). Serum from the coagulated blood samples was used for the measurement of total protein, albumin, globulin and glucose.

The proximate analyses of sorghum sprout waste and the experimental diets were according to method of AOAC (1995). The metabolizable energy was calculated according to the procedure of Pauzenga, (1985) as ME (kcal/kg DM) = 37 x % protein + 81.8 x % fat + 35.5 x %NFE.

Data collected were subjected to analysis of variance (ANOVA) using the procedure of SAS (1999). The means were separated using the Duncan Multiple Range Test of the same package.

Table 1: Gross composition of experimental diets

Ingredients	Treatments				
	T1 (0% SS)	T2 (25% SS)	T3 (50% SS)	T4 (75% SS)	T5(100% SS)
Maize	40.00	30.00	20.00	10.00	0.00
SS	0.00	10.00	20.00	30.00	40.00
GNC	3.85	3.75	3.75	3.75	4.75
BDG	25.00	25.00	25.10	25.10	24.00
SBM	2.05	2.00	3.60	3.60	4.60
P KC	24.00	24.00	21.80	21.80	20.80
Palm Oil	0.15	0.15	0.15	0.15	0.15
Bone Meal	2.00	2.00	2.00	2.00	2.00
Oyster Shell	2.20	2.20	2.20	2.20	2.20
*Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.20	0.20	0.20	0.20	0.20
Lysine	0.15	0.15	0.15	0.15	0.15
Methionine	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00
Determined nutrient composition (%)					
Crude protein	15.34	15.88	16.42	16.96	17.50
Crude fiber	9.01	10.19	11.38	12.57	13.76
*ME (KJ/kg)	10.72	10.43	10.15	9.86	9.65

SS= Sorghum sprout, GNC= Groundnut cake, BDG= Brewers dried grains, SBM= Soybean meal, PKC= Palm kernel cake. *Composition of Premix: vitamin A: 3,000,000iu/ kg, vitamin E: 3000iu/kg, vitamin B_1: 200mg/kg, vitamin B_6: 80mg/kg, Niacin: 6000mg/kg, Molybdenum: 200mg/kg, Iron: 16,000mg/kg, Cobalt: 100mg/kg, Zinc: 20,000mg/kg, Copper: 2400mg/kg, vitamin D_3: 600,000iu/kg, vitamin K_3:800mg/kg, vitamin B_{12}:2000mg/kg, B iotin: 20000mg/kg, Iodine: 200mg/kg, Selenium: 40mg/kg, Manganese: 40,000mg/kg, Pantothenic acid: 2400mg/kg

Results and discussion

The gross and the determined nutrient compositions of the experimental diets are presented in Table 1. The various ingredients and the levels of inclusion are as indicated. The determined proximate composition showed that the crude protein of the experimental diets met the recommendation of 14-17% for weaned rabbits (Banerjee, 2008). The crude fiber and metabolisable energy values also compared favourably with 10-12% and 10.47 KJ/kg recommended for rabbits (Omole *et al.,* 2007). Stephen (2006) recommended a diet containing 8-9% crude fiber. The proximate composition of Sorghum Sprout (Table 2) showed a crude protein, crude fiber, ether extract, Ash and Nitrogen free extract values of 15.39, 13.88, 4.47, 6.89 and 51.11% respectively. The determined gross energy was 14.46 KJ/kg. The CP, CF and EE values in this study were lower than 21.85, 16.55 and 6.73% respectively reported for spent sorghum grain (Kwari *et al.,* 1999). The CP value obtained in this study is higher than the range of 6.96-11.59% reported by Shuping *et al.* (2009). However, the trend is comparable to 93.31% dry matter, 12.01% crude fiber, 3.90% ether extract and 6.90% Ash contents reported by Etuk *et al.* (2012). The likely reasons for any differences could be varietal difference of sorghum used and sprouting which could have affected the crude protein.

Table 2: Proximate composition of Sorghum Sprout

Constituents	% Composition
Dry Matter	91.74
Crude Protein	15.39
Crude Fiber	13.88
Ether Extract	4.47
Ash	6.89
Nitrogen free extract	51.11
Gross Energy	14.46KJ/kg

Results of the effects of sorghum sprout on rabbit's performance are presented in Table 3. The average daily feed intake, cost per kg feed and cost of feed per kg weight gain were significantly ($p< 0.05$) affected by dietary treatments. Daily feed intake per animal was 78.95, 73.33, 65.22, 75.74 and 73.57g respectively for 0, 25, 50, 75 and 100 replacement levels. The FCR and average daily weight gain obtained in this study were similar to 7.8-8.23 and 11.62-12.17g respectively reported for growing rabbits (Adeyemi *et al.,* 2011). The growth performance of rabbits in studies reported from tropical countries is generally in the range of 10-20g per day, in contrast to 35-40g per day commonly observed in temperate regions (Cheeke, 2003). Cost per kg feed reduced ($p< 0.05$) with increasing levels of sorghum sprout from *N*69.07 (€0.32), *N*63.95 (€0.30), *N*62.88 (€0.29), *N*59.77 (€0.28) and *N*55.11 (€0.25). Cost of feed per kg live weight followed the same trend decreased from *N*582.84 (€2.69), *N*509.04 (€2.35), *N* 445.30 (€2.06), *N*433.12 (€2.00) and *N*403.68 (€1.86). An important objective of the adoption of unconventional feed ingredients in livestock production is to reduce the cost of feeds and thus cost of producing a unit of livestock products. This is with the attendant aim of reducing the cost of the products and makes such more affordable by the relatively poor members of the society. Similar reductions in cost per kg feed and cost per kg weight gain were obtained for rabbits fed cocoa pod husk (Adejinmi *et al.,* 2007), pineapple peel meal (Adeyemi *et al.,* 2011) in place of maize in the diets. In all, the least cost of production was obtained at 100% level of replacement (100% SS). There was up to 30.74% reduction in the cost of producing similar body weight as the control (0% SS). The average initial live weight, final live weight, total weight gain and daily weight gain were not significantly ($P< 0.05$) different for all dietary treatments. This may suggest that the nutrients in the diets were adequately utilized by the rabbits.

Table 3: Performance characteristics of rabbits fed graded levels of sorghum sprout-based diets

Parameters	Treatments					SEM
	T1 (0% SS)	T2 (25% SS)	T3 (50% SS)	T4 (75% SS)	T5 (100%SS)	
AILW (g)	616.67	611.67	598.33	602.00	618.00	31.27
AFLW (g)	1153.40	1136.50	1171.80	1236.30	1191.00	69.17
TWGPA g)	536.80	524.80	573.40	634.30	573.00	41.30
ADWG (g)	9.59	9.37	10.24	11.33	10.23	0.74
ADFI (g)	78.95^{a}	73.33^{a}	65.22^{b}	75.74^{a}	73.57^{a}	1.06
FCR	8.44	7.96	7.08	7.29	7.33	0.54
Cost per kg feed (~~₦~~/€)	69.07^{a} (€0.32)	63.95^{b} (€0.30)	62.88^{c} (€0.29)	59.77^{d} (€0.28)	55.11^{e} (€0.25)	0.08
Cost of feed per kg weight gain (~~₦~~/€)	582.84^{a} (€2.69)	509.04^{ab} (€2.35)	445.30^{ab} (€2.06)	433.12^{b} (€2.00)	403.68^{b} (€1.86)	36.99

^{a,b,c,d,e} Mean with different superscript a long the same row are significantly ($p < 0.05$) different AILW: average initial live weight; AFLW: average final live weight; TWGPA: total weight gain per animal; ADWG: average daily weight gain; ADFI: average daily feed intake; SS: Sorghum sprout; FCR: Fe ed Conversion Ratio

Result of the effects of SS on carcass and organ parameters of rabbits are presented in Table 4. The pre-slaughter weight for the experimental rabbits were 1125.35, 1150.38, 1100.78, 1150.38 and 1100.67g, respectively for 0, 25, 50, 75 and 100% SS. The corresponding carcass weights were 1075.22, 1100.12, 1050.26, 1100.17 and 1000.32g in the same order. The highest dressed weight (47.83%) obtained at 0% SS was higher (P< 0.05) than 45.45% (25% SS), 45.45% (50% SS), 44.37% (75% SS) and 43.48% (100% SS). Variations obtained in the pre-slaughter weight, carcass weight, dressed weight and organs (heart, lung, liver, kidney and spleen) were significant (P< 0.05). The highest dressed weight (47.85%) obtained at 75% SS was higher than 43.48% for animals on 25% SS despite the same pre-slaughter and close carcass weight at both levels. It can therefore not be expressly stated that dressed weight increased with body weight. The highest heart (0.36%) and lungs (1.00%) obtained at 50% were significantly (P< 0.05) higher than 0.24 - 0.27% and 0.46 - 0.82% for the other treatments. The heart weight of rabbits at 75% was similar (P> 0.05) to those on 50% SS. The highest (P< 0.05) liver (3.40%) and kidney (0.80%) obtained at 100% SS were higher than 2.76 - 3.08% and 0.10 - 0.70% respectively. Variations obtained for the organs did not follow any particular trend to be associated with effect of contents of the diets. Increase in weight of liver and kidney with increasing SS would have been suspected to be as a result of contents of anti-nutritional factors. Both organs have been reported to be organs of biotransformation involved in handling of toxins in the body (Onyeyilli, *et al.* 1998). Hypertrophy or hypotrophy of both organs has also been linked to presence of toxins (Voss *et al.,* 1990 with Ewuola *et al.,* 2003). Enlargement of organs such as the liver and pancreas has been linked with presence of anti-nutritional factors due to their higher detoxification activity (Aderemi, 2003). The trend obtained for heart and lungs did not also establish the presence of any stress as a result of the diets. The differences could have been due to differences in growth of anatomical parts of the animals.

Table 4: Carcass and organ characteristics of rabbits fed graded levels of sorghum sprout-based diets

Parameters	Treatments					SEM
	T1 (0% SS)	T2 (25% SS)	T3 (50% SS)	T4 (75% SS)	T5 (100% SS)	
PSW (g)	1125.35	1150.38	1100.75	1150.38	1100.67	14.43
Carcass (g)	1075.22^{b}	1100.12^{a}	1050.26^{c}	1100.17^{a}	1000.32^{d}	14.43
Carcass (%)	95.55	95.65	95.45	95.65	90.91	1.06
Dressed (%)	44.37^{b}	43.48^{b}	45.45^{ab}	47.83^{a}	45.45^{ab}	2.00
% Carcass wt						
Heart (%)	0.27^{ab}	0.26^{ab}	0.36^{a}	0.31^{a}	0.24^{b}	0.01
Lung (%)	0.69^{c}	0.82^{b}	1.00^{a}	0.46^{e}	0.61^{d}	0.02
Liver (%)	2.76^{c}	3.01^{b}	2.79^{ab}	3.08^{b}	3.40^{a}	0.15
Kidney (%)	0.70^{b}	0.68^{c}	0.10^{e}	0.65^{d}	0.80^{a}	0.00
Spleen (%)	0.06^{bc}	0.04^{c}	0.11^{a}	0.07^{b}	0.05^{bc}	0.02
Stomach (%)	27.58	32.09	28.06	30.85	31.27	3.61

SS: Sorghum sprout; Carcass and Dressed as %LW
PSW= Pre-slaughter wt
^{a,b,c,d,e} Mean with different superscript along the same row are significantly ($p < 0.05$) different

Presented in Table 5 are the serological and haematological parameters of the experimental rabbits. Out of all the serum biochemical parameters measured, total protein and albumin were significantly P< 0.05) influenced by the dietary treatments. Total protein (17.80mg/dl) and albumin (12.90mg/dl) obtained in rabbits fed diets containing 100% SS were higher than range of 11.70 – 13.00mg/dl and 7.70 – 9.10 mg/dl, respectively for the 2 parameters obtained for the other treatments. Although, not a perfect relationship, the higher total protein and albumin values obtained at 100%SS could be a reflection of protein content of this diet. Increase in albumin has been linked to protein intake being in excess of the amount required for growth and maintenance (Bowes *et al.,* 1989). Globulin, albumin: globulin ratio and glucose were similar (P> 0.05) for all the treatments. All the haematological parameters investigated were significantly (P< 0.05) affected by the dietary treatments. The highest PCV (31%), RBC (2.60 x $x10^6$/l), Hb (10.55g/100ml) and MCV (119.23μ^3) were obtained in rabbits fed 100% SS compared to the range of 21 – 27%, 1.78 – 2.30 $x10^6$/l, 8.60 – 9.15g/100ml and 109.10 – 117.95μ^3 respectively for the other treatments. The highest WBC (137 x 10^3/l) was obtained in rabbits fed diets containing 75% SS compared with 110.50 – 130.50 $x10^3$/l obtained for the other treatments. The highest MCHb (50.10 µµg) and MCHC (42.38%) obtained in rabbits fed 50% SS –based diets compared with 38.26 – 40.58 µµg and 32.59 – 35.83% obtained in the other treatments.

Blood examination gives the opportunity to investigate the presence of several metabolites and other constituents and helps detect conditions of stress, which can be nutrition, environmental or physical (Aderemi, 2003). The fact that the total protein and albumin of rabbits fed 100% SS –based diets was the highest and similar values of globulin, albumin: globulin ratio for all dietary treatments may suggest adequate consumption of the components. This is in agreement with the submission of Babalola and Akinsoyinu (2009) that a general reduction in these constituents was as a result of insufficient protein consumption, an indication of malnutrition or impaired protein digestion. The highest values of packed cell volume, red blood cells and haemoglobin obtained in the rabbits fed 100%SS shows enhanced quality of blood at this level. Esonu *et al.* (2012) reported similar enhanced quality of blood in broilers fed 10% fermented bovine blood and rumen digesta meal. Generally, higher PCV values have been correlated with the nutritional status of the animals (Iheukwumere, 2008). The highest albumin at 100% SS is also desirable as an indication of good state of health. This is in agreement with the submission of Rodgers (1994) that a decrease in albumin below normal range is a symptom of pathological state. The highest Hb value obtained for 100% SS coupled with similar values for the other treatments is desirable. Haemoglobin has a link with Oxygen carrying capacity of the animals. The values of this parameter in this study compare favourably with the normal range of 9-11g/100ml reported (Archetti *et al.,* 2008). The MCV also falls within the normal range of 10.70-11.90g/l as reported by Ismene *et al.* (2011).

Table 5: Serum and haematological parameters of rabbits fed graded levels of sorghum sprout-based diets

Parameters	Treatments					SEM
	T1 (0% SS)	T2 (25% SS)	T3 (50% SS)	T4 (75% SS)	T5 (100%SS)	
Total Protein (mg/dl)	11.50^{b}	12.05^{ab}	11.70^{b}	13.00^{ab}	17.80^{a}	1.54
Albumin (mg/dl)	8.10^{bc}	8.10^{bc}	7.70^{c}	9.10^{b}	12.90^{a}	0.17
Globulin (mg/dl)	3.40	3.95	4.00	3.90	4.90	0.12
Albumin: Globulin Ratio	2.38	2.05	1.93	2.33	2.63	0.38
Glucose (mg/dl)	52.50	51.00	65.00	59.00	63.00	2.25
Packed cell volume (%)	27.00^{b}	24.00^{c}	21.00^{d}	27.00^{b}	31.00^{a}	1.99
White blood cell (x10^{3}/l)	119.00^{d}	130.50^{b}	125.00^{c}	137.00^{a}	110.50^{e}	3.18
Red blood cell (x10^{6}/l)	2.29^{b}	2.20^{b}	1.78^{c}	2.30^{b}	2.60^{a}	0.15
Haemoglobin (g/100ml)	9.15^{b}	8.60^{b}	8.90^{b}	8.80^{b}	10.55^{a}	0.71
Mean corpuscular volume (μ^{3})	117.95^{a}	109.10^{b}	117.11^{a}	117.39^{a}	119.23^{a}	1.75
MCH (μ μg)	39.97^{b}	39.09^{b}	50.10^{a}	38.26^{b}	40.58^{b}	1.23
MCHC (%)	33.89^{c}	35.83^{b}	42.38^{a}	32.59^{c}	34.07^{c}	1.02

SS: Sorghum sprout ; MCH: mean corpuscular haemoglobin; MCHC: mean corpuscular haemoglobin concentration

^{a,b,c,d,e} Mean with different superscript along the same row are significantly ($p < 0.05$) different

Conclusion

It was concluded that the performance, carcass, serological and haematological indices of rabbits were not adversely affected by contents of SS as substitutes up to 100% for maize in the diets. The least cost of production obtained at 100% level could indicate SS as a cheaper alternative for maize in rabbits' diets.

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References

Adejinmi, O. O., Adejinmi, J. O. and Babatunde, B. B. 2000. Performance and carcass characteristics of young rabbits fed varying levels of soldier fly larvae meal. *Tropical Journal of Animal Science* 3: 127-131.

Adejinmi, O. O., Hamzat, R. A. and Fapohunda, J. B. 2007. Performance and Nutrient Digestibility of Rabbits fed Fermented and Unfermented Cocoa Pod Husk. *Nigerian Journal of Animal Production* 34 (1): 63-68.

Aderemi, F. A. 2003. Effect of enzyme supplemented cassava root sierate (CRS) in Cassava-based diet on some visceral organs of pullet chicks.Proc. 8th Ann. Conf. Anim. Sci. Ass. Nig. ASAN, FUT, Minna, Nigeria.

Adeyemi, O. A., Ajado, A. O., Okubanjo, A. O. and Eniolorunda, O. O. 2011. Response of growing rabbits to graded levels of fermented and unfermented pineapple peel. *Nigerian Journal of Animal Production* 38 (1): 86-98.

Amagbade, 2006. The Tropical Agriculturist. 16 Series, Macmillan Press Ltd, 14.

AOAC, 1995. Official Methods of Analysis, 16th Edition. Association

of Official Analytical Chemists, Washington D.C

Archetti, I., Tittarelli, C., Ceriodi, M., Brivio, R., Grilli, G. and Lavazza, A. 2008. Biochemistry and haematology values in commercial rabbits: preliminary data from industrial farms in Northern Italy. 9th World Congress- June 10-13, 2008- Verona-Italy.

Atsu, D. W. 2002. Contributingrole of Animal Production to National Development. 7th Conference of Animal Science Association of Nigeria (ASAN), Abeokuta, Nigeria, 13-23.

Babalola, O. O. and Akinsoyinu, A. O. 2009. Proximate, mineral and biochemical evaluation of the haemolymph of growing snails fed fresh lettuce waste, whole lettuce, pawpaw leaves and cabbage waste. Asian Journal of Agricultural Sciences 3(1): 1-4.

Banerjee, G. C. 2008. A Text Book of Animal Husbandry; 8th Edition, Oxford and IBH publishing Co. Pvt Ltd. New Delhi; 110049, India.

Bolaji, B. A. 2005. Animal Welfare Vet. Science Handbook. Evans Press, Ibadan, Nigeria 10-17.

Bowes, V. A., Julian, R. J. and Stirtzinger, T. 1989. Comparison of serum biochemical profiles of male broilers with female broilers and White Leghorn chickens. *Can. J. Vet. Res. 53(1):*

Cheeke, P. R. 2003. Feeding systems for tropical rabbit production emphasizing root, tubers and bananas. http://www.fao.org/DOCEP/003/T0554E/T0554E16.html.

Esonu, B. O., Azubuike, J. C., Udedibie, A. B. I., Opara, M. N. and Iwuji, T. C. 2012). Physiological evaluation of broiler finishers fed fermented bovine blood and rumen digesta meal. *Nig. J. Anim. Prod.* 39 (2): 107 – 113.

Etuk, E. B., Ifeduba, A.V., Okata, U. E., Chiaka, I., Okoli, I. C., Okeudo, N. J., Esonu, B. O., Udedibe, A. B. I. and Moreki, J. C. 2012. Nutrient composition and feeding value of sorghum for livestock and poultry. *Journal of Animal Science Advances* 2 (6): 510-524.

Ewuola, E. O., Ogunlade, J. T., Gbore, F. A., Salako, A. O., Idahor, K. and Egbunike, G. N. 2003. Performance evaluation and organ histology of rabbits fed Fuserium verticilliodes culture materials. *Tropical Animal Investigation* 6: 111-119.

Iheukwumere, F. C. 2008. Effects of feeding *Microdesmis puberula* leaf meal on haematological and serum biochemistry of weaner pigs. *Journal of Science of Agriculture, Food Technology and Environment* 8: 41 – 48.

Ismene, A. D., Katerina, A. M., Dimitrios, I., Nektaria, T., Geoge, A. P. and Theodore, K. 2011. Changes of blood biochemistry in the rabbit animal model in atherosclerosis, a time of stress-effect. Lipid in health and

d i s e a s e s . http//www.lipidsworld.com/content/10/1/139.

Kelly, W. R. 1979. Veterinary Clinical Diagnosis. 2nd edition, Bailliere Tindall, London.

Kwari, I. D., Igwebuike, J. U. and Kwada, M. V. 1999. Effect of replacing maize with spent sorghum grain in performance of laying hens. *Journal of Sustainable Agriculture and the Environment* 1: 25-31.

Omole, T. A., Omoeti, O., Ogunleke, O. 2007. Performance characteristics of weaned rabbits fed graded level of dry cassava peel fortified with soya corn residue. *Journal of Agriculture and Environment* 4: 36-38.

Onyeyilli, P. A., Iwuoha, C. L. and Akinniyi, J. A. 1998. Chronic toxicity study of Ficus platyphylla blumen in rats. *West African Journal of Pharmacology and Drug Resources* 14: 27-30.

Pauzenga, U. 1985. Feeding parent stock. Zootecnica Internationa. 22-24.

Rodgers, R. P. C. 1994. Clinical laboratory methods for detection of antigens and antibodies. Basic and Clinical Immunology, 8th edition. (Eds. D.P. Stites; A.I. Terr and T.G. parslow), pp. 151 – 193. Appleton and Lange, Norwalk, C.T.

SAS 1999. SAS Institute Inc. SAS/STAT Users Guide. Version 8 for windows. SAS Institute Inc., SAS Campus Drive, Cary, North Carolina, USA.

Shuping, Y., Wu, J. D., Scott, R. B., Finlay, M., Jeff, D. W. and Donghai, W. 2009. Properties of field –sprouted sorghum and its performance in ethanol production. *Journal of Cereal Science* 51: 374-380.

Stephen, E. D. 2006. Introduction to Animal Science. Third edition. Global, biological, social and industrial perspectives. Oklahoma State University. Published by Pearson education, Inc., Upper Saddled River, New Jersey 07458.

Taiwo, A. A., Adejuyigbe, A. D., Adebowale, E. A., Oshotan, J. S. and David, O. O. 2004. Effect of *Tridax procumbens, Panicum maximum* and pawpaw (*Carica papaya*) leaves supplement with concentrates on the performance and nutrient digestibility of weaned rabbits. Proc. Of the 29th Annual Conference Nigerian Society of Animal Production (NSAP), March 20 – 25, Usman Dan Fodio University, Sokoto, Nigeria.

Voss, K. A., Platner, R. D., Bacon C. W. and Norred, W. P. 1990. Comparative studies of hepatotocity and fumonisin strain MRC 826 culture material. *Mycopathologia* 112: 81 – 92.

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