World Applied Sciences Journal 35 (8): 1229-1234, 2017
ISSN 1818-4952

DOI: 10.5829/idosi.wasj.2017.1229.1234

Growth Performance and Organ Indices of Rabbit Bucks Fed *Moringa oleifera* Leaf Meal

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Abstract: To investigate the effect of *Moringa oleifera* Leaf Meal (MoLM) on performance and some organs characteristics in rabbit bucks, twenty rabbit bucks aged 7 - 8 weeks old were randomly allocated to four (4) experimental diets containing MoLM at 0, 2.5, 5.0 and 7.5 % levels as diets 1, 2, 3 and 4 respectively for 20 weeks. Record on performance of the bucks was taken weekly throughout the period of the experiment. At the end of the experiment, the animals were weighed, stunned and sacrificed. The visceral organs were harvested and weighed. Samples from the visceral organs were taken for histopathological evaluation. The result showed that inclusion of *Moringa oleifera* leaf meal in the diet of rabbit bucks significantly ($p<0.05$) reduced weight gain. The dietary levels of MoLM had no significant effect on the relative weights of heart, liver, spleen, pancreas and kidney while the weight of adrenal gland significantly ($p<0.05$) increased with increasing dietary MoLM. Lungs weight was significantly higher in bucks on diet 2 compared to those on other treatment. Bucks on 5% dietary MoLM had significantly higher weight than those fed 7.5%. Varying degree of damages was observed in the organs and rated as mild, moderate or severe. From the results of hisopathological examinations, it could be concluded that MoLM should be included in ration in levels ≤ 2.5% to avoid their toxic effect on visceral organs that negatively influenced the health status of supplemented animals.

Key words: Histopathology · Organ weight · Supplement · Weight gain · *Moringa oleifera*

INTRODUCTION

In a bid to explore available feed resources such as leaf meals from tropical trees, some of these leaf meals have been reported to contain substances that influence growth and development of farm animals [1, 2] and others that may not be beneficial to the animals. Green plants leaf meal are used in the ration of the livestock to reduce the cost of production [1], enhance reproductive performance [3], enhance health status and promote growth [4] of farm animal, thus increasing overall livestock production when used as a feed component or additive.

Moringa oleifera Lam belongs to monogeneric family of shrubs and tree, Moringaceae and commonly known as "Drumstick". Moringa seeds have no dormancy period, so they can be planted as soon as they are mature and they will retain the ability to germinate for up to one year [5]. The plant possesses many valuable properties which made it of great scientific interest [6-8]. It must also be noted that few parts of the tree contain some toxins that might decrease its potential as a source of food for animals or humans [9]. Different morphological parts of the tree has been evaluated as a potential animal feed ingredient with the crude protein (CP) content of fresh leaves, soft twigs and stems as 260, 70 and 60 g kg^{-1} respectively [9]. The leaves had negligible amounts of tannins (12 g kg^{-1}), while trypsin and amylase inhibitors, lectins, cyanogenic glucosides and glucosinolates were not detected. The phytochemical screening of the leaf indicated the presence of flavonoids, tannins, steroid, alkaloid, saponins in the Moringa leaf extracts [10]. The saponin content of the leaves was 80 g kg^{-1} having no haemolytic activity and a phytate content of 21 g /kg [9]. The presence of this substance in feed ingredients may

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produce various responses in farm animals based on the ability of the animals to utilize the feed components. The efficiency of feed utilization can be expressed in organ development in terms of weight and functions. A reduction or increase in the size of an organ maybe an indication of injury or diseased condition. An understanding of the normal structure and function of different tissues is essential for interpreting the changes that occur during disease. Several research findings on leaf meal and its effects on organs have been reported [11 -14]. The concentrations of toxic metals increased in the roots, leaves and seeds of *Moringa oleifer*a respectively [15]. However, there is paucity of information on the effect of MoLM on organs of rabbit. Thus, this study aimed to determine the effect of *Moringa oleifera* leaf meal as a dietary supplement on weight gain, organ weights and organ-histopatology of rabbit bucks.

MATERIALS AND METHODS

Experimental Location: The study was conducted at the Rabbitry unit of the Teaching and Research farm, University of Ibadan which is located between latitudes 7°25' to 7°31' N and longitudes 3°41' to 3°56' E. The site has a mean altitude of 220m above sea level and lies in the south-western agro-ecological zone of Nigeria.

Experimental Animals and Management: Twenty cross bred rabbit bucks (New Zealand white × Chinchilla) aged 7-8 weeks old were used for the experiment. The bucks were housed individually in wooden cages that were raised from the floor. The *Moringa oleifera* leaf meal (MoLM) was air-dried, milled, incorporated into the diets and analyzed. Four experimental diets were formulated to meet the nutrient requirement of rabbits as recommended by NRC [16], the proximate composition of moringa and the experimental diets was done (Table 2) using the method of AOAC [17]. The animals were fed the experimental diets for 24weeks after two weeks of acclimatization. Feed and clean water was provided *ad-libitum*. Diet 1 contained no MoLM and served as the control diet while Diets 2, 3 and 4 contain MoLM at 2.5(97.5% Control diet + 2.5% MoLM), 5.0 (95.0% Control diet + 5.0% MoLM) and 7.5 % (92.5% Control diet + 7.5% MoLM), respectively.

Growth Study: All the rabbits were weighed at the beginning of the experiment before they were allocated to the treatments. Record on the performance was taken weekly throughout the period of the experiment.

Table 1: Gross Composition of the Experimental (Control) Diet

Ingredients	Quantity (%)
Maize	42.0
Rice Husk	25.0
Soyabean Meal	20.0
Wheatbran	10.3
Common Salt	0.25
Premix	0.25
Dicalcium Phosphate	2.00
Methionine	0.12
Lysine	0.13
Total	100
Calculated Analysis:	
Crude Protein (%)	16.3
Crude Fiber (%)	10.5
Digestible Energy (Kcal/Kg)	2541

Daily feed was provided *ad libitum* as a known quantity of feed (70 – 120g/rabbit/day [16]) was offered to the animals twice daily depending on their growth requirement per time. Daily feed consumed was recorded and the feed leftover and/or wastage were weighed daily before supplying fresh feed. Record of average daily feed intake and daily body weight gain was taken. Feed Conversion Ratio (FCR) was calculated as the ratio of feed intake to weight gain.

Organ Assessment: The bucks on each treatment group were weighed, slaughtered and skinned. The head and paws were removed. The carcass were eviscerated, all the internal organs were removed after which the dressed weights were taken using sensitive digital scale. The direct weights of organs such as liver, kidney, etc were taken using the analytical weighing balance and recorded to the nearest 0.01gram as absolute weight. Paired organs were weighed individually and recorded; both were added together to obtain the paired weight of the organs. Percentage relative weights of the organs were calculated using the formula:

Relative weight of organ =Absolute weight of the organ/ Live weight of the rabbit X 100

Liver, kidney and ileum were carefully removed, weighed and fixed in 10% formalin solution and processed for histopathological examination at the department of Veterinary Pathology of the University of Ibadan as described by [18].

Data Analysis: The relative organ weights were subjected to statistical analysis of variance (ANOVA) procedure using Statistical Analytical System [19]. Treatment means

Table 2: Proximate Composition of *Moringa oleifera* Leaf Meal and Experimental diets

Nutrients	MoLM	Diet 1 0% MoLM	Diet 2 2.5% MoLM	Diet 3 5.0% MoLM	Diet 4 7.5% MoLM
Dry Matter (%)	88.0	90.5	90.4	90.4	90.3
Crude Fibre (%)	11.0	13.7	13.6	13.5	13.4
Ether Extract (%)	13.0	5.00	5.23	5.41	5.76
Crude Protein (%)	27.9	16.8	17.1	17.4	17.6
Ash (%)	11.5	10.0	10.0	10.1	10.1
Nitrogen Free Extract (%)	24.6	45.0	44.5	44.0	43.5

CD – control diet

were compared using Duncan multiple range test of the same software. Result on organ histopathology was analyzed using descriptive statistics.

RESULTS AND DISCUSSION

Performance of Rabbit Bucks Fed Varied Levels of *Moringa oleifera* Leaf Meal: The result on growth performance of rabbit bucks fed varied levels of *Moringa oleifera* leaf meal (MoLM) is presented in Table 3. Inclusion of *Moringa oleifera* leaf meal in the diet of rabbit bucks resulted in reduction in weight gain. Bucks fed 2.5, 5.0 and 7.5 % MoLM had lower weight gain compared with those fed control diet (0% MoLM). Weight gain was significantly ($p<0.05$) influenced by the dietary levels of MoLM. The reduction in weight gain observed in this study with increase in the quantity of MoLM consumed by the rabbits may be as a result of the cumulative effect of tannin and saponin present in *Moringa oleifera* leaf meal. Polyphenols, commonly known as tannins, occur widely in many different plants, especially from tropical regions [9]. Their consumption by animals has adverse effects on productivity and health. The result from this study disagreed with the findings that replacement for *centrocema pubescens* with *Moringa oleifera* had no significant effect on average body weight of rabbits [20]. However, the result from this study contradicts also the report of Nuhu [21] who observed significant increase in weight gain when growing rabbits were fed *Moringa oleifera* leaf meal based diet. *Moringa oleifera* possess growth enhancing property when its methanolic extract was sprayed on young plants [22]. This property was obviously not expressed in promoting growth in bucks fed MoLM of this study. The average feed intake was not significantly different among the treatments. Dietary levels of MoLM had significant effect on average weight gain of the rabbit bucks.

Effect of *Moringa oleifera* Leaf Meal on Organ Weight of Rabbit Bucks: The relative weights of some internal organs of the rabbit bucks fed *Moringa oleifera* leaf meal (MoLM) is presented on Table 4. Lungs, adrenal gland and bile weights were significantly ($p<0.05$) influenced by the dietary treatments. The levels of MoLM fed to the bucks had no significant effects on the relative weights of heart, liver, spleen, pancreas and kidney.

Plants are generally known to possess phytochemicals which may be beneficial or harmful to animals if consumed at certain quantities; the effect is often expressed in the weight of some of the visceral organs. Organ weight changes have long been accepted as a sensitive indicator of chemically induced changes of organs [23, 24]. Results from this study showed that organ weights of the rabbit bucks were not adversely affected by MoLM consumption. The significant or non significant decrease or increase in the relative weights of some organs as observed in this study despite the increase in the inclusion levels of MoLM in the diets might implies higher physiological activity of these vital organs in maintaining homeostasis. It has been reported that increased metabolic rate of an organ in an attempt to reduce toxic elements to non-toxic metabolites result in differences in the weight of the organ [25]. However, administration of dietary MoLM consumption within six to eight weeks in different farm animals may not exert any significant abnormalities on internal organs [14].

Effect of *Moringa oleifera* Leaf Meal on Organ Histopathology of Rabbit Bucks: The result on organ histopathology of liver, kidney and ileum are presented on Table 5. The result revealed various level of damage done to the organs by the dietary treatment. Lesions observed on the organs based on the effect of *Moringa oleifera* leaf meal were rated as mild, moderate and severe. It was observed that all the bucks fed 2.5% MoLM had mild lesion / necrosis in their liver, kidney and ileum. 100% moderate lesions were recorded in the liver and kidney the bucks fed 5.0 and 7.5 % MoLM levels respectively. Thirty-three percent (33%) of the bucks fed 5.0 and 7.5% had moderate lesion/sloughing off of the ileum while 66.67% of them had severe lesions.

Table 3: Growth performance of rabbit bucks fed varied levels of *Moringa oleifera* leaf meal

Body weight	Diet 1 (0% MoLM)	Diet 2 (2.5% MoLM)	Diet 3 (5.0% MoLM)	Diet 4 (7.5% MoLM)
Initial BW /g	1137±50.9	1125±67.6	1146±88.2	1126±70.6
Final BW/g	2154±145	1995±116	1908±107	1998±126
The % of BW gain	47.21±6.49^{a}	43.61±4.17^{ab}	39.94±3.76^{b}	43.64±4.40^{ab}
Total BWGain (g/rabbit)	1017±134^{a}	870±96.8^{b}	762±98.4^{b}	872±44.0^{b}
Daily weight Gain (g/rabbit)	6.05±0.79^{a}	5.18±0.58^{b}	4.54±0.59^{b}	5.19±0.26^{b}
Average Feed Intake (g/rabbit/day)	84.7±4.48	85. 5±4.75	83.9±4.56	85.1±4.97
Feed Conversion Ratio	12.0±3.67	10.18±3.69	9.08±2.29	10.25±2.74

Means in the same row with different superscripts (a, b) are significantly different at P< 0.05), Body weight (BW), % of body weight gain = [(Final BW-Initial BD)/Final BW*100]

Table 4: Relative organ weights of rabbit bucks fed varied levels of *Moringa oleifera* leaf meal (MoLM)

PARAMETERS	Diet 1(0%MoLM)	Diet 2(2.5% MoLM)	Diet 3(5.0% MoLM)	Diet 4(7.5% MoLM)
Heart (%)	0.21±0.01	0.22±0.02	0.23±0.02	0.22±0.07
Liver (%)	0.56±0.09	0.60±0.04	0.70±0.42	0.51±0.07
Lungs (%)	0.59±0.07^{b}	0.93±0.19^{a}	0.55±0.05^{b}	0.59±0.21^{b}
Spleen (%)	0.04±0.01	0.04±0.01	0.04±0.01	0.03±0.01
Adrenal gland (%)	0.03±0.01^{a}	0.02±0.01^{ab}	0.02±0.00^{ab}	0.01±0.00^{b}
Bile (%)	0.03±0.01^{ab}	0.03±0.01^{ab}	0.05±0.01^{a}	0.02±0.01^{b}
Kidney (%)	0.41±0.05	0.46±0.09	0.51±0.12	0.50±0.05
Paired testis (%)	0.27 ±0.06	0.35± 0.08	0.23± 0.07	0.25 ±0.02

Means in the same row with different superscript (a, b) are significantly different (P< 0.05)

Table 5. Organ histopathology of rabbit bucks fed varied levels of *Moringa oleifera* leaf meal (MoLM)

PARAMETERS	Diet 1(0% MoLM)	Diet 2(2.5% MoLM)	Diet 3(5.0% MoLM)	Diet 4(7.5% MoLM)
LIVER (%) Necrosis/lesion				
Mild	0(0/0)	100(3/3)	0(0/0)	0(0/0)
Moderate	0(0/0)	0(0/0)	100(3/3)	100(3/3)
Severe	0(0/0)	0(0/0)	0(0/0)	0(0/0)
KIDNEY (%) Necrosis/lesion				
Mild	0(0/0)	100(3/3)	0(0/0)	0(0/0)
Moderate	0(0/0)	0(0/0)	100(3/3)	100(3/3)
Severe	0(0/0)	0(0/0)	0(0/0)	0(0/0)
ILEUM (%) Necrosis/lesion				
Mild	0(0/0)	100(3/3)	0(0/0)	0(0/0)
Moderate	0(0/0)	0(0/0)	33.3(1/3)	33.3 (1/3)
Severe	0(0/0)	0(0/0)	66.7(2/3)	66.7 (2/3)

Findings from this study showed that the anti-nutritional components of the test ingredient might have contributed to the varying effect observed in the internal organ when the duration of consumption is long (beyond eight weeks). The changes observed in some organs during this study could be attributed to the presence of toxins present in the leaf meal which are capable of disrupting the integrity of the cells. Findings from this study corroborate the variation observed in the values of Alanine aminotransferase and Asparte aminotransferase from previous study [26] which is an indication of organ damage. Rats that received Methanolic extract of MoLM at 200 and 400 mg/kg body weight had significantly increased serum ALT, AST, blood urea and creatinine which points to hepatic and kidney damage [27]. Changes observed in the liver hepatocyte varied from mild to moderate. This disagrees with the findings that a dose of 0.10g/100g dietary Moringa leaf supplementation had hepatoprotective effect in fingerlings and significantly reduced the activities of AST and ALT [28].

Sloughing off of the epithelium and congestion of the renal blood vessels were observed at the inclusion of MoLM in the diets which ranged from mild in rabbits fed 2.5% MoLM to severe in rabbits fed 5.0 and 7.5 % MoLM. Insufficient surface area for nutrient absorption in the small intestine might have resulted in reduced weight gain observed in rabbit bucks despite adequate feed intake. Cadmium in the leaves of *Moringa oleifera* exceeded the WHO maximum acceptable limit hence makes it unfit to be consumed as traditional medicine [15]. The cumulative effect of the anti-nutritional components of MoLM present in each diet might have exceeded the tolerable levels of the bucks thus exerted slight abnormalities on the organs.

CONCLUSION

Based on the findings from this study, it can be concluded that *Moringa oleifera* leaf meal cannot be feed as growth booster to rabbit bucks. Feeding MoLM above 2.5% to rabbits may have toxic effect on visceral organs. Prolong consumption or chronic administration of Moringa. oleifera leaves might predispose animals to hepatic and kidney damage. Thus, MoLM can be recommended as a feed supplement when fed at <2.5% inclusion in the diet of rabbit bucks.

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