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PERFORMANCE CHARACTERISTICS AND HAEMATOLOGICAL INDICES OF GROWING RABBITS FED *MORINDA LUCIDA* LEAVES

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ABSTRACT

An 84-day feeding trial was carried out to investigate the performance characteristics and haematological indices of growing rabbits fed *Morinda lucida* (ML) leaves. Fifty weaner crossbred (New Zealand white x Chinchilla) rabbits (10 per treatment) of mixed sexes with an average initial body weight of 548.41g were randomly assigned to five (5) treatment diets in a completely randomized design (CRD) where T1, T2, T3, T4 and T5 were made up of the components as described: T1= 0% ML + 100% concentrate, T2 = 5% ML + 95% concentrate, T3 = 10% ML + 90% concentrate, T4 = 15% ML and 85% concentrate and T5 = 20% ML + 80% concentrate. Average daily weight gain and average feed intake were monitored. Dry matter (DM) content of diets in treatment 2 (87.40%) was significantly (P<0.05) lower than other treatments. Crude protein, ether extract, ash and Nitrogen Free Extract (NFE) values were similar in all treatment samples. Crude fibre values for treatment 3 was significantly (P<0.05) highest (12.62%). There were no significant differences (p<0.05) in the crude protein, ether extract, ash and NFE content of diets. Average body weight gain of rabbits fed the different diets were similar. Rabbits fed diets containing *Morinda lucida* leaves had significantly higher (P<0.05) daily feed intake. Analysis of blood components showed that Packed Cell Volume (PCV), Red Blood Cells (RBC), White Blood Cells (WBC), Monocytes and Eosinophils (EOS) were not affected by diets. It was concluded that *Morinda lucida* leaves can be included in the diet of growing rabbits up to 10% without any deleterious effect on the performance and haematological indices.

Keywords: Haematology, *Morinda lucida*, Performance, Processing, rabbits.

INTRODUCTION

Nutrition of rabbits in Nigeria is primarily met by feeding *Tridax procumbens L.* and or *Centrosema pubescens Benth*. whose growth and accessibility in the dry season cannot support rabbit production all-year round (Odeyinka *et al*., 2007). Trees and shrubs provide valuable forage to herbivorous animals possibly since domestication (Robinson, 1985). They have multipurpose uses since parts such as their fruits pods, leaves and young leaves serve as food for human consumption, trunk for wood, leaves, pods and seeds for animal feeding (Dahlanuddin, 2001). Use of trees and shrubs as food supplements may provide a possible alternative; because they are resistant to drought and have high production of edible and acceptable biomass (Matumuini *et al*, 2017). These trees contain a high amount of nutrients and are rich sources of protein and minerals (Babayemi *et al*., 2004). Protein content of tree leaves are high ranging from 13-26% crude protein on the average (Espinosa, 1984). Brimstone tree (*Morinda lucida) Benth* is a medium size tree with short crooked branches. Although it is very bitter, the whole plant, leaves, bark and roots are known to have medicinal properties (Adeleye *et al*., 2018). In West Africa, the plant is used in traditional medicine for the treatment of arthritis, leprosy, rheumatism, pulmonary troubles and as a

vermifuge (Burkill, 1997). *Morinda lucida* is a nutrient block and is readily accessible throughout the year in Southwestern Nigeria (Adeleye *et al*., 2018). Despite all the proven nutritional and health benefits of *Morinda lucida*, there are limited literature on the inclusion of *Morinda lucida* in the diet of growing rabbits. Hence, this study evaluated the performance characteristics and haematological indices of growing rabbits fed diets containing graded levels of *Morinda lucida* leaves.

MATERIALS AND METHODS

Experimental site

The research was carried out at the Sheep and Goat Unit of the Teaching and Research Farm of Obafemi Awolowo University, with latitude 7°31 8.4"N and longitude 4° 31 15.96"E in the tropical rainforest ecological zone of Nigeria (Amujoyegbe et al., 2008). Laboratory analyses were carried out at the Poultry Meat Laboratory, Faculty of Agriculture of the same University.

Experimental Diets

Fresh *Morinda lucida* leaves were harvested around the premises of the Teaching and Research Farm and Faculty of Agriculture, O.A.U. Ile-Ife, Osun State, Nigeria. The plant was authenticated at the herbarium of the Department of Botany, Obafemi Awolowo University, Ile- Ife. The experimental diets were compounded at a reputable feed meal and divided into Five (5) treatments. The diets of the rabbits contained fresh *Morinda lucida* (ML) leaves included with the diet at 0, 5, 10, 15 and 20% of the total diet allowance and concentrate. The diets were constituted as follows: (T1= 0% ML and 100% concentrate; T2= 5% ML and 95% concentrate; T3= 10% ML and 90% concentrate; T4= 15% ML and 85% concentrate and T5= 20% ML and 80% concentrate). The experimental diets were offered twice daily at 8:00 and 14:00 hours with clean water *ad libitum*.

Experimental Animals and Management

Fifty (50) weaner rabbits were randomly assigned to five (5) experimental diets. There were ten animals per treatment. The experimental design used was completely randomized design (CRD). The animals were fed 3% of their body weight and weights of the animals were taken on weekly basis before the day's feeding so as to be able to account for the daily weight gain. Also, the experimental diets fed to each animal was weighed while the left-over feed was packed and measured on a daily basis to account for the daily feed intake. Feed conversion ratio was calculated as the ratio of feed intake per weight gain. The feeding trial lasted for a period of 12 weeks.

Chemical Analysis

All samples of processed *Morinda lucida* leaves were oven dried in an oven (70^{o}C) for 72 hours and some of the samples were ground in a mortal. They were analyzed for dry matter (DM), crude fibre (CF), ether extract (EE), ash and Nitrogen free extract (NFE) according to the procedures described by AOAC (2000). Crude protein (CP) was determined with the aid of a Kjeltec system digester and Kjeltec-distilling unit.

Blood Analysis

One ml blood sample was collected into labelled sterile bottles containing anticoagulant free bottles, allowed to coagulate at room temperature and centrifuged at 3000 rpm for 10 minutes. The haematological parameters were determined using the method described by Adedapo *et al*. (2007)

Statistical Analysis

All data obtained from the study were analyzed using General Linear Model of SAS (2006) and the means were separated using Duncan Multiple Range Test option of the same package.

RESULT AND DISCUSSION

The proximate composition of experimental diets compounded and fed to the weaner rabbits

was shown in Table 2. Significant (P<0.05) differences were observed in values for dry matter and crude fibre contents of the experimental diets. Dry matter (DM) values of diets ranged between 87.40 (T2) to 89.77% (T5). These values are lower than DM values (90.72 - 91.45g/100g) reported by Abegunde *et al*., (2014) for concentrate diets with garcinia kola leafmeal replacing maize. The dry matter content for treatment 5 (87.7%) was significantly (P<0.05) higher than the values for other treatments. Crude fibre content (12.62%) of treatment 3 was significantly (P<0.05) highest. There were no significant differences (P<0.05) in the crude protein, ether extract, ash and nitrogen free extract content of the experimental diets. The ether extract content of treatment 5 was higher than others. The dry matter composition of the experimental diets was similar to those (86-89%) reported by Ikyume *et al*. (2019) for some grasses and legumes. These values were lower than the reports of Ajayi and Raji (2012) who reported DM values of above 89% for wild sunflower forage leaf mixture. The crude protein content of the diets was in line with the study of Ikyume *et al*. (2019) who reported a range of 12-22%. The crude fibre content of the diet was lower than the reports of Ikyume *et al*. (2019) and Alvarenga *et al*. (2017). They reported a value range of 11-17% and 16-30% respectively. The results from this study were in line with the nutritional requirement of rabbits as stated by Ograin (2011) except for the crude fibre which had a slight difference. The values stated by Ograin (2011) include: Protein- 12-18%; crude fibre- 12-16%; Fats- 2-5%.

The performance of the weaner rabbits fed the experimental diets is shown in Table 3. There was no significant difference (P>0.05) in the average body weight gain (g/day/animal) of the rabbits fed the different diets. However, the values for daily feed intake were affected (P<0.05) by treatments. The Feed Conversion Ratio (FCR) obtained from the trial were not significantly affected by diets. There were no significant differences (P>0.05) in the feed conversion ratio of the rabbits across the treatments. The average daily weight gain of animals is similar to those (10.85 - 20.86 g/day) reported by Oso *et al*., (2006). Adeyemo *et al*., (2013), reported a value range between 10.25 - 13.75 g/day which is similar to the result from this study. However, Shehu *et al*., (2018) recorded a higher value (12 - 14.55 g/day) compared to this study when they fed graded levels of soaked *faidherbia albida* pod meal to weaner rabbits. Similarly, Ragab *et al*., 2013 also observed higher values (19.95-23.26 g/day) for daily weight gain in their study when they fed diets supplemented with pumpkin (*Cucurbita moschata*) and Black Seed (*Nigella sativa*). The reduction observed in the average daily weight gain for 15% (T4) and 20% (T5) levels of inclusion was in contrast to the increasing values from 0% (T1) - 10% (T3) inclusion level. This might have been as a result of increasing levels of fresh *Morinda lucida* in the diet. *Morinda lucida* contains a high level of phenol confirming the reports of Makkar *et al*., (1999) and Krishnaiah *et al*., (2011).

The increasing level of ML in the diet directly increased the amount of anti-nutritional factors present in the diets, which resulted in depressed weight gain. This observation is consistent with the reports of Odeyinka and Olosunde (2017) who reported that the increasing inclusion level of bitter leaf meal in the diets of West African dwarf goats affected the average daily weight gain of the animals at the highest level of inclusion (45%) as a result of the higher content of antinutritional factor which in turn depressed growth. There were increases in the daily feed intake with increasing levels of inclusion of ML except for the 20% inclusion that was lower compared to 15% level though not significantly. The increase in the daily feed intake could be as a result of reduced energy density of the feed (Oyawoye and Ogunkunle, 1998). The reduction in the value for intake observed in diet with the highest inclusion level may be as a result of reduced palatability of the

diet (*Morinda lucida* has a bitter taste). The feed conversion range of 5.38-6.56 from the study is similar to those (4.88 - 6.55 and 3.78 - 7.88) reported by Balogun *et al*., (2018) and Mustapha *et al*., (2018) respectively. The values observed in this study were higher than the values (4.63 - 5.08) reported by Mohammad *et al*., (2018) who studied the effect of coffee (*Senna occidentalis*) leaf meal on the growth performance of weaner rabbits. Furthermore, Ibrahim and Olaniyi (2018) studied the effect of sweet potato (*Ipomoea batatas* Lam.) peel meal as replacement for maize on growth performance and cost of feeding weaner rabbits and reported feed intakes ranging from 10.35 - 12.62 which was higher than the one obtained in this study. It was observed that increasing values of feed intakes resulted in a corresponding reduction in weight gain from 10% inclusion level of ML, implying that higher levels of 15% and 20% inclusion exposed the animals to higher concentration of anti-nutrients leading to decrease in weight with more consumption.

The haematological indices of weaner rabbits fed different levels of *Morinda lucida* is shown in Table 4. The analysis of these blood components (PCV, RBC, WBC, MONO and EOS) showed they were not significantly ($P>0.05$) affected by diets fed to the rabbits. The Lymphocytes (LYMP) and Neutrophils (NEU) showed significant ($p<0.05$) differences. The LYMP had highest values (62.00) in treatment 4 and the lowest value (47.800) in treatment 1. The Neutrophil values ranged from 35.00 (T4) - 49.20 (T1). Haematological parameters are an indication of the effects of dietary treatments on the animal in terms of the type, quality and amounts of the feed ingested and available for the animal to meet its physiological, biochemical and metabolic necessities (Ewuola *et al*., 2003). In this study, animals fed 0% ML inclusion level had the highest value for neutrophils. These values were lower than the range of 47.33 - 53.83% and 38.82 - 43.10% reported by Ewuola and Egbunike (2008) and Shehu *et al*. (2018) respectively for growing rabbits. However, these results were higher than the value range of 28.33 - 30.00% reported by Ragab *et al*., (2013). Though the values observed here were within the normal range for rabbits as reported by Mitruka and Rawnsley (1977). PCV values when low, results in aneamia, increased pulse rate and sometimes heart failure (Odeyinka and Olosunde, 2017). There were no significant differences in RBC and WBC but RBC values reported in the study were a little higher than the values (5.58 - 6.29 x 10^{12}) reported by Adeyemo *et al*., (2013). White blood cells (WBC) were similar to range values of 4633 – 8000 $cumm^3$ reported by Adeyemo *et al*., (2013). The normal range values for RBC and WBC in rabbits are 3.8 - 7.9 x $10^6/mm^3$ and 5 - 13 x 10^9/l respectively (MediRabbit, 2021). There were significant ($P < 0.05$) differences in the lymphocytes and neutrophils which are components of the white blood cells. The lymphocytes values reported from this study corroborates those reported by Ewuola and Egbunike (2008) who reported a value range of 47.83 - 60.50%. Neutrophils values observed in this study were higher than those reported by Ewuola and Egbunike (2008) who reported a range of 36.17- 40.00%. The normal lymphocyte and neutrophils percentage of a rabbit are 44-80% and 34-70% respectively (MediRabbit, 2021). Lymphocytes are responsible for both humoral and cellular immunity.

The significant difference observed between the lymphocytes and neutrophils is as a result of the body trying to get rid of toxins in the body. Excessive production of the WBC in the body helps to get rid of toxins from the body system hence an increase in lymphocyte production (Ewuola and Egbunike, 2008). However, the health status of the animals was not compromised during the study.

Table 1: Gross Composition of Experimental Diets

	TREATMENTS				
INGREDIENTS (%)	1	2	3	4	5
Maize	35.00	35.00	35.00	35.00	35.00
Rice Bran	10.00	10.00	10.00	10.00	10.00
Brewers' Dried Grain	20.00	20.00	20.00	20.00	20.00
Groundnut Cake	5.00	5.00	5.00	5.00	5.00
Fish Meal	1.00	1.00	1.00	1.00	1.00
Palm Kernel Cake	25.00	20.00	15.00	10.00	5.00
Morinda Lucida	0	5.00	10.00	15.00	20.00
Bone Meal	1.00	2.00	2.00	2.00	2.00
Oyster shell	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Vitamin Premix*	0.25	0.25	0.25	0.25	0.25
TOTAL	**100**	**100**	**100**	**100**	**100**
Calculated Value					
Crude Fibre (%)	11.00	10.91	10.85	10.72	10.68
Crude Protein (%)	18.85	18.48	18.1	17.72	18.35
Metabolizable Energy (kcal/kg)	2598	2574	2550	2526	2503

*Each one kg of premix (minerals and vitamins mixture) contains vit. A, 10000 I.U; vit. D, 2000 I.I; vit. E, 25 mg; vit. K, 2 mg; Thiamine B1, 1.8 mg; Riboflavin B2, 5 mg; Pyridoxine B6, 3.5 mg; Niacin, 28 mg; vit. B12 0.015 mg; Pantothenic acid, 7.5 mg; Folic acid, 0.75 mg; Biotin, 0.06 mg; chlorine chloride, 300 mg; Manganese, 40 mg; Zinc, 30 mg; Antioxidant 1.25mg Iron, 20 mg; Copper, 3 mg; Iodine, 1 mg; Selenium, 0.2 mg; Cobalt, 0.2 mg.

Table 2: Proximate composition of the diet fed to experimental animals

	TREATMENT						
Parameter	**1**	**2**	**3**	**4**	**5**	**SEM**	**P- value**
DM (%)	88.90^{a}	87.40^{b}	88.66^{a}	87.72^{a}	89.77^{a}	0.27	0.0039
CP	19.69	19.04	18.60	19.69	18.51	0.22	0.2418
CF	9.31^{d}	11.55^{b}	12.62^{a}	11.65^{b}	10.99^{c}	0.30	<0.0001
EE	2.33	2.89	3.15	2.91	4.53	0.37	0.4423
ASH	6.21	7.78	8.40	7.80	7.28	0.75	0.9413
NFE	51.37	46.16	45.90	47.68	48.47	1.06	0.5343

$^{a, b, c, d}$: Means within each row with different superscripts are significantly different ($p<0.05$).

ML = *Morinda lucida*, T1: 0% ML and 100% rabbit concentrate; T2: 5% ML and 95% rabbit concentrate; T3: 10% ML and 90% rabbit concentrate; T4: 15% ML and 85% rabbit concentrate and T5: 20% ML and 80% rabbit concentrate; DM: Dry Matter, CP: Crude Protein, CF: Crude Fibre, EE: Ether Extract, NFE: Nitrogen Free Extract.

Table 3: Growth Performance of weaner rabbits fed *Morinda lucida* (ML) fresh leaves and concentrate

	TREATMENTS						
Parameter (g)	**1**	**2**	**3**	**4**	**5**	**SEM**	**P- Value**
ILW	588.25	572.00	611.50	402.50	567.80	25.39	0.08
FLW	1528.80	1600.20	1708.80	1407.0	1469.80	37.50	0.10
BWG	940.50	1028.20	1097.25	1004.5	902.00	29.78	0.27
ADG	11.20	12.24	13.06	11.96	10.74	0.35	0.27
DFI	63.61^{b}	69.02^{a}	70.15^{a}	72.36^{a}	68.69^{a}	0.89	0.03
FCR	5.73	5.65	5.38	6.13	6.56	0.15	0.08

$^{a, b}$: Means within each row with different superscript are significantly different (P<0.05).

ILW: Initial live weight, FLW: Final live weight, BWG: Body weight gained, ADG: Average daily weight gain, DFI: Daily feed intake, FCR: Feed conversion ratio; T1= 0% ML and 100% concentrate; T2= 5% ML and 95% concentrate; T3= 10% ML and 90% concentrate; T4= 15% ML and 85% concentrate and T5= 20% ML and 80% concentrate.

Table 4: Haematological indices of weaner rabbits fed varying levels of *M. lucida* leaves:

	Treatments						
Parameter	**1**	**2**	**3**	**4**	**5**	**SEM**	**P-value**
PCV (%)	45.00	35.80	42.20	43.00	39.80	1.25	0.1405
RBC (x10^{12})	7.37	5.79	6.90	7.30	6.440	0.22	0.1168
WBC (x10^{12})	5.48	5.45	5.78	5.70	5.50	165.89	0.9669
LYMP (%)	47.80^{c}	53.60^{b}	57.60^{ab}	62.00^{a}	52.80^{bc}	1.16	0.0003
NEU (%)	49.20^{a}	43.00^{bc}	38.80^{cd}	35.00^{d}	43.80^{b}	1.12	0.0001
MONO (%)	1.60	2.20	2.20	1.00	2.00	0.15	0.0773
EOS (%)	1.60	1.60	1.60	2.00	1.80	0.16	0.9507

$^{a, b, c, d}$: Means within each row with different superscript are significantly different (p<0.05).

PVC: Packed cell volume, RBC: Red blood cell, WBC: White blood cell, LYMP: Lymphocytes, NEU: Neutrophils, MONO: Monocytes, EOS: Eosinophils; T1= 0% ML and 100% concentrate; T2= 5% ML and 95% concentrate; T3= 10% ML and 90% concentrate; T4= 15% ML and 85% concentrate and T5= 20% ML and 80% concentrate

CONCLUSION

It could be concluded that inclusion of fresh *Morinda lucida* in the diet of growing rabbit led to improved performance characteristics when fed up to 10% of diet without any deleterious effect on the haematological indices.

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