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EFFECTS OF DIETARY REPLACEMENT OF MAIZE WITH MALTED OR UNMALTED SORGHUM ON THE PERFORMANCE OF WEANER RABBITS

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ABSTRACT

This study was carried out at the teaching and research farm of Bowen University, Iwo Nigeria. It was designed to evaluate the performance of weaner rabbits fed concentrate and plantain leaf at ratio 50:50. Thirty six crossbred weaner rabbits obtained by crossing Newzealand and Chinchilla breeds purchased from Agrited farm Ibadan, Nigeria were used for this study .They were divided into nine groups such that each dietary treatment was replicated thrice. Three dietary treatments were formulated as the concentrates such that T1 which had maize and other ingredients served as the control while T2 and T3 had their maize portion replaced separately with malted and unmalted sorghum. Thirty six weaned eight week old rabbits were fed for a period of forty nine days which was the duration of the experiment. The feed intake, weight gain, digestibility, blood parameters and economics of raising weaner rabbits on the experimental diets were determined. The dry matter intake varied from 86.64 to 37.16g, the feed conversion ratio (FCR) from 4.09-7.71g.Similar feed intake of rabbit on T1 and T2 indicated that malted sorghum could actually replace the maize portion. The nutrient digestibility of dry matter, crude protein and ether extract were similar between dietT1 and T2 but higher in T3. The blood analysis indicated that white blood cells (WBC) were significantly affected by the dietary treatment while red blood cell (RBC), packed cell volume (PCV), glucose, total protein and Albumin were not significantly ($P>0.05$) affected. Assessment of the carcass characteristics of the weaner rabbit indicated similar carcass weight and dressing percentage for all the dietary treatments. Final liveweight, kidney weight, head and fur were similar for T1 and T2 but were significantly higher in T3.However, the heart and the lungs were similar among the treatments. Mortality rate of 33.33% was, however, recorded in T3 unmalted sorghum in combination with plantain leaf at 50:50. Market weight of 2.5kg/rabbit was attained by 6.46 months for rabbit fed control which was earlier than the other diets which were 8.23 and 9.18 months, respectively.

Key words: Sorghum, concentrates, rabbit performance

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INTRODUCTION

Meeting the animal protein intake for the increasing human population of Nigeria, which is well over 120 million, is a continuous challenge to the animal scientist. Even though a huge percentage of the population in many developing countries have resorted to taking protein of plant origin, the place of animal protein still cannot be over emphasized as animal protein is balanced in essential amino acids[1]

Rabbit meat production has increased considerably in order to meet the increasing demand for animal protein, and to seek alternative to poultry meat, which has declined since the advent of avian influenza [2]. Rabbit meat is also increasingly becoming popular due to the fact that it is nutritious lean and low in fat and cholesterol. Rabbits require at least 6% fiber in their diets for efficient functioning of the alimentary tract and to prevent enteritis [3, 4].Compared with most other meats such as beef, chicken, lamb or pork, it is high in protein and low in fat, cholesterol and sodium. The meat is white fine grained delicately flavored, nutritious and appetizing [4].The potential of rabbits to mitigate the problem of protein –calorie malnutrition in the humid tropics had been recognized and well documented [5,6,7,8] Most of the rabbits in Nigeria are raised mainly on green forages in the wet months of the year. However, with the onset of dry season, the conventional green forages wither, lignifies and at times may not be available due to bush burning. In addition, forages combined with concentrates at certain levels gave better performance than either forage or concentrate fed alone [3, 9].The new impetus for rabbit production in Africa amongst a wide range of people creates the need for alternative cheap sources of rabbit feed to replace or supplement cereals in rabbit concentrate in order to reduce total cost of production [10]. Sorghum (Sorghum bicolor) is grown in many parts of the world where it is used as food for both humans and livestock [11].Malting of sorghum involves steeping or soaking germination, drying and curing in kiln and polishing [12]. Steeping encourages germination to start, germination prepares the conversion of the starch to sugars, and kilning stops the germination to ensure starch is hydrolysed. Conversion of starch to maltose occurs in the mashing process.Plantain leaf has been reported to contain100% dry matter, 5.3 ether extract, 4.38 nitrogen free extract, 23.6 crude fiber, 12.4% ash and 14.8% crude protein [13]. The problem of low intake of animal protein is due to poor economic situation as well as high cost of feeds in intensive commercial units.

This research work, therefore, aims at investigating the effect of replacing maize with malted and unmalted sorghum meal in the diet of rabbits, on their growth performance and carcass characteristics. It also aimed at determining the cost-benefit of this replacement in combination with plantain leaves as supplement.

MATERIALS AND METHODS

The experiment was conducted in the rabbit unit of Teaching and Research farm Bowen University Nigeria. The environmental temperature range for the area was 15-28^{o}C during the dry harmattan season and 20-36^{o}C in the hot season. It receives an annual rainfall of 1400 mm which spreads from April to October.

Experimental Animals and Housing

Thirty six crossbred weaner rabbits obtained by crossing Newzealand and Chinchilla breeds purchased from Agrited Farm Ibadan, Nigeria were used for the study. They were individually housed in wooden cages located in a well ventilated house.

Experimental diets

Sorghum (70kg) to be malted was measured and steeped in quantity of water enough to get it submerged for 4-10 days. Malting is the limited germination of the sorghum grain under carefully controlled conditions. There were three phases: Steeping, germination and kilning. During the steeping water was changed every 8 to 12 hours. A system was devised whereby the water was constantly but slowly drained while being replenished by some type of slow sprayer. The traditional floor malting method was embarked upon where the soaked sorghum was spread on a clean floor to a depth of about 8 inches. The temperature in the germinating room was kept constant at about 60^{o}C. It took about 8 to 10 days for the sorghum to germinate with occasional turning. In the curing stage of kilning, the temperature was raised from 266^{o}C to 338^{o}C for another day and half to 2 days [14].

The malted and unmalted sorghum were separately milled and experimental diets were formulated as shown in Table 2. T1 had 30% maize while in T2 and T3 the maize portion was replaced with malted and unmalted sorghum weight for weight, respectively. These concentrates were fed in combination with plantain leaves at 50:50.The rabbits were randomly assigned, twelve rabbit per dietary treatment replicated thrice in a complete randomized design. The plantain leaves used in this study were harvested dried under the shade and chopped. Rabbits were individually fed the concentrate and plantain leaves in separate feeders at 8.00hours interval implying feeding the animals twice daily. Water was also supplied *ad libitum* in flat bottomed earthen pots. Feed intake and weight changes were monitored.

Digestibility Study

The digestibility study was conducted using six rabbits per treatment in the fifth week of feeding. Faecal and urine samples were collected daily for four days and stored at -20^{o}c in a deep freezer immediately after collection. At the end of each collection period, the faecal samples were bulked for each animal and chemical analysis was done to assess the proximate composition according to procedure outlined by AOAC [13].

Carcass analysis
Carcass characteristics were assessed at the end of the seventh week. Nine rabbits (three per treatment) were weighed randomly selected from each treatment for carcass evaluation. These were weighed, fasted overnight and re-weighed prior to slaughtering. The animals were thoroughly bled by hanging; head down through the hind leg on a nail, then the carcass were dissected and eviscerated. The weight of internal and external offals were taken and recorded.

Blood analysis
Six rabbits randomly selected from each group were bled by puncturing the ear vein with new syringes and allowing free flow of blood into labeled sterile universal bottles. Blood was collected into sterile bottles containing 1.0 mg/ml ethyl diamine tetra acetic (EDTA) and 0.1 mg/ml Heparin for haematological components while another set were collected in bottles without anticoagulant to determine the biochemical components [15].

Chemical analysis
The milled samples of feed, faeces and aliquots of urine samples were analyzed for nitrogen, using semi micro kjedahl techniques AOAC [13]. The feeds were analyzed for ether extract, crude fiber and ash. The gross energy values of the feed faeces and urine were determined using Gallenkamp oxygen bomb calorimeter AOAC [13].

Economic analysis
To calculate the cost per kg feed, the price of each ingredient was taken, and this was used to multiply the quantity (kg) of ingredients used in compounding each diet, then summed up for different experimental diets for the calculation of feed cost per kg. The market cost of each experimental ingredient at the time of this study was used to calculate the total cost of the feed per kg diet, and total cost of feed consumed per rabbit. The required market weight for a rabbit is 2.5kg, thus, time required to attain a market weight was calculated by dividing the weight required, by the daily weight gain and then dividing by 30 days to convert to months [16].

Data analysis
Data generated were subjected to analysis of variance, differences between means were separated with Duncan multiple range test using the SAS software package[17].

RESULTS

From the results in Tables 1, 2, 3, 4, 5 and 6, the following observations were recorded. The dry matter intake of rabbits fed diets I and II were significantly ($P \leq 0.05$) higher than Diet 3. The crude protein and ether extract intake had same statistical trend as the dry matter intake. The final body weight of the experimental animals fed diets 1 and 2 were similar (Fig I). The white blood cells were significantly ($P \leq 0.05$) affected by the dietary treatment, however, red blood cell, packed cell volume, glucose, total protein and

albumin were not affected. Carcass characteristics indicated significant effect of the dietary treatment on most of the parameters considered. The economic analysis revealed that T3 was cheaper compared to other diets. However, rabbits on Diet 3 required longer period to attain the desired market weight.

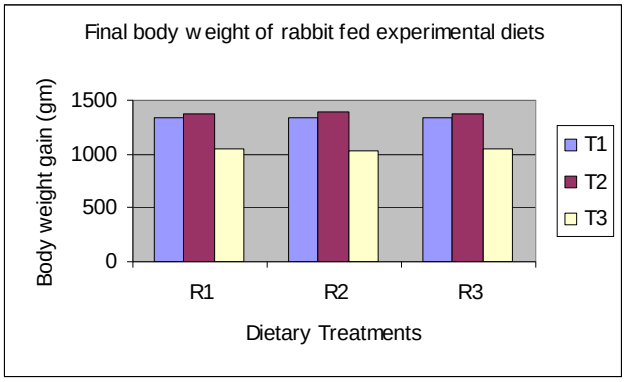

Figure 1: final body weight of rabbits fed experimental diets

DISCUSSION

The dry matter intakes were at variance to those of Adegbola and okonkwo [18] who reported 44.24 to 66.85g/d for rabbit fed diet containing maize and varying levels of cassava leaf meal. It was asserted that feed intake is a logical consequence of the energy content of the diet. The similar body weight gain recorded for rabbit on diets 2 and 3 is an indication of feed utilization and thus implies the malted sorghum could replace maize in concentrate, fed with plantain leaves without adverse effect on the rabbit. The nutrient digestibility of dry matter, crude protein and ether extract which were similar in Diets 1 and 2 but higher than 3 can be attributed to the importance of steeping of sorghum before inclusion in the diet as adduced by Jonathan[14]. Grains with hard testa or those with high content of tannins may be sprouted before incorporation into the feed. During germination process, most of the nutrients in the growing grains are predigested with the grains innate enzymes, making them more available probably the tannin content was drastically reduced by this process thus enhancing its utilization.

The serum total protein and albumin non significant difference could probably be due to isonitrogenous nature of the diets. This agrees with the findings which reported that albumin levels tend to remain constant throughout life after reaching a maximum at about 3 weeks of age [19]. The findings here also showed that there were significant differences in the glucose of the rabbits fed. The result here agrees with findings of a study which did not support the hypothesis that foods rich in soluble fiber produce low blood sugar responses [20].

The red blood cells, packed cell volume, glucose, total protein and albumin revealed no significant difference; by implication the dietary treatments were able to support normal growth. The white blood cell of rabbits fed control were significantly ($P<0.05$) lowered compared to others. Values observed in this study were lowered than those values reported by [20]. The results of the haematological indices suggest that all the rabbits, irrespective of diet, have normocytic and normochromic red cells. This is an indication that feeding of rabbits with diets containing malted or unmalted sorghum at 50:50 ratio with plantain leaves does not affect the utilization of iron.

Assessment of the carcass characteristics indicated similar carcass weight and dressing percentage for all the dietary treatments. Final liveweight, kidney, head and fur weight were similar in diets T1 and T2 but significantly higher than T3. However, the heart and the lung were similar among the treatments. The replacement of maize with either malted or unmalted sorghum in rabbit diet did not have significant influence ($P>0.05$) on the heart and the lung. Carcass analysis reported in this study was comparable to the observation of Agunbiade [21] for rabbits fed varying levels of cassava peel and cassava leaf meal diet.
The carcass results obtained for the external offal in this study were in close range with the result obtained by Olorunsanya [22] for rabbits fed diet with varying levels of raw and processed puereria seed meal. It was established that the dietary feeds were not promoting weight of viscera organs at the expense of lean meat.

Total feed required to market weight (TFWT) was calculated as daily feed intake multiplied by cost per kg intake as outlined by Iyeghe-Erakpotobor [16]. Although the feed cost incurred on diet 3 was the cheapest, animals fed on the diet did not attain desired market weight early enough. This was similar to the report of Arowora [23] who fed biodegraded cassava to weaner pig.

It could be observed that comparable gains were obtained between the control diet and diet 2.The lowest feed cost per kg live weight was recorded in Diet 3 but if we are projecting that rabbit should reach market weight quickly Diet 1 will be preferred. Mortality of 33.33% was however, recorded in diet 3 the cause was not immediately understood but could be attributed to varied management practices as reported by Gugolek [24] precisely handling of hygiene. The tannin content of unmalted sorghum in diet 3 was implicated for the mortality since it produces anti- nutritive effect on nutrient digestibility and utilization in animals.

CONCLUSION

Nutritional adequacy for economic growth of weaner rabbits can be attained with the use of malted sorghum supplemented without negatively affecting the performance of the experimental animals.

Table 1: Chemical composition of feed ingredients (%)

Components	Maize	Sorghum
Dry matter	90.10	87.34
Organic matter	90.53	93.76
Crude protein	9.65	11.62
Ether extract	3.98	2.92
Crude fiber	1. 99	4.83
Ash	9.47	6.24
Nitrogen free extract	73.46	67.97
ME, kcal/kg	3271	3087

ME = Metabolisable energy

Source: AOAC

Table 2: Gross composition of experimental diet

Ingredients	T1(%)	T2(%)	T3(%)
Maize	30.00	0.00	0.00
Malted Sorghum	0.00	30.00	0.00
Unmalted Sorghum	0.00	0.00	30.00
Corn Bran	10.00	10.0	10.00
Wheat Bran	17.00	17.00	17.00
Soybean meal	16.00	16.00	16.00
Groundnut Cake	13.00	13.00	13.00
Palm Kernel Cake	7.00	7.00	7.00
Bone meal	2.00	2.00	2.00
Oyster Shell	1.00	1.00	1.00
Fish meal	3.00	3.00	3.00
Salt	0.50	0.50	0.50
*Premix	0.50	0.50	0.50
Total	100	100	100
Calculated analysis			
Crude Protein (%)	22.78	22.48	22.48
Metabolisable energy (Kcal/g)	2611.35	2391.15	2391.15

*1kg premix
Vit A I.U 10,000,000.00, Vit B I.U 2,000,000.00, Vit E mg 20,000.00, Vit K3 mg 2,000.00, Vit B1 mg 3,000.00, Vit B2 mg 5,000.00, Niacin mg 45,000.00, Calcium Pantothenate mg 10,000.00, Vit B6 mg 4,000.00, Vit B12 mg 20.00, Folic acid mg 1,000.00, Biotin mg 50.00, Chorine Chloride mg 300,000.00, Manganese mg 120,000.00, Iron mg 100,000.00, Zinc mg 80,000.00, Copper mg 8,500.00, Iodine mg 1,500.00, Cobalt mg 300.00, Selenium mg 120.00, Anti-Oxidant mg 120,000.00

Table 3: Performance characteristics and nutrient digestibility of rabbit fed experimental diets

Parameters	T1	T2	T3	SEM
Actual weight gain (g)	753.10 [a]	881.10 [a]	546.90 [b]	0.22
Average weight gain (g/day)	12.9	10.12	9.08	0.09
Totaldry matter intake (g/day)	86.64 [a]	88.00 [a]	37.16 [b]	0.15
Crude protein (g/day)	19.31 [a]	19.46 [a]	7.2 [b]	0.12
Ether extract (g/day)	3.42 [a]	2.72 [a]	1.40 [b]	0.10
Feed conversion efficiency	7.11	7.71	4.09	0.12
Mortality (%)	0 [a]	0 [a]	33.33 [b]	0.57
Percentage digestibility				
Dry matter	80.45 [a]	81.23 [a]	68.67 [b]	8.77
Crude protein	77.34 [a]	75.23 [a]	63.11 [b]	5.67
Crude fiber	43.44 [a]	40.38 [a]	32.75 [b]	4.89
Ether extract	76.78 [a]	78.45 [a]	63.00 [b]	6.73

Means along the same row with different superscripts differ significantly (P<0.05)

Table 4: Some haematological and serum metabolites of rabbit fed experimental diets

	TREATMENTS			
PARAMETERS	T1	T2	T3	SEM
Red Blood Cell (* 10^{12}/L)	5.32[a]	6.24[a]	6.52[a]	0.11
White Blood Cell (* 10^{9}/L)	8.68[b]	9.24[ab]	10.32[a]	0.45
Packed Cell Volume (%)	33.00	34.00	35.33	0.96
Glucose (mg/dl)	99.19[b]	117.74[b]	158.51[a]	11.11
Total Protein (g/l)	6.06	6.82	6.67	0.25
Albumin (g/l)	2.77	3.26	3.07	0.23

Means along the same row with different superscripts differ significantly (P<0.05)

Table 5: Carcass characteristics of rabbits fed experimental diet

	TREATMENTS			
PARAMETERS	T1	T2	T3	SEM
Final live weight (g)	1348.30[b]	1381.31[a]	1056.90[c]	0.16
Bled weight (g)	1316.50[a]	1342.71[a]	1029.30[c]	0.19
Heart weight (g)	2.60	3.00	2.70	0.10
Lung weight (g)	6.00[a]	5.80[b]	6.10 [a]	0.08
Liver weight (g)	26.30[b]	19.90[c]	32.90 [a]	0.13
Kidney weight (g)	6.20[b]	8.40[a]	1.10[c]	0.10
Head weight (g)	124.50[b]	138.00[a]	113.50[c]	0.41
Gastro intestinal tract (g)	253.80[c]	275.40[a]	265.00[b]	0.36
Dressed weight (g)	772.70[a]	734.30[b]	549.50[c]	0.20
Fur (g)	101.80[b]	112.30[a]	81.40[c]	0.11

Means along the same row with different superscripts differ significantly (P<0.05)

Table 6: Cost analysis and economy of production of rabbits fed experimental diets

Parameters	T1	T2	T3
Cost per kg diet( )	37.81	38.11	36.61
Cost of feed intake/rabbit( )	3,275.85	2972.58	1360.43
Time required to market weight (mth)	6.46	8.23	9.18
Total feed required to market weight(kg)	599.69	641.94	341.13
Total cost of feeding( )	22,674	24,464	12,488

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