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Growth performance, hematological and serum characteristics of rabbit fed *Moringa oleifera* leaves pellets as substitute to commercial concentrate

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Abstract

A seventy day feeding trial was carried out to determine the effect of *Moringa oleifera* leaves pellets (PML) on weight gain, production cost and blood profile of weaned rabbits. The PML was substituted to a commercial feed at level of 0, 10 and 15% to obtain respective diets PML0 (control), PML10 and PML15. Forty five weaned rabbits, 35-55 days of age, were allocated to three treatment groups with five replicates in a completely randomized design. Blood was collected from rabbits at different ages. Pellets of *M. oleifera* were totally consumed. Average daily weigh gains were higher in rabbits fed PML10 and PML15 diets. Feed conversion ratios were better for rabbits fed PML10 and PML15 diets (4.2: 1 and 4.0: 1, respectively). Increasing PML level from 0 to 10% in commercial feed resulted in 17.71% reduction in feed cost, while at 15% of substitution, the cost reduction was about 21.99%. But, serum parameters varied significantly with the age of rabbits. Pellets of *M. oleifera* can help in the production of cheaper meat of rabbits in developing countries.

Keywords: Blood; feed conversion ratio; production cost; weight gain

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Introduction

Livestock is one of the main economic activities which contribute significantly to human livelihood, food security and cash income. It is also the main insurance against risks to millions of poor people whose livelihoods depend on rain-fed agriculture. Rabbit production has over the years gained popularity in many tropical countries especially in Benin. According to Iyeghe-Erakpotobor (2007), rabbit meats consumption is currently increasing because of its low cholesterol content. For this last author, rabbit meat is advocated to people for good health, because there is no uric acid formation during its metabolism.

To cover the increasing demand of rabbit's meat, there is a need to increase the production. However, a major constraint of rabbitry in Benin is the high cost of feed, due mainly the used of concentrate commercial feedstuffs. So, there is a need for readily available, high quality, alternative proteins that are cheaper and capable of reducing production costs of meat. It seems that the utilization of underutilized tropical legumes will help in this regard. In Vietnam, the forages of water spinach (*Ipomoea aquatica*) and sweet potato (*Ipomoea batatas*) vines are common vegetables used for rabbit feeding as the basal and even only diet (Luyen and Preston, 2012). The nutritional qualities of *Moringa oleifera* are excellent; it contains significant

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quantities of crude protein (20 to 29%), metabolizable energy for poultry (2.005 kcal/ kg), vitamins and minerals, and has low anti-nutritional factors (Kakengi et al., 2007; Ayssiwede et al., 2011; Abou-Elezz et al., 2012). Also, the valorization of *M. oleifera* leaves in animal feeding is reported in guinea pigs (Tedonkeng et al., 2005), cricetoms (Dougnon et al., 2011) and catlle (Houndonougbo et al 2012). However, *M. oleifera* tree loses its leaves early from the beginning of the dry season, and its growth and forage availability in the dry season cannot sustain rabbit production a whole year. It is therefore important to conserve *M. oleifera* forage for future use. Moreover, Kpodekon et al. (2009) experiment showed that pellet feed provides better performance for rabbits than flour concentrate. However, *M. oleifera* forage conservation in the form of pellet for growing rabbits is not well documented.

Blood examination gives the opportunity to investigate the presence of several metabolites and other constituents and helps in the detection of stress conditions, which can be nutritional, environmental or physical (Aderemi, 2004).

Thus, this study was carried out to evaluate the effects of the substitution of commercial feed by pellets of *M. oleifera* leaves (PML) on growth performance, production cost, and blood and serum composition in weaned rabbits (*Oryctolagus cuniculus*).

Materials and Methods

Diet and fattening rabbits

The experiment was laid out as a completely randomized design. Three levels of pellets of *M. oleifera* leaves (PML) were substituted at 0, 10 and 15% to the commercial feed, to obtain respective diets PML0, PML10 and PML15. Each treatment had 5 replicates making a total of 15 experimental units. Three rabbits were installed in each hutch. A total of 45 rabbits aged 35-55 days were used for fattening experiment.

M. oleifera leaves were collected and then dried in the shade on fillet net for a week, to lose about 80% of moisture. The twigs were collected and disposed after drying. Leaves were then passed directly into the pellet press with 4 mm mesh. The commercial pellet feed was composed of 5% maize, 29.0% of palm kernel cake, 16.0% cottonseed meal, 7.0% soybean meal, 20.5% wheat bran, 15.0% rice bran, 2.5% of oyster shell, 0.5% salt, 4.0% sawdust (Kpodekon et al., 2009). The different feeds were supplemented with fresh forage of *Panicum maximum C1.*

The average body weight of each rabbit in early test was ranged from 594.32 to 613.64 g. Each fattening rabbit hutch measured 75 cm long, 46 cm wide and 30 cm high. Rabbits were fed an allowance ranging from 100 to 130 g DM per head, once a day and water was provided *ad libitum*. Commercial feed and pellet of *M. oleifera* were in separate feeder. The feed left over was weighed daily to determine feed intake. Feed samples were taken for determination of dry matter in an oven at 70°C to constant weight every 14 days. This was then used to calculate an average daily feed intake. The rabbits were weighed at the beginning of the trial and every 14 days. Similarly, weights taken every 14 days were used to calculate an average daily weight gain. The average daily feed intake was divided by the average daily weight gain to calculate the feed to gain ratio or feed conversion ratio (FCR). The diet samples were used to determine the dry matter with oven and mineral matter by incineration. The nitrogen determination was done by the Kjeldahl method (AOAC, 1990). The measured nitrogen was multiplied by 6.25 to calculate the crude protein.

Evaluation of serum biochemical parameters

Blood samples, about 4 ml per animal were collected from 12 rabbits via ear vein puncture using a 22 gauge needle VENOJECT before feeding. Blood collection was done for the post-weaned rabbit (at 0 days of experiment), for young rabbit (at 42 days of experiment) and for adult rabbit (at 84 days of experiment).

About hematological analyses, the samples were collected in a tube containing ethylene-diamine-Tetra acetic-acid (EDTA K2) as an anticoagulant. The blood samples were introduced in a hematology analyzer, type nicros-ABX for the analysis of the red blood cell, the white blood cell and hematocrit parameters, using kits.

Concerning biochemistry parameters, the samples in the tubes were centrifuged for 5 minutes at 3200 Tower/min to obtain serum. Biochemical parameters such as glucose, creatinine and urea were determined by spectrophotometer.

Statistical Analysis

The data were subjected to analysis of variance (ANOVA) using the software STATISTICA (1998). An ANOVA with two criteria was used to examine the effects of substitution of pellet of *M. oleifera* proportion in the diet (n = 3: 0%, 10%, 15%); blood sampling age (n=3: post-weaning, young, adult). In case of significant difference, the Student-Newman-Keuls test was used to separate homogeneous groups at a significance level of 5%.

Results and Discussion

Nutritive value of *M. oleifera* leaves pellets

The proximate composition of pellets of *M. oleifera* indicated a crude protein (CP) content of 27.5%, ash content of 11.5% and dry mater content of 81.83%. The commercial feed indicated a CP value of

18.2%, ash content of 11.2% and dry mater content of 88.73%. Similar crude protein content (27.1 to 27.51%) of *M. oleifera* leaves has been recorded (Oduro et al., 2008). The ash content recorded is somewhat similar to that reported (11.39%) by Ndong et al. (2007). The processing of *M. oleifera* leaves in pellets had no effects on some nutritional values. Compared to the commercial concentrate which is constituted by a set of feed ingredients, PML alone constitutes local forage, exceptionally rich in proteins and minerals, confirming the findings of Fahey et al. (2001).

Diet intake and rabbit growth performance

All the offered PML was almost consumed by rabbits. The average total intake was higher for control diet (Table 1). The performance of rabbits improved with the inclusion of PML in the diet. Rabbits fed the control diet (PML0) recorded the lowest average final live weight, average daily live weight gain and the highest feed conversion ratio (FCR). However, rabbits fed PML15 and PML10 diet had similar average final live weight gain, average daily live weight gain and feed conversion ratio. The range of feed intake values recorded in this study is within the range of 80-105g reported for rabbits (Adeyemi et al., 2010). The partial substitution of the commercial feed by PML brought an extra protein in the diet. This may explain the better weight performance of rabbits fed diet containing PML.

The mechanism that guides the growth responses observed in rabbits does not appear to be related to the amount of dry mater (DM) intake. But it is rather related to the nutritional quality including proteins content and may be the nutritional digestibility. Indeed, the leaves of *M. oleifera* are rich in minerals, vitamins A, B, C and E and especially protein with eight essential amino acids (Odeyinka et al., 2008). The better FCR (4.2:1; 4.0:1) obtained for rabbits fed PML diets, suggested that the *M. oleifera* pellets based diets contained appropriate concentration of energy and protein quality. The FCR registered during this experiment are similar to that (4.06 - 4.25) obtained by Luyen and Preston (2012) for New Zealand White rabbits fed sweet potato (*Ipomoea batatas*) vines with supplementation of paddy rice. But, when fed Guinea grass plus commercial concentrate to the rabbits, there was a tendency for FCR obtained by these authors to be relatively higher compared to that register during our experiment. Also, the study carried out to evaluate the reproductive performance of rabbits fed freshly harvested *M. oleifera* as a replacement for *Centrosema pubescens* in addition to the concentrate, indicated that rabbit does on 100% *M. oleifera* had higher values in litter size at birth, litter weight at birth and litter weight at weaning than those on 100% *Centrosema pubescens* (Odeyinka et al., 2008).

Feed cost

Feed cost analysis shown that cost per kilogram were higher for PML10 and PML15 (Table 2). Although that, the production costs per live weight gains were lower in PML10 and PML15 diets than in control diet. Increasing the PML level from 0 to 10% resulted in a 17.71% reduction in feed cost, while at 15% PML inclusion level, a cost reduction of 21.99% was obtained. Rabbits fed with the sweet potato vine-paddy rice system, feed costs increased only marginally as the paddy rice level was increased (Luyen and Preston, 2012).

Hematological and serum biochemical characteristics

The rates of red blood cell, white blood cells, hemoglobin and hematocrit were similar (P>0.05) when fed control diet or PML diets to rabbits (Table 3). However, these hematological parameters varied significantly (P<0.05) among age. The hematological values recorded in post-weaning and growing of age are in accordance with those reported by Archetti et al (2008) about White blood cells (2.6 - 12.7 10^3/µl and 3.3 - 12.2 10^3/µl); hemoglobin (6.7 - 12.7 and 9.5 - 13.7g/dl) and hematocrit (18.9 - 34.7 and 25.5 - 37%).

Concerning serum characteristic, none of the parameters tested including urea, creatinine and glucose levels were not significantly influenced by experimental diets (Table 4). But, serum urea and serum creatinine significant variability (P<0.05) occurred with rabbit's age. In the present study, the serum urea values in

Table 1: Feed intake and effects of level of pellets of *Moringa oleifera* leaves (PML) on rabbits performance characteristics

	PML level (%) in the diet (DM basis)			P
Parameters	0	10	15	
Concentrate intake (g/d/rabbit)	88.4^a	77.2^b	72.5^c	<0.001
M. oleifera intake (g/d/rabbit)	0.0^a	10.0^b	14.3^c	<0.001
Grass intake (g/d/rabbit)	13.1^a	6.9^b	6.6^b	<0.001
Total intake (g/d/rabbit)	101.5^a	94.2^b	93.4^b	0.004
Initial live weight (g)	614 a	610^a	594^a	0.89
Final live weight (g)	1956^b	2166^a	2222^a	0.017
Average daily weight gain (g/d/rabbit)	19.2^b	22.0^a	23.2^a	<0.001
Average feed conversion ratio (FCR)	5.3^a	4.2^b	4.0^b	<0.001

$^{a, b}$Means followed by different letters on the same row are significantly different at 5% level

Table 2: Effect of pellets of *Moringa oleifera* leaves (PML) inclusion level in the diet on cost analysis

	PML level in the diet (%)			
Parameter	0	10	15	P
Cost/kg feed FCFA	245	265	265	-
Total feed intake (kg)	6.59[b]	6.83[a]	7.02[a]	0.010
Total feed cost (FCFA)	1285[a]	1224[b]	1215[b]	0.036
Total weight gain (kg)	1.343[c]	1.555[b]	1.628[a]	0.032
Cost/live weight gain (FCFA/kg)	957[a]	776[b]	744[b]	0.027

a, bMeans followed by different letters on the same row are significantly different at 5% level.

Table 3: Variation of hematological parameters of rabbits fed pellets of *M. oleifera* leaves

PML level (%) in the diet	Red blood cell (10^6/µl)	White blood cell (10^3/µl)	Hemoglobin, g/dl	Hematocrit (%)
		Post-weaning rabbit		
0	7.36[aB]	7.30[aA]	10.50[aB]	35.65[aB]
10	7.30[a]	7.63[a]	10.69[a]	35.80[a]
15	7.30[a]	7.67[a]	10.32[a]	35.40[a]
		Young rabbit		
0	8.00[aA]	7.01[aB]	10.85[aA]	36.01[aA]
10	7.94[a]	7.10[a]	10.77[a]	36.08[a]
15	8.96[a]	7.06[a]	10.62[a]	35.72[a]
		Adult rabbit		
0	8.39[aA]	7.01[aB]	10.95[aA]	36.45[aA]
10	7.92[a]	7.00[a]	10.91[a]	36.10[a]
15	7.98[a]	7.05[a]	10.81[a]	35.82[b]
Source of variation	P	P	P	P
Age	0.000	0.000	0.000	0.001
Type of diet	0.069	0.29	0.060	0.002
Age x type of diet	0.24	0.56	0.41	0.45

a, b: Means followed by different letters on the same colon are significantly different at 5% level for age; A, B, C: Means followed by different letters on the same colon are significantly different at 5% level for age

Table 4: Variation of biochemical parameters of rabbits fed pellets of *M. oleifera* leaves

PML level (%) in the diet	Glucose (g/dl)	Urea (g/l)	Creatinine (mg/l)
		Post-weaning rabbit	
0	0.114[aA]	0.380[aA]	11.000[aA]
10	0.103[a]	0.360[a]	11.500[a]
15	0.055[a]	0.377[a]	11.000[a]
		Young rabbit	
0	0.123[aA]	0.220[aB]	10.000[aB]
10	0.109[a]	0.220[a]	10.750[a]
15	0.117[a]	0.240[a]	9.750[a]
		Adult rabbit	
0	0.113[aA]	0.200[aC]	7.000[bC]
10	0.106[a]	0.165[a]	8.250[a]
15	0.111[a]	0.205[a]	7.750[ab]
Source of variation	P	P	P
Age	0.08	<0.001	<0.001
Type of diet	0.18	0.07	0.005
Age x type of diet	0.11	0.88	0.53

a, bMeans followed by different letters on the same colon are significantly different at 5% level for age; A, B, C: Means followed by different letters on the same colon are significantly different at 5% level for age.

young rabbit are similar to that recorded (23.29mg/dl) in young New Zealand rabbit (Olayemi et al., 2007). But, the rate of serum urea and serum creatinine in young and adult of age obtained in this experiment are lower compared to that reported by Olayemi et al. (2007). The difference may be related to diet protein level, age difference, live weight or renal insufficiency of rabbit.

Blood serum metabolites parameters have often been associated with health indices and are of diagnostic significance in routine clinical evaluation of the state of health (Toghyani et al., 2011). Furthermore, these parameters have been shown to be some indices of physiological, pathological and nutritional status of an organism and changes in the constituent compounds of blood (Toghyani et al., 2011). According to the current findings, substituted commercial concentrate to PML at 10 or 15% level, influence positively rabbit's growth performance with good health.

Conclusions

Moringa oleifera leave is a good feed source for growing rabbits. It has a positive effect on FCR and production cost. This natural feed ingredient available in rural area can be used to replace high cost conventional feedstuffs to help in the production of cheaper animal protein for poor populations. *Moringa oleifera* leaves can be used in fresh form or conserve as pellet for future use. Furthermore, PML had no adverse effect on hematological and biochemical characteristics of rabbit.

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