

Effect of roselle (*Hibiscus sabdariffa* LINN) calyx residue on growth performance, haematological and serum biochemical indices of weaner rabbits

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ABSTRACT: The study was carried out to determine the growth performance, haematological and serum biochemical indices of weaner rabbits fed roselle (*Hibiscus sabdariffa*) calyx residue. Thirty (30) rabbits were allotted into five treatments with six rabbits per treatment. Each treatment was replicated three times with two rabbits per replicate. The rabbits were fed concentrates and varied levels of *Tridax procumbens* and roselle calyx residue (100 and 0% for T₁, 75 and 25% for T₂, 50 and 50% for T₃, 25 and 75% for T₄, 0% and 100% for T₅ respectively). Parameters measured for growth performance are feed intake, weight gain and feed conversion ratio (FCR). The experiment lasted for four weeks, at the end of which blood samples were collected for haematological and serum biochemical indices. Results showed that rabbits in T₄ had significantly higher average daily weight gain (15.66 g/r/d) and better FCR (0.72) when compared to other treatments. The white blood cells values varied significantly ($p < 0.05$) across the dietary treatments in which rabbits in T₄ recorded the highest value ($6.30 \times 10^3/\text{mm}^3$) which was statistically similar to those in T₁ ($6.13 \times 10^3/\text{mm}^3$), while the lowest value was observed with rabbits in T₃ ($4.50 \times 10^3/\text{mm}^3$). The neutrophils count observed ranged from 23.00 to 32.50% while the eosinophils count ranged from 1.50 to 3.00%. The result for serum biochemical indices showed that the dietary treatment did not significantly influence ($p > 0.05$) the parameters measured except for Alanine Amino-transferase. The alanine amino-transferase value ranged significantly from 40.24 to 53.22 g/dL. It was therefore concluded that 75% of roselle calyx residue presented a better result in all parameters evaluated and can be recommended as a supplemental feed for growing rabbits.

Keywords: Haematology, performance, rabbits, roselle calyx residue, serum biochemistry, *Tridax procumbens*.

INTRODUCTION

Rabbit (*Oryctolagus cuniculus*) plays significant role in solving the inadequacies of animal protein due to their high prolificacy, high growth rate, short generation interval, limited vital space, early maturity, ample nutritional spectrum, remarkable capacity to convert roughages into meat, easy management, good meat quality and low capital intensive (Jiwuba et al., 2016). Rabbit meat is white, high in quality protein with very low fat and cholesterol. It contains fats with higher proportion of essential polyunsaturated fatty acid such as linolenic and linoleic acids and also rich in certain vitamins and minerals (Amaefule et al., 2005). In view of the above, rabbit keeping is increasingly becoming important and popular in

developing countries especially Nigeria, due to the fact that no religious taboo is against its rearing and consumption (Makinde et al., 2014). However, the use of compounded concentrate alone in the feeding of rabbits has also not given optimal results. The use of high concentrates and conventional feedstuff which have numerous uses for human consumption with low forage levels currently practiced by rabbit farmers has made the demand very high resulting in very expensive rabbits that consumers are unwilling to purchase (Balogun et al., 2016). This has become a problem given low price of selling rabbit compared with the high cost of production therefore making commercial production of rabbit an

expensive and unprofitable venture. Dietary fibres are one of the main components of rabbits' feed (Gidenne and Lebas, 2002) because they play a key role in rabbit feeding by contributing to caecum activity for efficient digestion. Crude fibre level in growing rabbits diet varies from 14 to 16% (Djago et al., 2010), unfortunately, the availability of forages, main sources of fibre is low in peri-urban areas and farmers have difficulties in providing rabbits with grass (Houndonoubo et al., 2012). Therefore, the search for alternative cheap sources of feed to improve the scope of animal production which may as well increase the amount of protein intake by Nigerians continue to challenge the professionals in livestock farming in Nigeria (Ukorebi et al., 2019a).

Roselle (*Hibiscus sabdariffa* L.) calyx residue could solve this problem. This is because, the calyx residue is considered as a waste product and usually discarded after the production of the beverage that is savored for its sweet, unique taste and medicinal attributes. Roselle is a popular plant belonging to the family Malvaceae that has been cultivated in Asia for over 300 years and is now cultivated in many countries of the world (Tindal, 1986). At the moment, the crop is cultivated mainly for its calyces but its leaves and seed are also used for soup and as pot herbs (Adigun, 2003). Dashak and Nwanegbo, (2002) observed that the crude fibre profile of roselle calyx residue is similar to that of *Tridax procumbens*. The ash content has been reported to be 7.00% (Isidahomen et al., 2006) and 10.09% (Dashak and Nwanegbo, 2002). Roselle calyx residue contains 7.12% to 15.0% crude fibre (Dashak and Nwanegbo 2002; Isidahomen et al., 2006).

This study is therefore carried out to investigate the potential use of roselle calyx residue as feed supplement for rabbits.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Rabbitry Unit, Teaching and Research Farm, Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, Oyo state. The area lies within the rain forest ecological zone, and falls within longitude and latitude 7°27' and 3°25' respectively at altitude 200 to 300 m above the sea level with an annual rainfall of about 1250 mm. The temperature and relative humidity ranges from 30 to 35°C and 76 to 84% respectively (google earth, 2014).

Experimental animal, management and duration

A total of 30 weaner rabbits of mixed breed and sex were obtained from the college farm and used for this experiment. The rabbits were randomly selected, weighed and assigned into five treatments of six rabbits per treatment and three replicates with two rabbits per replicate. The rabbitry was kept clean daily, while the

cages were dusted and floors washed weekly. The feed and water were replaced daily with leftover of the feed weighed and disposed appropriately. Other routine management practices were strictly adhered to. The experiment lasted for four weeks.

Experimental diet

Roselle calyx residue were collected from different roselle juice seller from different locations within Ibadan metropolis, Oyo state, Nigeria. The residues were air dried till a constant weight was attained and fed to the rabbits at different levels of 0, 25, 50, 75 and 100%. *Tridax procumbens* were collected within the premises of the college and also fed alongside the roselle calyx extract at 100, 75, 50, 25 and 0% for T₁, T₂, T₃, T₄ and T₅ respectively. Same quantity and quality of concentrates were given to the rabbits across the treatments.

Experimental design

The experimental design was complete randomized design

Data collection

Data collected for growth performance were weight gain, where body weight changes were observed on weekly basis and deduced by subtracting the initial weight from final weight of the rabbits in each replicate. Feed consumed/intake was determined by subtracting weight of feed leftover from weight of feed given. Feed conversion ratio was determined as feed to weight gain ratio.

At the end of the experiment, blood samples were collected from each of the animals in each replicate; 2.5 mLs were dispensed into anticoagulant bottle for the haematological indices as stated in the Practical Haematology Manual (2008). The haematological indices investigated were; packed cell volume, haemoglobin concentration, red blood cell count, white blood cell count, and its differential- the lymphocytes, neutrophils, monocytes and eosinophils and platelet. Another 2.5 mLs were dispensed into plain bottles for serum biochemical indices according to Laboratory Procedure Manual (1999). The serum biochemical parameters investigated were; total protein, albumin glucose aspartate aminotransferase and alanine aminotransferase. Globulin was taken as the difference between total protein and albumin.

Statistical analysis

Data collected were subjected to analysis of variance using SAS (2003) package and mean differences were separated using Duncan's multiple range test of the same software.

Table 1. Effect of roselle calyx residue on growth performance of grower rabbits.

Parameter	T1	T2	T3	T4	T5	SEM
Initial weight (g/r)	1025.25	1039.25	1057.25	1081.75	1045.75	13.90
Final weight (g/r)	1314.25 ^b	1291.75 ^b	1398.75 ^{ab}	1520.25 ^a	1370.50 ^b	29.70
TWG (g/r)	289.00 ^{ab}	252.50 ^b	341.50 ^{ab}	438.50 ^a	329.75 ^{ab}	25.90
ADWG (g/r/d)	10.32 ^{ab}	9.02 ^b	12.20 ^{ab}	15.66 ^a	11.78 ^{ab}	0.93
TFI (g/r)	349.61 ^a	347.96 ^a	339.11 ^a	313.82 ^b	258.02 ^c	11.50
ADFI (g/r/d)	12.49 ^a	12.43 ^a	12.11 ^a	11.21 ^b	9.21 ^c	0.41
FCR	1.22 ^{ab}	1.42 ^a	1.07 ^{ab}	0.72 ^b	0.78 ^{ab}	0.11

^{a,b,c}Means along the same row with different superscripts are significantly ($p < 0.05$) different. TWG: Total weight gain; ADWG: Average daily weight; TFI: Total feed intake; ADFI: Average daily feed intake; FCR: Feed conversion ratio; T₁: rabbits on 100% *Tridax procumbens* and 0% roselle calyx residue; T₂: rabbits on 75% *Tridax procumbens* and 25% roselle calyx residue; T₃: rabbits on 50% *Tridax procumbens* and 50% roselle calyx residue; T₄: rabbits on 25% *Tridax procumbens* and 75% roselle calyx residue; T₅: rabbits on 0% *Tridax procumbens* and 100% roselle calyx residue.

Table 2. Effect of Roselle calyx residue on the haematological parameters of grower rabbits.

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	SEM
PCV (%)	25.50	34.50	33.00	34.00	27.50	2.02
Hbc (g/dL)	8.50	11.60	10.85	11.45	8.95	0.72
RBC ($\times 10^6/\text{mm}^3$)	4.02	5.34	5.27	4.34	4.34	0.33
WBC ($\times 10^3/\text{mm}^3$)	6.13 ^a	5.80 ^{ab}	4.50 ^b	6.30 ^a	5.03 ^{ab}	0.26
Lym (%)	65.00	72.00	63.00	69.00	71.00	1.44
Neut (%)	32.00 ^a	23.00 ^b	32.50 ^a	26.50 ^{ab}	25.00 ^{ab}	1.47
Mon (%)	1.50	2.50	1.50	1.50	1.50	0.21
Eos (%)	1.50 ^b	2.50 ^{ab}	3.00 ^a	3.00 ^a	2.50 ^{ab}	0.22
Platelet ($\times 10^9/\text{L}$)	2.25	1.33	0.96	1.25	1.30	0.32

^{a,b}Means along the same row with different superscripts are significantly ($p < 0.05$) different. PCV: Pack Cell Volume; Lym: Lymphocytes; Eos: Eosinophils; Hb: Haemoglobin concentration; Neut: Neutrophils; WBC: White Blood Cell; RBC: Red Blood Cell; Mon: Monocyte; SEM: standard error of mean; T₁: rabbits on 100% *Tridax procumbens* and 0% roselle calyx residue; T₂: rabbits on 75% *Tridax procumbens* and 25% roselle calyx residue; T₃: rabbits on 50% *Tridax procumbens* and 50% roselle calyx residue; T₄: rabbits on 25% *Tridax procumbens* and 75% roselle calyx residue; T₅: rabbits on 0% *Tridax procumbens* and 100% roselle calyx residue.

RESULTS

The effect of roselle calyx residue on growth performance of grower rabbits is presented in Table 1. Significant differences ($p < 0.05$) were observed among all parameters measured except for the initial weights of the rabbits. The values obtained for total weight gain in this study varied significantly from 252.50 to 438.50 g/r. Rabbits fed 75% roselle calyx residue (T₄) recorded the highest values for final weights, weight gain and average daily weight gain. The least FCR was also observed in rabbits on T₄.

Presented in Tables 2 and 3 is the result obtained for the haematological and serum biochemical indices of grower rabbits fed roselle calyx residue. Significant differences ($p > 0.05$) were not observed among dietary treatments except for the values obtained for white blood cells, whose values varied significantly ($p < 0.05$) across the dietary treatments in which rabbits fed 75% roselle calyx residue and 25% *Tridax procumbens* (T₄) recorded the highest value ($6.30 \times 10^3/\text{mm}^3$) which was statistically similar to

those rabbits fed 100% *Tridax procumbens* (T₁) ($6.13 \times 10^3/\text{mm}^3$), while the lowest value was observed with rabbits fed 50% roselle calyx residue and 50% *Tridax procumbens* (T₃). The neutrophils count observed ranged from 23.00 to 32.50% while the eosinophils count ranged from rabbits fed T₁ (1.50%) to those fed T₃ and T₄ (3.00%) that were statistically similar ($p > 0.05$). For serum biochemical indices, result showed that parameters measured were not significantly influenced by the dietary treatments, except for the alanine aminotransferase, whose values ranged significantly from 40.24 to 53.22 IU/L.

DISCUSSION

Growth performance of grower rabbits fed roselle calyx residue

The main aim of feeding growing rabbits is to maximize their weight gain and final market weight. Results for

Table 3. Effect of roselle calyx residue on the serum biochemical indices of grower rabbits.

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	SEM
TP (g/dL)	8.57	4.92	5.71	4.38	5.05	0.67
ALB (g/dL)	3.30	3.12	3.00	2.92	2.94	0.06
GLOB (g/dL)	5.27	1.80	2.71	1.46	2.11	0.63
GLUC (mg/dL)	103.97	105.78	82.46	85.11	87.69	4.84
AST (I.U/L)	67.68	72.57	69.87	67.99	57.01	2.63
ALT (I.U/L)	47.52 ^{ab}	52.33 ^{ab}	48.18 ^{ab}	40.24 ^b	53.22 ^a	1.90

^{a,b}Means along the same row with different superscripts are significantly different ($p < 0.05$). TP: Total Protein; ALB: Albumin; ALT: Alanine Aminotransferase; GLOB: Globulin; GLUC: Glucose; AST: Aspartate Aminotransferase; T₁: rabbits on 100% *Tridax procumbens* and 0% roselle calyx residue; T₂: rabbits on 75% *Tridax procumbens* and 25% roselle calyx residue; T₃: rabbits on 50% *Tridax procumbens* and 50% roselle calyx residue; T₄: rabbits on 25% *Tridax procumbens* and 75% roselle calyx residue; T₅: rabbits on 0% *Tridax procumbens* and 100% roselle calyx residue.

growth performance showed significant differences in the weight gain, feed intake and feed conversion ratio. The weight gain showed that rabbits on T₄ (75% roselle calyx residue) had the highest final weight (1520.25 g/rabbit) when compared with those on other treatments which varied between 1291.75 to 1398.75 g/rabbit. Roselle calyx residue was well tolerated by the rabbits when it was served up to 75% in combination with *Tridax procumbens* (25%), and this increase in body weight gain and final weight of the rabbits indicates that the animal growth is potentially enhanced by the roselle calyx supplementation. Feed intake in the study significantly reduced as roselle calyx residue supplementation increased from 25% to 100%. The feed conversion ratio was significantly reduced (0.72) in rabbits fed diet containing 75% roselle calyx residue when compared to the control and other treatments. This indicates that there was better utilization of the feed at this level by the rabbits. As reported by Mercado-Mercado et al. (2015), roselle calyx and decoction residues are good sources of dietary fibre and polyphenols with antioxidant capacity. Al-Nasrawi (2013) corroborates this report by stating that the presence of antioxidants such as anthocyanins and protocatechuic acid in roselle calyx increases oxygen consumption and as a result stimulates thyroid gland which plays a major role in metabolism. Also, Sayago-Ayerdi et al. (2013) stated that this by product proves to be a good source of dietary fibre and natural antioxidants as most of the calyx components are normally retained in the residue after processing.

Haematological indices of grower rabbits fed roselle calyx residue

Blood analysis represents a means of assessing clinical and nutritional health status of animals and the haematological parameters most commonly used for assessment in nutritional studies include packed cell volume (PCV), red blood cell (RBC) count, haemoglobin concentration, white blood cell (WBC) count and its

differentials. The result obtained showed no significant ($p < 0.05$) differences in the PCV, RBC and haemoglobin concentration across the dietary treatments except the WBC count values which were observed to show significant ($p < 0.05$) differences. WBCs are the first line of defense in the body against infectious microorganisms. Here the significant increase in the WBC followed no particular trend as rabbits on control and 75% roselle calyx residue were statistically higher ($p < 0.05$) than what was obtained from rabbits on 50% roselle calyx residue, although similar to those on 25% and 100%. The values were however within the normal range of standard WBC range of 3.3 to 12.2 ($\times 10^3/\text{mm}^3$) as reported by Archetti et al. (2008). Jenkins (2008) opined that WBC count rise in rabbits rarely indicates an infection; it generally varies due to various stress factors and blood collection methods. Values obtained for neutrophils and eosinophils were also significantly different among the treatment means. The values obtained for the neutrophils followed no particular pattern as well. Sembulingam and Sembulingam (2012) reported that the number of neutrophils in the blood increases rapidly when acute infection is present, hence a blood count showing this increase is useful in diagnosis of infections. From the result obtained, rabbits on 50% roselle calyx residue and the control were statistically similar and had higher neutrophils than rabbits on 25% roselle calyx residue. Eosinophils which normally are scarce increase in numbers in certain chronic diseases, such as infection with parasites and also in allergic conditions and were observed to be significantly elevated as levels of roselle calyx residue increased in the diet of the rabbits, this could be as a result of the sources from which the calyx residues were obtained.

Serum biochemical indices of grower rabbits fed roselle calyx residue

Serum biochemical analysis revealed that dietary treatments produced no significant effect ($p > 0.05$) on serum biochemical parameters measured with the

exception of alanine aminotransferase (ALT). The serum ALT levels, according to Mahgoub et al. (2008) are elevated in nearly all liver disease and are particularly high in conditions that causes extensive cell necrosis, including severe viral hepatitis or toxic liver injury. In the result presented (Table 3), rabbits fed with 100% roselle calyx residue had significantly higher value 53.22IU/L ALT than those fed 75% roselle calyx residue and 25% *Tridax procumbens*. This indicates that supplementation of roselle calyx residue at up to 75% reduced the serum levels of ALT and has no toxic effect on the liver. The Aspartate aminotransferase (AST) was not statistically different among the dietary treatments; however, the values obtained were reduced as levels of dietary roselle calyx residue increased. The liver is a prime site for the destruction of toxic compounds found in the blood, however, when the challenge of such deleterious factors become excessive, the cells of the organ are damaged and the enzymes mentioned above which are contained in it leak into the general circulation. The serum concentration of the enzymes is therefore a function of hepatocellular integrity and function. The similarity of the values for the serum enzymes from this study suggests that whatever toxic factors are contained in roselle calyx residue were of mild concentrations and were adequately tolerated by the rabbits up to 75% dietary inclusions. This observation agrees with Ukorebi et al. (2019b) on serum or liver enzymes activities.

Conclusion

The study showed that a combination of 75% roselle calyx residue and 25% *Tridax procumbens* improved weight gain, feed conversion ratio and does not elicit deleterious effect on haematological and serum biochemical indices of weaner rabbits.

Recommendation

It is therefore recommended that roselle calyx residue which is considered as waste because it cannot be consumed by humans could be actively encouraged in the feeding of growing rabbits as a source of dietary fibre.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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