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Haematological Indices of Growing Rabbits Fed Herbaceous Plants as Sole Diet

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Authors' contributions

This work was carried out in collaboration among all authors. Author DOA designed the study. Author SSA wrote the protocol, managed the analyses of the study and wrote the first draft of the manuscript. Author OEF performed the statistical analysis and author TGJ managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Competition between humans and animals for food is inevitable since some feed stuffs used as animal feed are also consumed by humans. Therefore, suitable alternatives for animal feed are compelling. This study was conducted with 32 mixed bred (New Zealand white and Chinchilla) growing rabbits (16 bucks and 16 does of 7 to 8 weeks old and of average weight 1.03kg) for a period of seven (7) weeks to assess haematological indices of rabbits fed herbaceous plants as sole diet. The rabbits were completely randomized into *Corchorus olitorius* (T1)*, Moringa oleifera* (T2) and *Telfairia occidentalis* (T3) and commercial feed as the control diet (T0), with each treatment having eight rabbits, in four replicates of two rabbits per replicate. Blood samples were collected pre and post exposure to the treatment. Haematological parameters assayed were packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). Analysis of Variance (ANOVA) was carried out for the assessment of the variations in these parameters. The values obtained (Mean ± SD) for each blood parameter pre-exposure to the treatment were within

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the normal physiological range of healthy rabbit, except the value of the Mean corpuscular volume (MCV) which was lower than the normal physiological range. Blood indices assayed for, post exposure to treatment showed significant difference ($P < 0.05$) in the Mean corpuscular hemoglobin. Based on the data from the haematological parameters. It was concluded that Corchorus olitorius could solely sustain rabbits with no adverse effect on their well being.

Keywords: Haematology; herbaceous plants; rabbit; sole diet.

1. INTRODUCTION

Rabbit (*Oryctolagus cuniculus*) can be referred to as a micro-livestock species, and it is the cheapest and sustainable means of producing high quality protein for the expanding populations of developing countries like Nigeria [1]. Aside the provision of animal protein requirements of humans, other products from rabbit production are wool (fur) and skins or pelts for industrial purposes and they could also serve as pets and laboratory animals for research.

In recent times, the scarcity of feed resources has been the main limitation in rabbit production. The conventional cereal and vegetable protein sources being used in rabbit feeds are under pressure of competition as a result of their use in human diets. Therefore, in a bid to maximize food production and meet protein requirements in Nigeria and other countries with similar characteristics, viable means need to be grasped and evaluated [2], hence, the need to incorporate into the feeding scheme of livestock some herbaceous plants that are in less demand by human or for industrial use, which would satisfy their nutritional requirements with no adverse effect, and also be of high nutritional value and low cost.

The herbaceous plants; *Corchorus olitorius, Moringa oleifera* and *Telfairia occidentalis,* used have proven to be of high nutritive value. The chemical composition of leafy vegetables such as *Corchorus olitorius* have been documented [3,4,5] and preliminary experiments have shown that herbaceous plants are acceptable by rabbits and have allowed excellent growth performances [6]. *Corchorus olitorius* and some other forages have been reported to have good nutritional characteristics, resulting to high growth rate and high feed intake [7]. *Moringa oleifera* leaf meal also possesses good dietary protein quality for optimal growth of rabbits which could be used to improve rabbits' daily weight gain and feed intake [8]. The nutritional qualities of *Moringa oleifera* are excellent which constitute a source of high quality forage for growing rabbits [9]. Likewise, there is significant improvement in haematological parameters of rabbits fed pumpkin (*Telfairia occidentalis*) leaf extract [10].

Assessment of haematological parameters of animals have been confirmed to be a means of establishing the physiological status of animals, owing to different feeds or replacement of certain nutrients in the feed being fed to them, as consumed diets have significant impact on their ideal physiological status [11]. Haematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment [12] and are useful in the diagnosis of many diseases as well as investigation of the extent of damage to blood [13], therefore, haematological parameters are good indicators of the physiological status of animals [14].

Amongst the whole parameters of haematology, red blood cells (RBC) are involved in the transport of oxygen and carbon dioxide in the body. Thus, a reduced red blood cell count implies a reduction in the level of oxygen that would be carried to the tissues as well as the level of carbondioxide returned to the lungs [15,16], while packed cell volume (PCV) is an easily obtained measure for detecting anaemia or polycythemia and can be useful in estimating changes in hemodilution or hemoconcentration [17], and the white blood cell (WBC) plays a most important role in phagocytosis and immunity towards defense against infection, hence, the higher the value of WBC count, the better the ability of the animal to fight diseases [18]. Therefore, haematology was adopted, based on the fact that laboratory tests carried out on blood are vital tools that help detect any deviation from normal in animals or human body.

The chemical composition of *Telairia occidentalis* includes.

The key focus of the experiment was to evaluate the positive impacts of these forages on the health and well-being of rabbits as they supply relevant nutrients, considering their availability and less competitive nature in order to

encourage rabbit farmers to substitute them for commercial feeds, thereby reducing the competition for cereals and protein sources between rabbits and humans, as well as reducing the cost of feeding in rabbit production. This study was therefore aimed at assessing the variation in the haematological indices of growing rabbits fed *Corchorus olitorius, Moringa oleifera* and *Telfairia occidentalis* differently as sole diet.

2. MATERIALS AND METHODS

2.1 Study Site

This study was carried out at the Rabbitry Unit of Teaching and Research Farm, University of Ibadan, Oyo State, Nigeria. Ibadan is located on the latitude of 7º30' and longitude of 3º54'. It is situated in the south-western agro-ecological zone of Nigeria which is about 275m above the sea level with mean annual rainfall of 1420.06mm, having temperature range between 21.42ºC and 26.46ºC with average relative humidity of 74.55%.

2.2 Experimental Animals

Thirty-two (32) mixed bred (New Zealand white and Chinchilla) growing rabbits (16 bucks and 16 does) of 7-8 weeks of age of average weight 1.03kg, were used for the experiment which lasted for a period of seven weeks. The study animals were purchased from a rabbit farm at Moniya, Akinyele Local Government, Oyo State, Ibadan.

2.3 Experimental Diets

An appropriate commercial rabbit diet was formulated (as shown in Table 1). Moreover, *Corchorus olitorius and Telfairia occidentalis* were purchased from a local market at Bodija market, Ibadan, on a daily basis and *Moringa oleifera* was collected from department of Veterinary Medicine, University of Ibadan, also on a daily basis throughout the period of the experiment using hand harvesting method and the period between harvesting and use of these vegetables was within thirty minutes and one hour. Withered portions of the plants were detached, after which the fresh parts were rinsed with water prior to serving the rabbits. The stems observed to be very thick were removed and succulent ones were supplied to the rabbits in their fresh form.

Table 1. Composition of the commercial diet

Ingredients	**Quantity (%)**
Maize	35
GNC	30
Wheat bran	11
Rice bran	14.5
Fish meal	2
Bone	4
Limestone	2
Salt	0.5
Methionine	0.3
Lysine	0.3
Broiler premix	0.4
Proximate Composition (%)	**Mean ± SD**
Crude Protein	19.40 ± 0.02
Crude Fat	2.40 ± 0.10
Crude Fibre	4.70 ± 0.10
Ash	9.20 ± 0.10
Moisture	4.40 ± 0.10
Gross Energy (Kcal/g)	85.10±0.02
Dry Matter	91.06±0.44

GNC: Groundnut Cake

Table 2. Proximate Composition of *Moringa oleifera, Corchorus olitorius and Telfairia occidentalis* leaves

Components	*Moringa oleifera*		*Corchorus olitorius*		*Telfairia occidentalis*	
	Adapted from: (Mean ± SD)					
Analytes	Soetan and Aiyelaagbe, [19] 2016	Igwilo et al., [20] 2017	Kadiri, [21] 2014	Adeniyi et al. [22] 2018	Idris, [23] 2011	Usunobon and Egharevba, [24] 2014
Crude Protein (%)	15.04 ± 0.18	27.60±0.14	4.66 ± 0.02	5.24±0.32	8.72 ± 0.03	21.14±0.32
Crude Fat (%)	3.91 ± 0.04	2.00 ± 2.31	4.30 ± 0.10	1.20±0.17	14.27 ± 0.25	6.46 ± 0.07
Crude Fibre (%)	17.27±0.2	-	2.70 ± 0.10	2.60±0.18	20.17 ± 0.12	11.56 ± 0.68
Ash(%)	9.85 ± 0.2	11.60±3.65	2.90 ± 0.10	1.15±0.11	17.2 ± 0.02	8.31 ± 0.21
Moisture(%)	7.10 ± 0.02	6.87 ± 0.50	84.40±0.10	86.35±0.36	87.00 ± 0.6	10.99 ± 1.34
Gross Energy (Kcal/g)	3.52 ± 0.01	4.26 ± 0.12	85.10±0.02	190.53±0.5	290.16±0.03	53.10 ± 0.68
Dry Matter(%)	-	-	95.46±0.44	13.65±0.02	-	89.01± 0.13

2.4 Experimental Design and Management of Animals

Four experimental diets were prepared for four treatments; T0 (control diet which contained formulated diet as shown in Table 1), and T1, T2 and T3 contained *Corchorus olitorius*, *Moringa oleifera* and *Telfairia occidentalis* respectively (all fed solely). The four treatment groups were assigned the four experimental diets in a completely randomized design (CRD). Each treatment was replicated four times and there were two rabbits per replicate. On arrival to the farm, commercial diet (used as control diet) were supplied to all the animals and they were all given vitamins as anti-stress, as well as Embazin forte (with sulphaquinoxaline, diaveridine, and vitamin K as the active ingredients), against coccidiosis. Amivit liquid vitamin was administered at 6mls into 1litre of water and Embazin forte was administered at 3g into 5litre of water. The rabbits were fed with the forages at 0800h daily and water was given ad libitum. The experimental animals were kept for two weeks for acclimatization and were housed in wooden hutches measuring 80cm x 60cm x 45cm in length, width and height respectively, having their base and upper part as wire mesh and also raised from the floor, enhancing proper ventilation and allowing their hard droppings fall off easily. The housing uses natural ventilation with no thermal insulation or cooling system and all the rabbits were kept under natural lighting throughout the experiment. Feed and water were provided in earthen pots secured to prevent spillage. The study animals were all exposed to the same housing and management conditions throughout the period of experiment.

2.5 Blood Collection and Haematological Analysis

At the end of two weeks' period of acclimatization, prior to administering of experimental diet, the animals were starved of feed for 24 hours before blood samples of about 2ml were collected from each rabbits via ocular vein and finally at the end of the experiment, the same amount of blood samples were also collected from each rabbit, using sterilized disposable capillary tubes between 7.00 and 8.00 am. The collected blood samples were decanted into Heparin fortified sample bottles and immediately submitted to the pathology laboratory of the Department of Veterinary Medicine, University of Ibadan for haematological test. Haematological parameters assessed include Packed Cell Volume (PCV), Haemoglobin (Hb), erythrocyte, leukocyte and leukocyte differential count.

2.6 Statistical Analysis

Data obtained from the study were analyzed using Analysis of variance (ANOVA) in a Completely Randomized Design (CRD) with Statistical analysis system [25] at P=0.05. Mean separation was done using Duncan's Multiple Range Test (DMRT).

The Statistical Model: $Yi = \mu + Tij + eij$

Where:

Y_i = the effect of the j^{th} observation in the i^{th} treatment
μ = general mean of the population
T_{ij} = the effect of the i^{th} treatment in j^{th} observation where i = 0-3, j = 4
e_{ij} = random error associated with the j^{th} observation in the i^{th} treatment

3. RESULTS AND DISCUSSION

The haematological indices of growing rabbits that were fed different herbaceous plants as sole diets were investigated. Firstly, the haematological indices of the rabbits, prior to subjection to treatment were obtained (as shown in Table 3) in a bid to understand the health status of the experimental animals to be put to use. The results obtained from the tests carried out were in alignment with the ranges reported for normal rabbits PCV (21.56 – 30.84%) and RBC (3.53 – 5.36 x 10^6/mm^3) by Olabanji [26] *et al.* (2007) who carried out research on haematological and serum biochemistry of rabbits and the WBC and MCHC values recorded were also within the normal ranges (4.5 -11 x 10^3 /l) and (27 – 37 pg/cell) for rabbits as recorded by Research Animal Resources [27] and Burke [28].

The MCV and MCH values of the rabbits were found to be slightly higher ($p>0.05$) than the range recorded as the normal MCV (60.15 – 60.18 fl) and MCH (19.85–20.06 %) values by Togun [13] et al. and this could be attributed to the physiological status of the animals. All these confirmed that the rabbits used for the experiment were in good state of health prior to exposure to treatments.

Upon the subjection of the rabbits to experimental diets (as shown in Table 4), variations were noticed in the haematological parameters which could be attributed to the difference in the proximate composition of each experimental diet. The PCV and RBC values of rabbits fed, *Corchorus olitorius and Telfairia occidentalis* leaves were in the same level ($p>0.05$) when compared with the control diet, while the PCV and RBC levels of rabbits fed *Moringa oleifera,* were lower ($p<0.05$) and this aligned with the findings of Ozovehe [29] and Aderinola et al. [30] which reported that the mean levels of PCV and RBC reduced as the percentage of *Moringa oleifera* leaf meal increased in the diet. This decrease in PCV and RBC of the rabbits could therefore be attributed to feeding of the rabbits solely on *Moringa oleifera,* thereby causing cellular damage in the rabbits.

Table 3. Haematological Parameters of experimental rabbits (growing rabbits) prior to subjecting them to treatments

Variable	Mean	SD	SE	Variance	Range	COV
PCV (%)	30.00	3.96	0.72	15.66	18.00	13.19
RBC (x10^6/mm^3)	4.72	0.69	0.13	0.48	3.16	14.68
WBC (x10^3/l)	5.02	1.15	0.21	1313.72	4.20	0.022
MCV (fl)	63.72	3.18	0.58	10.13	12.58	5.00
MCH (%)	20.73	1.13	0.21	1.27	4.81	5.43
MCHC (pg/cell)	32.54	0.96	0.18	0.92	3.69	2.95

COV: Coefficient of Variation; SE: Standard Error; SD: Standard Deviation; PCV: Packed Cell Volume; RBC: Red Blood Cells (Erythrocytes); WBC: White Blood Cells (Leukocytes); MCV: Mean Corpuscular Volume; MCH: Mean Corpuscular hemoglobin; MCHC: Mean Corpuscular Hemoglobin Concentration.

Table 4. Haematological parameters of growing rabbits fed different herbaceous plants as sole diet

	T0	T1	T2	T3	SEM
PARAMETERS					
Packed Cell Volume (%)	28.14	27.60	23.33	26.33	1.74
Erythrocyte (x10^6/mm^3)	4.62	4.46	4.09	4.66	0.30
Leukocyte (x10^3/l)	4.44	4.29	3.12	4.40	0.63
MCV (fl)	60.78	61.73	57.35	57.25	1.78
MCH (pg)	20.29^{ab}	20.94^{a}	19.06^{b}	19.20^{b}	0.51
MCHC (%)	33.39	33.93	33.26	33.66	0.45

T0 = Control Diet, T1 = Corchorus olitorius T2 = Moringa oleifera, T3 = Telfairia occidentalis
a, b: Means in the same row with different superscript are significantly different (P< 0.05)
SEM: Standard Error of Mean

The Leukocyte (WBC) values of rabbits fed *Corchorus olitorius and Telfairia occidentalis* leaves were within the same range ($p>0.05$) and were comparable with the control diet, while the leukocyte value of rabbits fed *Moringa oleifera* was lower ($p<0.05$) which implied that sole feeding of *M. oleifera* negatively affected the rabbits because decrease in number of WBC below the normal range is an indication of allergic condition, anaphylactic shock and certain parasitism [31].

The MCV values obtained for rabbits fed *Corchorus olitorius* were increased ($p>0.05$) when compared with the control diet. This could be attributed to the increased RBC recorded in the rabbits as MCV is the average volume of red blood cells and this is indicative of absence of microcytic anaemia. However, the MCV values of rabbits fed *Moringa oleifera and Telfairia occidentalis* were lower ($p<0.05$) than the normal range of MCV values (60.15 – 60.18 /fl) Togun et al. [13], as well as the report given by RAR [27] for normal range of MCV (78 – 95 fl). This could imply microcytic anaemia which is an indication of iron deficiency [32].

There was no significant change ($p>0.05$) in the MCHC values of the rabbits in all the treatments as they were all within the normal reference range of MCHC (33-50%) [33] which suggest the absence of hereditary spherocytosis in the rabbits since MCHC values are known to be elevated in hereditary spherocytosis [34]. The MCH value of rabbits fed *Corchorus olitorius* significantly increased ($p>0.05$) when compared with the mean level prior to treatment and also with the recorded range of 19.21- 23.41(pg) Jiwuba et al. [35] for normal MCH value while reduction was noticed in the MCH value of *Moringa oleifera and Telfairia occidentalis.* This inferred that exposure of rabbits to *Corchorus olitorius* solely was advantageous to the rabbits while sole feeding with *Moringa oleifera and Telfairia occidentalis* resulted to reduction in haematological indices, which is a sign of ill health [36] and could be attributed to the excessive exposure of the treatments.

4. CONCLUSION

Unlike *Moringa oleifera* and *Telfairia occidentalis,* results from this study showed positive changes in all the haematological indices of the experimental rabbits fed *Corchorus olitorius* and they were not significantly different from the control diet. This is indicative of the fact that feeding of rabbits with *Corchorus olitorius* as sole diet could sustain rabbits without posing any adverse effect on their health.

ETHICAL APPROVAL

There is no ethical issue as the research was carried out at the teaching and research farm of the University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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