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Effects of Different Agro Industrial by-Products on the Growth Performance, Carcass Characteristics and Blood Profiles of Growing Rabbits

Makinde, O. John[1]*, Sikiru Akeem B[2], Ajibade, A. Johnson[3], Opoola, Emmanuel[4], Ibe, E. Agwor[5] and Ibikunle K. Yemiola[6]

[1]Department of Animal Science, Federal University, Gashua, Nigeria
[2]Department of Animal Production Technology, Federal University of Technology, Minna, Nigeria
[3]Department of Animal Production Technology, Federal College of Wildlife Management, Nigeria
[4]Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria
[5]Department of Agricultural Technology, Akanu Ibiam Federal Polytechnic, Unwana, Afikpo, Nigeria.
[6]National Institute of Hospitality and Tourism, Edo State, Nigeria.

***Corresponding Author:** Makinde, O. John, Department of Animal Science, Federal University, Gashua, Nigeria*

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ABSTRACT

An experiment was conducted to evaluate the response of growing rabbits to diets containing different agro industrial by-products. A total of 24 weaner rabbits were used for this study. Four experimental diets were formulated and designated as T1, T2, T3, and T4. T1 (control diet) contained 20% rice offal (RO) as its main fibre source while T2, T3 and T4 contained 20 % each of Burukutu waste (BKT), Cassava peel meal (CPM) and Maize offal (MO) respectively as their main fibre source. The rabbits were randomly allocated to four experimental treatments of six rabbits per treatment while each treatment was replicated three times with two (2) rabbits per hutch in a completely randomized design. The result of growth performance revealed that average weight gain and feed conversion ratio were significantly ($P<0.05$) influenced by the dietary treatments. Rabbits fed 20% BKT had superior weight gain compare with those fed other diets. Average feed intake was however not influenced ($P>0.05$) by the dietary treatments. There were significant ($P<0.05$) differences in the carcass parameters measured except the weight of chest, thigh, hindleg and foreleg. Rabbits fed 20% MO diet had lowest values in all the parameters measured. Organs weight were not significantly ($P>0.05$) different across the treatment groups except in intestinal weight. Also, there were significant ($P<0.05$) differences in all the haematological parameters measured except in the values of haemoglobin. Glucose and Urea were significantly different ($P<0.05$) among the serum parameters measured. It was concluded that 20% BKT can be included in the diet of grower rabbits without adverse effect on growth performance of rabbits.

Keywords: *growing rabbits, burukutu waste, maize offal, rice offal, growth performance*

INTRODUCTION

The rabbit (*Oryctolagus cunniculus*) is a non-ruminant herbivore which utilizes much undigested, unabsorbed feed materials, primarily cellulose, as a source of nutrients for maintenance and production. They are known to have the ability to thrive on non-conventional feedstuffs and forages which cannot be consumed directly by man.

Although rabbits can survive on all forage diets, optimum performance can only be ensured in a mixed feeding regime involving forage and formulated feeds (Arijeniwa *et al.*, 2000). The profitability of rabbit production as an enterprise depends on the number of rabbits kindled per doe per year and the postnatal survival of the kittens.

Feed constitute the dominant input in animal production ranging from 65 - 75 % of the total cost of production. Similarly, feed ingredient account for over 90 % of compound feed industry (Esonu *et al.*, 2006). Therefore, the relationship between feed ingredient and animal

production output is both direct and obvious. It has been reported that conventional protein and energy feed ingredients for non-ruminants including rabbits, are very scarce and expensive because of the competition between humans and this group of livestock (Esonu *et al.*,2004). This trend has necessitated the use of agro industrial byproducts such as cassava peel meal, wheat offal, yam peel meal, maize offal, sweet potato peel meal, rice offal, groundnut shell, palm kernel meal, brewers dried grains etc. in formulating feed for the livestock.

Locally processed brewers dried grain (Burukutu waste) was reported to contain 93% dry matter, 22.39% crude protein, 19.1% crude fibre, 4 %ash, 48.6% nitrogen free extract, gross energy of 2280kcal per kg, 6.2% ether extact (Obidimma, 2009). It was also reported to contain very high fibre which made it very difficult for monogastrics such as poultry to utilize effectively at high levels in their diets (Makinde *et al.*, 2013). Maize offal is a by-product of maize milling processes, second to wheat offal as the most preferred and utilized conventionally in livestock feeds in Nigeria (Babatunde and Oluyemi, 2002). Maize offal contains about 110 to 120 g/kg crude protein and 80 to 90 g/kg crude fibre (Onifade and Babatunde, 1998). The relatively low crude fibre content compared to other agro industrial by-products could be an advantage in fibre nutrition whereas the low protein content appears to be a limitation. Rice offal has high lysine and methionine content (Tsvetanov and Duneva, 1990) and it is available in large quantities all year round in many towns in the rice growing areas of Nigeria (Makinde *et al.*, 2014). However, its phytate content, enzyme inhibitor, high fibre content and oxidative rancidity may have deleterious effects on poultry. Rice offal may become rancid and decrease poultry growth performance and lipid stability of meat (Chae *et al.*, 2002). It is suggested to include it at relatively low levels (up to 15% only) in poultry diets (Vieira *et al.*, 2007; Makinde *et al.*, 2014) as higher levels may result in low calcification, decreased feed intake and even mortality above 80% inclusion (ArunaTomar and Singh, 1999). Despite the availability of various nutrients in these agro industrial byproducts, information on the response of rabbits when fed these byproducts in the diets is scanty, therefore, this study aimed at assessing the response of growing rabbits to diets containing different agro industrial byproducts.

MATERIALS AND METHOD

Experimental Site

This study was conducted at the Rabbitry Unit of the Teaching and Research Farm, Federal College of Wildlife Management (FCWM), New Bussa, Niger State, Nigeria. The poultry building is an open sided type that permits adequate ventilation in the house, with a concrete floor and zinc-roofing sheet. New Bussa sits at 9°53′N 4°31′E, and the original town of Bussa is located about 40 km North of New Bussa at 10°13′51″N 4°28′31″E (altitude 170 m.a.s.l.). The climate of the area is tropical with monthly average temperature of 34°C and mean annual relative humidity of 60%.

Sources of Experimental Materials

The agro industrial by-products used in this study were burukutu waste, cassava peel meal, rice offal and maize offal which were purchased around Neighbouring market within New- Bussa and its catchment areas.

Experimental Design and Management of Birds

Twenty four (24) weaner rabbits of composite breeds and mixed sexes, aged between 5 and 6 weeks were procured from the local rabbitry farmers in Mokwa, Niger state. The rabbits were raised on hutches at the College farm. The rabbits were housed according to treatments in a well-ventilated room in hutches. The hutches were fitted with drinkers and feeders. The rabbits were pre-conditioned for 3 days, during which they were treated against parasitic infestation with Ivermectin subcutaneously. They were given access to feed and clean water *ad libitum* during the 54 days in which experiment lasted. At the commencement of the study, the rabbits (initial average weight = 805g) were randomly allocated to four experimental treatments of six rabbits per treatment, while each treatment was replicated three times (2 rabbits per replicate) in a completely randomized design (CRD).

Experimental Diets

Four experimental diets were formulated and designated as T1, T2, T3, and T4. T1 (control diet) contained 20% rice offal (RO) as its main fibre source while T2, T3 and T4 contained 20 % each of Burukutu waste (BKT), Cassava peel

meal (CPM) and Maize offal (MO) respectively as their main fibre source. The proximate composition of the different agro industrial by products and gross composition of the experimental diets are presented on Table 1 and 2 respectively.

Table1. *Proximate Composition of different agro industrial by products*

Nutrients, %	Rice offal	Burukutu waste	Cassava Peel Meal	Maize offal
Dry Matter	92.63	93.54	90.56	93.89
Crude protein	17.08	24.07	18.98	17.02
Crude fibre	6.04	8.20	8.05	4.91
Ash	6.21	5.00	6.64	6.81
Ether Extract	6.69	4.50	5.19	6.77
Nitrogen free extract	56.61	51.77	51.7	58.38

Table2. *Gross composition of Experimental diets*

Ingredients, Kg	20% RO	20% BDG	20% CPM	20% MO
Maize	50.00	50.00	50.00	50.00
Groundnut cake	15.00	15.00	15.00	15.00
Fish meal	1.00	1.00	1.00	1.00
Soyabean	12.00	12.00	12.00	12.00
Rice offal	20.00	-	-	-
Burukutu waste	-	20.00	-	-
Cassava peel meal	-	-	20.00	-
Maize offal	-	-	-	20.00
Bone meal	1.00	1.00	1.00	1.00
Salt	0.40	0.40	0.40	0.40
*Premix	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Nutrients, %				
Crude protein	16.93	17.06	15.98	15.67
Crude fibre	10.39	10.47	10.87	10.65
Ether extract	5.73	5.88	5.76	5.80
M.E (Kcal/kgME)	2502.08	2670.46	2571.65	2580.09

*BKT=Burukutu waste, MO=Maize offal, RO=Rice offal, CPM=Cassava peel meal. ME=Metabolizable energy. *Premix in diets provided per kg: Vit. A 10000 IU, Vit. B 2000 IU, Vit. E 13000 IU, Vit. K 1500mg, Vit. B12 10mg, Riboflavin 5000mg, Pyridoxine 1300mg, Thiamine 1300mg, Panthothenic acid 8000mg, Nicotinic acid 28000mg, Folic acid 500mg, Biotin 40mg, Copper 7000mg, Manganese 48000mg, Iron 58000mg, Zinc 58000mg, Selenium 120mg, Iodine 60mg, Cobalt 300mg, Choline 27500mg*

Data Collection

Growth Performance Study

Rabbits were weighed individually at the beginning of the experiment and weekly thereafter for the duration of the experiment using weighing scale. Weighing was done before the morning feeding. The parameters determined for the evaluation of growth performance were initial weight (g), average feed intake (g), average weight gain (g) and feed conversion ratio. Weight gain for each animal was calculated by subtracting the initial weight (g) from the final weight (g), while the feed conversion ratio was calculated by dividing the average feed intake (g) by the average weight gain (g).

Blood Collection

At the end of the study period, 5ml of blood was collected from three rabbits per treatment by severing the jugular vein and put into bottles containing Ethylene Diaminetetra- acetic Acid (EDTA) to determine the packed cell volume (PVC), red blood cell (RBC), haemoglobin (Hb), and white blood cell (WBC). Blood sample meant for serum biochemical studies were collected into plane bottles (without Anti-coagulant) to enhance serum separation. The blood serum obtained was used to determine total protein (TP), Albumin, Globulin, Glucose and Urea. All the analysis was done at the

College Research Laboratory according to the methods described by Kohn and Allen (1995); Schalm *et al*. (1975) and Peters *et al.* (1982).

Carcass and Organs Weight Determination

At the end of the feeding trial, three rabbits per treatment were selected for carcass evaluation. The rabbits were fasted overnight but allowed access to water so as to empty the gut and allow excretion of the undigested feed residue. They were weighed, slaughtered, defurred using flame (singering) and then eviscerated. Individual internal organ (heart, liver, kidneys, lungs, viscera and spleen) were weighed and expressed as percentage of the live weight. The dressed carcass were weighed and dressing percentage was calculated as a percentage of the live weight using the formula.

$$\text{Dressing percentage (\%)} = \frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

The carcass were subsequently cut into different portions viz: head, tail, feet, shoulder, rack/ribs, loin and hind legs, weighed on sensitive weighing scale and expressed as percentages of the carcass following the standard procedures described by Njidda and Isidahomen (2011).

Chemical Analysis

Proximate composition of different agro industrial by products and experimental diets were analysed using the methods described by AOAC (2006).

Statistical Analysis

Data collected were subjected to analysis of Variance using SAS software (SAS, 2008) while significant means were separated with Duncan multiple range test at 5% level of significance.

RESULTS

Table 3 shows the result of the growth performance of growing rabbits fed diets containing different agro industrial by-products. There were significant (P<0.05) differences in the daily weight gain and feed conversion ratio of the rabbits. Daily weight gain of rabbits fed 20% BKT was higher (P<0.05) than those fed other diets. The lowest daily weight gain was recorded among rabbits fed 20% MO diets. Rabbits fed 20% BKT had better feed conversion ratio (P<0.05) than those fed other diets. There was no significant (P>0.05) difference in the daily feed intake of rabbits.

Table 4 shows the result of the Carcass characteristics and Organs weight of growing rabbits fed diets containing different agro industrial by-products. There were significant (P<0.05) differences in the parameters measured except the weight of chest, thigh, hindleg and foreleg.

Rabbits fed 20% MO diet had lowest values in all the parameters measured. Organs weight were not significantly (P>0.05) different across the treatment groups except in intestinal weight. BKT diet gave higher values (P<0.05) in most of the parameters measured.

Table 5 shows the result of the Haematological parameters and serum biochemical indices of growing rabbits fed diets containing different agro industrial by-products. There were significant (P<0.05) differences in the parameters measured except in the values of haemoglobin. Glucose and Urea were the only serum biochemical indices that were significantly different (P<0.05) among the serum parameters measured across the treatment groups.

Table3. *Growth Performance of growing rabbits fed diets containing different agro industrial by-products*

Parameters	20% RO	20% BKT	20% CPM	20% MO	SEM
Initial weight, g	806.62	805.01	805.90	804.98	0.83
Final weight, g	1503.33^{b}	1850.00^{a}	1523.07^{b}	13337.64^{b}	128.09
Total weight gain, g	696.71^{b}	1044.99^{a}	717.17^{b}	532.66^{b}	128.08
Daily weight gain, g	12.90^{b}	19.35^{a}	13.29^{b}	9.86^{b}	2.37
Total feed intake, g	3222.90	3176.06	3357.90	3188.70	90.95
Daily feed intake, g	59.68	58.82	62.18	59.05	1.69
Feed conversion ratio	4.62^{b}	3.04^{a}	4.68^{b}	5.99^{c}	0.74

abc = mean with different superscripts within the same row are significantly (P<0.05) different. SEM=standard error of mean. BKT=Burukutu waste, MO=Maize offal, RO=Rice offal, CPM=Cassava peel meal

Table4. *Carcass characteristics of growing rabbits fed diets containing different agro industrial by-products*

Parameters	20% RO	20% BKT	20% CPM	20% MO	SEM
Live weight, g	1450.00^{b}	1733.33^{a}	1325.98^{bc}	1226.67^{c}	128.67
Slaughter weight, g	1400.00^{a}	1648.34^{a}	1235.00^{ab}	1107.01^{b}	135.33
Dressed weight, g	1010.00^{a}	1381.67^{a}	958.07^{b}	856.60^{b}	131.27
Dressing percentage,%	69.66^{b}	79.71^{a}	72.25^{b}	69.83^{b}	2.51
Chest,%	14.94	15.49	14.98	12.00	1.80
Thigh, %	7.57	7.64	6.51	5.79	0.93
Loin, %	18.75^{a}	20.62^{a}	20.63^{a}	13.05^{b}	1.89
Hindleg, %	3.81	6.24	5.19	2.90	0.84
Foreleg, %	3.80	3.82	3.81	2.89	0.47
Organs weight					
Lungs, %	0.54	0.63	0.50	0.40	0.12
Kidney, %	0.62	0.71	0.66	0.52	0.11
Liver, %	2.17	2.55	2.31	1.54	0.52
Spleen, %	0.03	0.04	0.04	0.02	0.01
Heart, %	0.23	0.28	0.23	0.16	0.07
Intestine weight, %	16.26^{a}	18.75^{a}	17.26^{a}	11.58^{b}	1.79

abc = mean with different superscripts within the same row are significantly (P<0.05) different. SEM=standard error of mean. BKT=Burukutu waste, MO=Maize offal, RO=Rice offal, CPM=Cassava peel meal

Table5. *Haematological parameters and serum biochemical indices of growing rabbits fed diets containing different agro industrial by-products*

Parameters	20% RO	20% BKT	20% CPM	20% MO	SEM
Packed cell volume (%)	30.60^{b}	29.17^{b}	38.26^{a}	28.05^{b}	2.55
Haemoglobin (g/dl)	10.20	9.70	12.68	8.96	1.87
White blood cell X10^{6}	75.10^{c}	85.81^{b}	97.90^{a}	82.29^{b}	5.71
Red blood cell X 10^{9}	16.63^{a}	12.77^{b}	14.99^{ab}	13.05^{b}	1.93
Serum Biochemistry					
Albumin, g/dl	3.22	3.07	3.24	3.15	0.09
Glucose, g/dl	98.05^{a}	102.29^{a}	99.24^{a}	90.81^{b}	2.88
Total protein, g/dl	5.01	6.43	5.65	5.98	0.72
Globulin, g/dl	1.79	3.36	2.41	2.83	0.79
Urea, g/dl	31.28^{b}	43.16^{a}	35.94^{b}	38.94^{a}	2.97

abc = mean with different superscripts within the same row are significantly (P<0.05) different. SEM=standard error of mean. BKT=Burukutu waste, MO=Maize offal, RO=Rice offal, CPM=Cassava peel meal

DISCUSSION

Growth Performance

There have been wide variations in responses of rabbits to the use of Agro industrial byproducts in poultry diets. These were attributed to differences in quality, varieties, storage periods, climatic conditions to mention but a few. However, there are several literature reports on the inclusion levels of these unconventional, agro by-products in rabbit diets without adverse effect on performance in Nigeria (Orunmuyi *et al.*,2006; Adeyemi *et al.*,2014; Makinde, 2016). In this present study, the average daily weight gain and feed conversion ratio of rabbits fed 20% BKT diet was better than those fed other diets. This observation may be attributed to the higher crude protein content (24.07%) of BKT compared with other test ingredients. This result agrees with the report of (Abdulmalik, 1997) reported that sorghum beer residue from the industry can be included at a level of 15 and 20% in the diets of breeding and weanling does respectively without adverse effects on performance. (Tegbe *et al.*, 1995) fed diets of 0, 12.5, 25 and 37.5% *burukutu* waste to adult pigs and found that performance characteristics related to feed intake, weight gain and feed to gain ratio were not affected by the level of inclusion of the waste. The decrease observed in

body weight gain of rabbits fed 20%R.O, 20%CPM and 20% M.O diets may be attributed to the anti-nutritional factors such as trypsin inhibitors and tannins which might have impaired the absorption of nutrients in the ingesta thereby resulting in depressed weight gain (Esminger *et al.,* 1996). Anti-nutrients are known for interfering with nutrient utilization by forming complexes with the substrate at the site of digestion (Abeke *et al.,* 2008). Also, it can be inferred from these results that the nutrients supplied by these diets were not enough to produce significant increase in weight similar to the rabbits fed BKT based diets. Kocher (2001) reported that rice offal is known to contain high level of fibre and low protein and energy and high dietary fibre depresses apparent digestibility of dry matter and nitrogen, decreases daily body weight and increase feed to gain ratio (Longe and Adekoya, 1988).

Carcass Characteristics

The values obtained on the carcass parameters measured across the treatment groups is a true reflection of the body weight performance indices and that of body development. This indicates that the nutrients supplied by the BKT diet was adequate and produced carcass parameters that were better than those on other diets. The cut-up parts such as head, tail, feet, shoulder, rack/ribs, loin and hind legs (expressed as percentage of carcass weight) of the rabbits fed 20% BKT diet followed the performance pattern of the body weight development. The weight of different organs measured were not (P>0.05) different across the treatment groups. The values of these organs indicate that there were no metabolic defects among rabbits fed the experimental diets. The lower weight of some organs have been attributed to the pathological effect of residual of antinutritional factors (tannin, phytin e.t.c) present in some agro industrial by products. The lack of effect (P>0.05) in the values of spleen and other organs of grower turkeys fed the control and 15% W.O diets implies that wheat offal can be included in the diet of rabbits and the immunity of the rabbits against disease would not be compromised since spleen is the major source of lymphocytes and the storage site for white and red blood cells (Hetland and Svihus, 2001). Similar reports have been given on carcass characteristics of rabbits fed other relatively high fibre sources such as cassava peels and cassava leaf meal (Agunbiade *et al*., 1999).

Blood Profiles

Haematological parameters are good indicators of the physiological status of animals (Adenkola and Durotoye, 2004; Khan and Zafar, 2005). Changes in haematological parameters are of value in assessing the responses of animals to various physiological and disease conditions (Schalm *et al.*, 1975; Yadav *et al.*, 2002; Khan and Zafar, 2005). The values of haematological parameters and serum biochemical indices observed in this study fall within the normal range reported by Mitruka and Rawnsley (1977). According to Togun *et al.* (2007), when the haematological values fall within the normal range reported for rabbits by Mitruka and Rawnsley (1977), it is an indication that the diets did not show any adverse effects on haematological parameters during the experimental period, but when the values fall below the normal range, it is an indication of anaemia (Mitruka and Rawnsley, 1977; Radostits, 1994; Ameen *et al.*,2007).

Low haematological values such as 30% Packed Cell Volume (PCV), Haemoglobin Concentration (Hb) of 10.30g/dl and Red Blood Cell (RBC) counts of 7.10 x 10^6/ml as reported by Bawala *et al.* (2007) could be due to the harmful effects of high dietary content. Differences observed in Packed Cell Volume (PCV) and MCV for animals in different treatment groups may be attributed to the physiological and nutritional status of the animals (Esonu *et al.*, 2001). Eheba *et al.* (2008) noted that a decrease in WBC count, however, reflected a fall in the production of defensive mechanism to combat infection. Togun *et al.* (2007) reported that a significantly lower lymphocyte count was an indication of a reduction in the ability of the experimental rabbits to produce and release antibiotics when infections occur (Campbell and Lasley, 1975).

CONCLUSION

Based on the result of this study, it can be concluded that out of the four fibre sources studied, burukutu waste gave the best result in terms of the growth performance, carcass yield and blood profiles of growing rabbits.

RECOMMENDATIONS

Based on the result of this study, it is recommended that 20% burukutu waste can be included in the diet of growing rabbits without

adverse effect on growth performance, carcass yield and blood profiles of growing rabbits.

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