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Performance characteristics, nutrient digestibility and blood profile of rabbits fed diets containing graded levels of *Moringa oleifera* seed powder

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Target Audience: rabbit farmers, researchers

Abstract

A ten-week feeding trial was conducted to determine the performance, nutrient digestibility and blood profile of rabbits fed diets containing graded levels of Moringa oleifera seed powder (MSP). Twenty-four male growing rabbits of mixed breeds were randomly allotted to four dietary treatments. Each treatment group was further sub-divided into three (3) replicates of two (2) rabbits each in a completely randomized design (CRD). Four diets were formulated to include MSP at varying inclusion levels of 0, 0.5, 1 and 2% for treatments T_1, T_2, T_3 and T_4 respectively, which were pelletized. Feed and water were provided ad-libitum. Data were collected on growth performance and nutrient digestibility of rabbits fed the experimental diet while at the end of the experiment, blood samples were collected to determine the effect of different inclusion levels of MSP on haematological and serum biochemical indices of rabbits. Result revealed that the average daily feed intake (68.76-78.93g) decreased significantly ($p<0.05$) across the dietary treatments as the MSP inclusion levels increased but a rise was noticed at the highest inclusion level of MSP (T_4). The weight gain and feed conversion ratio (FCR) were not significantly influenced ($p >0.05$) by the dietary treatments. No significant differences ($P>0.05$) among treatments were observed on all the blood profile except the lymphocyte, monocytes, total protein and globulin. Rabbits on T_4 recorded the highest values in total protein (6.91 g/dl) and globulin (3.03 g/dl). Digestibility studies however showed that all the parameters were significantly affected ($p<0.05$) by dietary treatments in which rabbits on T_2 had the highest dry matter (82.03%), crude protein (62.23%) and ash (89.48%) digestibility values. It can be concluded that Moringa oleifera seed powder (MSP) can be supplemented in growing rabbit's diet without any deleterious effects on performance, blood profile and nutrient digestibility.

Keywords: *Moringa oleifera*, Performance, Blood profile, Nutrient digestibility, Rabbits

Description of Problem

Rabbit production has been recognized to have a very important role to play in the supply of animal protein to Nigerians, especially in the rural and peri-urban areas (1). They are efficient converters of feed to meat, highly prolific, nutritious with low cholesterol content and relatively low cost of production (2). They can as well utilize up to 30% crude fibre as against 10% by most poultry species (3). Protein supplementation is often important to improve livestock performance, and this needs to be done with respect to the requirements of the animals in addition to the balance of other nutrients available. Improving rabbit nutrition will enhance greater productivity of rabbit without deleterious effects on animal health (4). There has been interest in the utilization of *Moringa oleifera* commonly called house radish tree or drumstick tree, as a protein source for livestock (5). The nutritional qualities of *Moringa oleifera* are excellent, which constitutes a source of high quality forage for animals. Ruminants, poultry and rabbits browse the forage due to the high protein and mineral contents (6, 7). Studies on

Moringa oleifera have shown that the leaves are rich in energy and vitamins (8). They are found to be of a good nutritional value as it contains a number of important vitamins, including: vitamins A, B complex (B1, B3, B6 and B7), C, D, E and K (9). It has medicinal uses and has been used against high blood pressure, diarrhea, inflammation of colon, intestinal worms, skin antiseptic and lastly as a diuretic agent (10). It is also used to maintain the levels of blood glucose in diabetic patients (11; 12) and as an antimicrobial agent (13) to treat ulcers. However, information is scanty on utilization of moringa seed powder (MSP) as feed supplement for rabbits. This study therefore aimed at evaluating the performance, nutrient digestibility and blood profile of growing rabbits fed diets containing graded levels of *Moringa oleifera* seed powder.

Materials and Methods

Experimental Location

The research was conducted at the Rabbit unit of the Teaching and Research Farm, University of Ibadan, Ibadan Nigeria which lies between Latitude 07^o 02' 49" and 07^o 43' 21"N longitude 3^o 31' 58" and 4^o 08' 20" E at an altitude of about 230 meters above sea level.

Preparation of Experimental Diets

The *Moringa oleifera* seeds used for this study were collected from the University of Ibadan, Oyo state, Nigeria. The seeds were harvested from dry moringa pods and approximately 10kg was ground using a hammer mill with screen size of 2.0mm. The ground powder was then stored in airtight, plastic containers until needed (14). Four diets of 16% crude protein were formulated such that the *Moringa oliefera* seed powder (MSP) was included at 0, 0.5, 1.0 and 2.0% in diets 1, 2, 3 and 4 respectively. Each diet compounded were moistened with water and then allowed to pass directly into the pellet press with 4 mm mesh to produce a pelletized feed. The pelletized feeds compounded were then spread on the concrete floor for sun drying, after which when properly dried, were bagged and stored for the feeding trial.

Table 1: Gross Composition of the Experimental Diet

Ingredients	**Inclusion levels of MSP**			
	T_1 (0%)	T_2(0.5)	T_3 (1.0%)	T_4 (2.0%)
Wheat bran	35.00	35.00	35.00	35.00
Maize	20.00	20.00	20.00	20.00
Cassava Peel	16.00	16.00	16.00	16.00
GNC	10.00	9.50	9.00	8.00
PKC	10.00	10.00	10.00	10.00
SBM	5.00	5.00	5.00	5.00
MSP	-	0.05	1.00	2.00
Oyster shell	2.00	2.00	2.00	2.00
DCP	1.00	1.00	1.00	1.00
DL-Methionine	0.30	0.30	0.30	0.30
L-Lysine	0.20	0.20	0.20	0.20
Grower- Premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis				
Crude Protein (%)	17.27	17.37	17.63	17.74
Crude Fibre (%)	6.97	6.96	6.95	6.93
Ether extract (%)	4.33	4.47	4.62	4.90

GNC: Groundnut cake, PKC: Palm Kernel cake, SBM- Soya bean meal, Moringa seed powder, DCP- Di calcium phosphate

Management of Experimental Animals, design and management

A total of twenty-four (24) growing rabbits with an average weight of 1.2kg of mixed breeds obtained from local farmers in Ibadan were used for this study. Prior to the start of the study, the animals were fed the same diet and were allowed an adjustment period of seven days to enable the animals get acquainted with the cages. The rabbits were dewormed and appropriate medications were administered as at when due. They were randomly allotted on weight equalization into four dietary treatments consisting of three replicates of two rabbits each in a completely randomized design. The rabbits were housed individually in wire mesh cages measuring 120 × 150 cm equipped with heavy earthen feeders and drinkers capable of reducing feed wastage. The cages were located inside a building equipped with vents and windows for ventilation. Feed and water were provided *ad-libitum* throughout the experimental period of 10 weeks.

Data collection

Feed Intake and Live Weight Gain

The rabbits were weighed individually at the beginning of the experiment and subsequently on a weekly basis using a sensitive hanging weighing scale prior to feeding in the morning. The initial live weight was subtracted from the final live weight to determine the weight gained by each animal. Feeds offered and remnants were weighed on a daily basis to determine the actual feed intake per animal. Feed conversion ratio (FCR) was calculated from feed intake and weight gain values.

$$\text{Weight Gain (g)} = \text{Final Weight (g)} - \text{Initial Weight (g)}$$

$$\text{Feed intake (g)} = \text{Feed offered(g)} - \text{Feed Refusal (g)}$$

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

Apparent Nutrient Digestibility study

A digestibility trial was conducted at 8th week of the study using twelve male rabbits with three rabbits per treatment. The animals were individually placed in metabolic cages and were fed the experimental diet meant for each treatment group for seven days to establish their average daily feed intake. Adaptation period of 7 days was followed by a 7-day of total faeces and urine collection. Faecal sample collection was done for seven days, using aluminium trays placed under the cage. Feacal sample collected from each rabbit were bulked, thoroughly mixed to have a representative sample, labeled in polyethylene bags, stored at -10^{0}C, then air dried and weighed. The air dried faecal samples (free of feed and visible hair contaminants) were later oven-dried at 60^{0}C for 24 hours and subsamples were stored for proximate analysis according to the procedures of (15). Apparent nutrient digestibility was calculated using this formula below:

$$\text{Apparent Nutrient Digestibility} = \frac{\text{Amount of nutrient intake} - \text{Amount of nutrient in faeces}}{\text{Amount of nutrient intake}} \times 100$$

Blood Collection

At tenth week of the trial, three rabbits per treatment were selected and bled at the last week of the experiment. About 5 ml of blood sample was collected from each rabbit in which half of it was poured into sample bottles containing ethylene diamine tetra-acetic acids (EDTA) as anti-coagulant and the bottles were gently shaken to ensure proper mixing of the blood with EDTA to prevent coagulation for haematological assay (16). The remaining 2.5ml blood sample was poured into a plain sample bottles and left to coagulate for serum biochemical indices determination. The haematological indices determined were packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC) count and white blood

cell (WBC) and differential count. Mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were obtained from the calculation according to standard formulae (17; 16). The PCV was determined using the wintrobe haematocrit method described by (18). WBC and RBC were determined using a haemocytometer after appropriate dilution (19), Haemoglobin and Mean corpuscular volume (20). Biochemical components of the serum samples estimated were total protein (g/dl) which was determined according to Biuret Method (21) while albumin (g/dl) level was obtained using Bromocresol green method as described by (22). Blood glucose (mg/dl) level was determined according to the method recommended by (23)

$$\text{MCV}\ (\%) = \frac{\text{PCV}(\%)\times 10}{\text{RBC}}$$

$$\text{MCH}\ (\%) = \frac{\text{Hb}\left(\frac{\text{g}}{\text{dl}}\right)\times 10}{\text{RBC}}$$

$$\text{MCHC}\ (\%) = \frac{\text{Hb}\left(\frac{\text{g}}{\text{dl}}\right)\times 100}{\text{PCV}\ (\%)}$$

Statistical design and analysis

Data collected were analyzed using one way analysis of variance (ANOVA) of (24) statistical package and the significant differences between means were compared at 5% level of significance using Duncan multiple range tests of the same package.

Chemical Analysis

The test ingredient, experimental diet and faecal sample were dried at 60 ^{O}C for 24 hours and ground to pass a 1-mm sieve screen using laboratory hammer mill machine. Dry matter (DM), Ash, crude protein CP; (N x 6.25), ether extract (EE) and crude fibre (CF) were determined on dry samples according to the methods of (15).

Result and Discussion

The proximate composition of the experimental diets and *Moringa oleifera* seed powder (MSP) is presented in Table 2. The nutrient composition of *Moringa oleifera* seed powder showed that it contained 78.12% dry matter, 30.45% crude protein, 3% crude fibre, 9% ether extract, 30.67% nitrogen free extract and 5% ash. The crude protein value of moringa seed powder was lower than the values (31.65%) and 36.76% reported by (25) and (26) respectively for moringa seed powder but however higher than the crude protein content of the moringa leaf meal (27.2%) reported by (27). The crude fibre content of MSP obtained in this study was lower than the value of 7.54% reported by (25). The differences observed in the values of the proximate composition of moringa seed powder used in this study and those reported in literature can be attributed to variation in planting location, maturity and weather condition. The proximate composition of the experimental diets showed that the diets had high dry matter (DM) contents that ranged from 86.03% in T_4 to 89.36% in T_1. This indicated that the diets can be stored for longer period of time without spoilage. The crude protein values which ranged from 13.95-16.45% increased across the dietary treatments as the MSP inclusion levels increased. The increment observed in crude protein values across the treatment groups was truly a reflection of the fact that the MSP itself had high crude protein values. However the crude fibre, ether extract, nitrogen free extract and ash of the experimental diet did not follow a particular trend but ranged from 5-6%, 6–7%, 32.41-43.12% and 20– 30% respectively.

Table 2: Proximate Composition of the Experimental diets and *Moringa oleifera* seed powder.

Parameters (%)	Inclusion levels of MSP				
	T_1 (0%)	T_2(0.5)	T_3 (1.0%)	T_4 (2.0%)	MSP
Dry matter	89.36	87.17	87.42	86.03	78.12
Crude protein	13.95	14.30	15.61	16.45	30.45
Crude fibre	6.00	5.00	5.00	6.00	3.00
Ether extract	7.00	6.00	6.00	7.00	9.00
Nitrogen free extract	32.41	34.72	43.12	33.42	30.67
Ash	30.00	25.00	20.00	24.00	5.00

MSP: Moringa seed powder.

Performance characteristics of rabbits fed diets containing graded levels of MSP are presented in **Table 3**. There were no significant differences ($p>0.05$) among the parameters observed except for the average daily feed intake (g/day). The average daily feed intake (ADFI) values obtained decreased across the dietary treatment with increase in the levels of MSP. This significant decline in feed intake could be attributed to the presence of some anti-nutritional factors (ANF), which are thought to be prevalent in most raw legumes (28). Previous studies have indicated that the presence of some anti-nutritional factors like tannins and phytate in the diets results in poor palatability, consequent decrease in feed intake due to its astringent property as a result of its ability to bind with protein of saliva and mucous. More so, phytate reduces bioavailability of minerals in non-ruminant animals (29). This result did not agree with the findings of (7) who reported increase in feed intake of rabbits fed graded levels of *Moringa oleifera* leaf meal simply as result of their acceptability to diet supplemented with *Moringa oleifera* leaf meal. The variation observed could be attributed to different parts used and the MSP had been confirmed to show greater concentration of anti-nutrients than moringa leaf meal (30). The comparatively higher amounts of anti-nutrients in the seeds rather than the leaves may explain why moringa seeds are used more in ethno-medicine than the leaves. The highest ADFI values were observed in rabbits on T_1 (69.58 g/d) followed by those on T_4 (65.47 g/d) and T_2 (65.09 g/dl), which were statistically similar but higher than rabbits on T_3 (60.04 g/dl). Total weight gain was not significantly ($P>0.05$) affected by the dietary treatments but values obtained in animals on T_1 and T_2 were however numerically higher than those in T_3 and T_4 indicating that the inclusion levels of 0.5% supported weight gain. This could be attributed to increase in anti-nutrients content of the diet as MSP inclusion level increased and thereby resulting to reduced nutrient utilization (31). The result from this study was in agreement with the findings of (32) who reported that replacement for *Centrocema pubescens* with *Moringa oleifera* leaf meal had no significant effect on average body weight of rabbits. Feed conversion ratio (FCR) values observed was not significantly ($p>0.05$) influenced by the dietary treatment. Feed conversion ratio (FCR) is an important index of performance, which is a direct indication of how best feed offered to animals was utilized for meat production. The values of FCR ranged from 4.70-5.92 with rabbits on T_2 having the lowest FCR numerical values. The FCR values obtained were comparable with the range of values of 4.22-5.13 reported by (7).

Table 3: Performance Characteristics of Rabbits fed diet containing graded levels of Moringa *oleifera* seed powder

Parameters	Inclusion levels of MSP				
	T_1 (0%)	T_2(0.5)	T_3 (1.0%)	T_4 (2.0%)	SEM
Initial wt (Kg)	1.36	1.30	1.31	1.33	0.05
Final wt (Kg)	2.29	2.28	2.14	2.18	0.06
Weight gain (Kg)	0.93	0.98	0.83	0.85	0.04
ADWG (g/day)	13.26	14.50	11.91	12.14	0.63
DM Feed intake (g)	4870.70^{a}	4591.40 ^{ab}	4202.80^{b}	4582.80^{ab}	101.62
ADFI (g/day)	69.58^{a}	65.59^{ab}	60.04^{b}	65.47^{ab}	1.45
FCR	5.49	4.70	5.22	5.92	0.27

^{a,b} Means within the same row with different superscripts are significantly different ($p<0.05$)
FCR-Feed conversion ratio, DM – Dry matter, MSP- Moringa seed powder.

Table 4 shows the nutrient digestibility of rabbits fed diet containing varying levels of moringa seed powder (MSP). All the parameters measured were significantly influenced ($P<0.05$) by the experimental diets. Animals on T_2 had the highest digestibility values in all the parameters observed except for crude fibre values. Dry matter digestibility values obtained in this study fall within the range of values (61.16-87.03%) reported by (33) who fed rabbits with diets containing varying levels of groundnut haulms and cowpea shells. The ash digestibility values observed in this study ranged from 59.69-89.48% in which the highest value was recorded among rabbits on T_2 while the lowest value was obtained from animals on T_4. The lowest ash digestibility values obtained in T_4 may be due to high concentration of phytate which had been reported to of minerals in non-ruminant animals (29) and thereby binding essential, nutritionally important divalent cations, such as iron, zinc, magnesium and calcium forming insoluble complexes, thereby making minerals unavailable for absorption (34). According to (35), tannins adversely affect protein digestibility but its minimum level is required to elicit a negative growth response that has not been fully established. More so, phytate was also reported to decline digestibility of starch and protein (36). In all the parameters monitored except crude fibre, highest value occurred with rabbits on T_2 containing 0.5% MSP inclusion level. High digestible crude protein values obtained in rabbits on T_2 might be due to lower MSP inclusion levels allotted and the MSP has been confirmed to contain acidic protein with haemagglutinating activity, glucosinolates which interacts with intestinal epithelium, interfering with nutrient digestion and absorption (37). The improved nutrient digestibility with these diets may be due to efficient utilization of MSP by growing rabbits (38).

Table 4: Nutrient digestibility of Rabbits fed diet containing graded levels of Moringa *oleifera* seed powder

Parameters (%)	Level of Inclusion of Moringa Seed Powder				
	T_1 (0%)	T_2 (0.5%)	T_3 (1.0%)	T_4 (2.0%)	SEM+
Dry matter	70.61^{b}	82.03^{a}	70.67^{b}	62.35^{b}	1.48
Crude Protein	52.33^{ab}	62.23^{a}	53.34^{a}	42.21^{b}	1.53
Crude fibre	58.13^{a}	45.45^{b}	59.17^{a}	43.14^{b}	1.40
Ether extract	55.93^{ab}	57.48^{a}	55.40^{ab}	46.27^{b}	1.91
Ash	71.95^{b}	89.48^{a}	67.09^{b}	59.69^{b}	0.85
NFE	42.69^{a}	41.17^{a}	34.01^{b}	30.46^{b}	1.76

NFE: Nitrogen free extract.

Indicated in Table 5 are the haematological indices of rabbits fed diets containing graded levels of *Moringa oleifera* seed powder (MSP). Dietary components of *M. oleifera* were reported to have measurable effects on blood constituents (39). However, parameters observed in this study were not significantly ($p>0.05$) influenced by the dietary treatments except the lymphocytes and monocytes. Packed cell Volume (PCV) is an index of toxicity reduction in the blood and it suggests presence of a toxic factor which adversely has effect on blood formation. The Packed cell Volume values (32.33- 40.00%) obtained in this study fell within the normal physiological range of 30.0-50.0% reported by (40) for healthy rabbits, suggesting that MSP were tolerated across the treatment groups. This agrees with the findings of (41) who reported that normal PCV values are indicators of adequate nutritional status of rabbits. This is an indication that the experimental diets fed were not detrimental to the health of the rabbits. In this study, the values obtained for WBC (3.74-6.88x10^3/mm^3) of rabbits were slightly below the reference range (6.40 to 12.90 x10^3/ mm^3) as reported by (42) for healthy young rabbits. Decreased white blood cell (WBC) below the normal range could be an indication of allergic conditions, anaphylactic shock and certain parasitism or presence of foreign body in circulating system while elevated values (leucocytosis) indicate the existence of a recent infection, usually with bacteria (43). Although the WBC counts were not significantly ($P>0.05$) influenced by the dietary treatments, but the numerical values increased across the treatment groups. The red blood cell (RBC) values (5.44-6.49 x 10^6/mm^3) were within the range 3.07 to 8.50 x10^6/mm^3 reported by (44). The lymphocytes value observed ranged from 62% in rabbits on T_1 to 71.67% in those on T_3. The lymphocytes values of the experimental animals increased across the dietary treatments as the MSP inclusion levels increased but later dropped at T_4. Animals on T_3 (2.67%) and T_4 (2.67%) were statistically similar ($p>0.05$) in monocytes value but higher ($p< 0.05$) than those on T_1 (1.67%) and T_2 (0.67%) respectively. This means that the PCV and other non-significant values observed in this study were within the normal physiological range recommended for rabbit according to (45). The red pigment of the erythrocyte functions in the transport of oxygen and carbon (IV) oxide in animal body. Results of Haemoglobin were therefore indicative of variations in oxygen and carbon (IV) oxide carrying capacity of rabbits fed graded levels of MSP based diets. The values were within the standard range of 10.4-17.4g/dl (45).

Table 5: Haematological parameters of Rabbits fed diets containing graded levels of Moringa seed powder

	Inclusion	Levels of	MSP		
Parameters	T_1 (0%)	T_2 (0.5%)	T_3 (1%)	T_4 (2%)	SEM±
PCV (%)	40.00	32.33	37.00	37.00	6.92
Hb(g/dl)	13.50	10.90	12.50	12.47	0.70
RBCx10^6/mm^3	6.49	5.44	6.31	6.25	0.34
WBCx10^3/mm^3	4.65	3.88	3.74	6.88	0.71
Lymphocytes (%)	62.00^{b}	62.33^{b}	71.67^{a}	64.33^{b}	2.12
Neutrophil (%)	34.67	35.33	24.33	32.00	2.19
Monocytes (%)	1.67^{ab}	0.67^{b}	2.67^{a}	2.67^{a}	0.29
Eosinophils (%)	2.33	1.67	1.33	1.33	0.31
MCV(*fl*)	61.69	59.76	58.59	59.14	0.55
MCH (pg)	20.83	20.18	19.78	19.85	0.26
MCHC(%)	33.75	33.75	33.75	33.56	0.21

[a,b] Means within the same row with different superscripts are significantly different ($p<0.05$)
PCV: Packed cell volume, Hb: Haemoglobin, RBC: Red blood cell, WBC: White blood cell, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin, MCHC: Mean corpuscular haemoglobin concentration, SEM: Standard error of mean

The serum biochemical parameters of rabbits fed diets containing varying levels of moringa seed powder are shown in **Table 6**. There were no significant differences ($p>0.05$) in all the parameters observed except Total protein (TP) values which ranged from 5.80 to 6.91 g/dl with animals on T_4 having the highest ($p<0.05$) among the treatments followed by those on T_2 (6.54 g/dl, 2.54 g/dl) and T_3 (6.44 g/dl, 2.58 g/dl) were not significantly different ($p>0.05$) but higher ($p<0.05$) than the values observed in T_1 (5.80 g/dl).

The variations in serum total protein stemmed from the different rate of protein metabolism and utilization by the rabbits. The values obtained were in line with earlier observation for healthy rabbits (46). This indicates that the diet was of relatively good quality and that rabbits fed this diet were more efficient in protein metabolism and utilization. Rabbits on diets T_2 and T_3 showed similar total protein values ($P>0.05$) and this revealed that the rate of protein metabolism and utilization were similar. The serum albumin values (3.86 to 4.00g/dl) obtained in this study was lower than the range of values (4.0 to 7.2 g/dl) reported by (46) but fell within the normal range of 2.5 to 4.0 g/dl reported by (45). The globulin values (1.86 to 3.03 g/dl) showed significant differences across the treatment groups and increased as the MSP inclusion levels increased. This variation observed indicates an alteration of normal systematic protein utilization and low dietary protein intake caused as a result of increase in anti-nutrients content of the diet as MSP inclusion levels increased. Since total proteins, albumin and globulin are generally influenced by total protein intake (46), the values obtained in this study were an indication of nutritional adequacy of the dietary proteins pointing to high immunity and good resistance to disease in the experimental animals. This perhaps highlights the ethno veterinary properties of *Moringa oleifera* as reported by (47). The blood glucose was higher than the range of 4.2-8.9 g/d1 reported by (48).

Table 6: **Serum biochemical parameters of Rabbits fed diet containing graded levels of moringa seed powder**

Parameters	Inclusion levels of MSP				
	T_1 (0%)	T_2 (0.5%)	T_3 (1.0%)	T_4 (2.0%)	SEM±
Total Protein (g/dl)	5.80[b]	6.54[ab]	6.44[ab]	6.91[a]	0.16
Globulin (g/dl)	1.86[b]	2.54[a]	2.58[a]	3.03[a]	0.15
Albumin (g/dl)	3.94	4.00	3.86	3.88	0.05
Cholesterol(mmol/L)	2.41	3.27	2.95	3.48	0.35
Glucose (g/dl)	11.08	10.38	13.49	9.61	0.88

[a,b] Means within the same row with different superscript are significantly difference ($p<0.05$)

Conclusion and Application

Based on the result of this study, it can be concluded that:

1. *Moringa oleifera* seed powder supplementation had no significant effect on growth performance of rabbit bucks except the feed intake thus a good processing method was suggested to unlock the nutrients present in *Moringa oleifera* seed for better utilization
2. The PCV, lymphocytes, monocytes and total protein concentration were within the normal range of values recommended for healthy rabbits.
3. Inclusion level of *Moringa oleifera* seed powder up to 2.0 % in rabbit's diet had no deleterious effect on the blood profiles of growing rabbits but rabbits fed 0.5% inclusion levels gave the best digestibility values

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