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Review Article

Growth Performance of Weaner Rabbits Fed Noni (Morinda Citrifolia) and Moringa Olifera Leaf Meal Mixture as Partial Replacement of Soya Bean Meal

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ABSTRACT

This experiment was carried to determine the growth performance of weaner rabbits fed Morinda citrifolia (Noni) and Moringa olifera leaf meal mixture (MCML) as partial replacement of Soybean meal (SBM). Fifty (50), 7-8 weeks bucks cross breed rabbits (Chinchilla × New Zealand White) with an average weight of 620g and 625g were allotted into five (5) dietary treatments of ten (10) rabbits per group and were individually caged in an all –wired metabolic cages. SBM was replaced by MCML at levels of 0%, 3%, 6%, 9% and 12% respectively and the experiment lasted for 98 days. Clean feed and water were provided ad libitum, experimental parameters covered feed intake, feed conversion ratio, daily water intake and mortality. The results of this experiment showed that there were no significant differences ($p>0.05$) in the final weight gain, feed intake, feed conversion ratio and daily water intake across the treatment, diet containing 3% MCML had the highest weight gain of 1157.0g, while rabbits fed 0% MCML had the lowest weight gain of 1084.0g. Significant differences ($p<0.05$) were observed in the mortality rate of the animals, animals in treatment 1 had 3 mortalities, no mortality was recorded for rabbits in treatment 2, 3, 4 and 5 respectively. It can be concluded that MCML can be used to replace SBM in the diet of rabbits up to 12% inclusion level without affecting the general performance and the health of the animals.

Key words: Weaner rabbits, Performance, Soybean meal, Moringa olifera, Mortality.

Introduction

Poultry production has experienced a lot of remarkable growth within the past forty years, but there are still some problems confronting the industry, one of which is the high cost of feed materials. Recent data have shown that feed cost constitutes about 70-75% of the total cost of production, this could be basically attributed to the stiff competition between humans and animals for grains and upward increase in human population, poor government policies and insurgency in some agricultural parts of the country. Formulation of diets for animals requires protein and energy sources (variable ingredients) as major components. One of the ways to solve the problem of high feed cost is the use of local feed materials (unconventional) to produce feed at least cost and providing enough animal protein since profit can only be maximized when animals are fed well-formulated diets at reasonable costs. (Fagbenro *et al*., 2004), reported that Soya meal which is regarded as an outstanding source of supplemental protein in diets of livestock has become relatively scarce and expensive. It is rich in highly digestible protein, and the protein is made up of amino acids (essential and non-essential) which are the building blocks of body protein for livestock. According to (Gary L. Cromwell, 2007), Soybean meal accounts for nearly sixty-nine of all macromolecule sources employed in animal feeds followed by rapeseed (canola) meal (13%), cottonseed meal (6%), sunflower meal (5%), fish meal (2%), and peanut meal (2%) worldwide.

One of the ways to minimize the cost of feed and get maximum production /performance is the use of some plants/leaves, which are found to be loaded with nutrients (Chisoro, 2015). Several reports have also shown that the use of plants as protein especially when incorporated into livestock feed are cheaper, improve digestibility, immune system (due to the presence of bioactive compounds) and growth performance. Some plants in this category includes noni leaf (Morinda citrifolia) and Moringa olifera. Morinda citrifolia belongs to the family Rubiaceae, it is a tropical and subtropical plant grown in Asia, Australia and other countries. M. citifolia also known as Noni is widely used as herbal plants and treatment of many disease because it contains several bioactive chemicals and minerals like selenium which has an important function to activate glutathione peroxidase and neutralize free radicals which attack fat molecules in the body (Kusnandar *et al*., 2003; Setiawan *et al*., 2005; Wang *et al*., 2002 and Takashima *et al*., 2007). Morinda citrifolia leaf have been reported to perform multiple role such as antibacterial (Aziz *et al*., 2009), anti-inflammatory (Dussossoy *et al*., 2011), antitumor (Satwadhar *et al*., 2004), antifungal and antidiabetic activities (Ramesh *et al*., 2012). The leaf meal provides protein source and some essential vitamins such as vitamins A, C, E and minerals (Su BN *et al*., 2005 and Liu C *et al*., 2007).

Moringa olifera belongs to the Moringaceae family, it is the most widely cultivated species of the genus Moringa commonly known as drumstick –tree or horse radish tree is a multi -purpose that has given considerable fodder yield in the tropical humid forest zone of Nigeria during wet and dry seasons (Fuglie, 2009). According to (Olson *et al*., 2001), Moringa leaves meal contains 27.51% crude protein, 19.25% crude fibre, 2.23% crude fat, 7.13% ash, 76.53% moisture, 43.88% carbohydrate and 1296.00 Kj/g calories. The leaves are rich in several minerals and vitamins (Bhatt *et al*., 2001, Moyo *et al*., 2011).

The tree is often called 'multipurpose' because all parts including the leaves, pods, seeds, flowers, fruits and roots are edible and high medicinal (Orwa *et al*., 2009; Aruna *et al*., 2012; Fahey *et al*., 2001; Abbas *et al*., 2012; Siddhuraju *et al*., 2003 and Atawodi *et al*., 2010).

Many research have been carried out on the use of Moringa olifera on livestock, for instance (Kakengi *et al*., 2013) reported that Moringa olifera can be included up to 30% in rabbit diet without any adverse effect on the growth performance, but there is little or no information on the combination of M. olifera with noni, mixing this plant will give a good result coupled with their nutrients profile and their abundance in the tropics. Therefore, the aim of this experiment is to evaluate the growth performance of weaner rabbits (Thryonomys swinderianus) fed noni (Morinda citrifolia) and Moringa olifera leaf meal mixture as partial replacement for Soy bean meal.

Materials and Methods

Study area

The experiment was carried out at Division of Animal Nutrition, Sumitra Research Farm, Gujarat, (Western India).

Collection of plant materials

Fresh healthy and mature Morinda citrifolia and Moringa olifera leaves were obtained with in the farm premises and it was authenticated and assigned a voucher numbers of SRF 102 and SRF 103 respectively. The leaves were collected in August, 2018.

Sample preparation

Both leaves were thoroughly washed under running tap water and air dried separately for 12 days. The leaves were then grind into coarse powder using high capacity grinding machine separately to obtain Morinda citrifolia leaf meal (MCM) and Moringa olifera leaf meal (MLM). It was finally stored in airtight containers at 5 ^{o}C for further analysis.

Parameters measured in the test materials

Phytochemical screening for the presence of tannin, flavonoids, alkaloids, saponins, phenols and oxalate were determined according to procedures outlined by Harbone (1984) and Boham and Kocipai-Abyazan (1974).
Mineral analysis was carried out using Atomic Absorption Spectrophotometer (AAS).
Vitamin content was determined by method described by (Sabrell *et al.*, 1967, Hussein *et al.*, 1997).
Amino acid profile was determined using Eppendorf- Germany LC 3000, amino acid analyzer.
Proximate analysis of crude protein, ash, ether extract and crude fibre were carried out in accordance with the Association of Official Analytical Chemists (AOAC, 2000).

Pre-experimental operations

The cages were thoroughly cleaned and disinfected before the arrival of the animals, feeders and drinkers were also washed and cleaned, all the cages were equipped with feeding and watering troughs. Separate isolation cage was also provided in the pen to accommodate any isolated animal after arrival. Anti-stress (strexia) and de-wormer (Promectin) injection as prophylactic against ecto and endo parasites were purchased.

Animal management

A total of fifty (50), 7-8 weeks bucks cross breed rabbits (Chinchilla × New Zealand White) with an average weight of 620 g and 625 g were used for this experiment. They were individually housed in an all wire cages measuring 50cm×30cm×35cm (width×length×height), they were allowed one-week adjustment period during which they were fed the basal diet and other medications administered. The animals were feed twice daily between 7:30 am and 3:30pm, clean feed and water were provided ad libitum throughout the experimental period which lasted for 98 days.

Experimental design

The experimental animals were randomly assigned to five treatments of ten (10) animals per group, each treatment was replicated ten times with each replicate having a rabbit in a completely randomized design (CRD).

Feed formulation

Morinda citrifolia leaf meal (MCM) and Moringa olifera leaf meal (MLM) were mixed in the ratio of 1:1 and thoroughly mixed to form Morinda-Moringa leaf meal (MCLM), they were further mixed with the basal diet to form five experimental diets as follows:
Treatment 1 (control): Basal diet + 0% MCLM
Treatment 2: Basal diet + 3% MCLM
Treatment 3: Basal diet + 6% MCLM
Treatment 4: Basal diet + 9% MCLM
Treatment 5: Basal diet + 12% MCLM
The basal diet was formulated to meet the nutrients requirements of growing rabbits according to the (NRC, 1977).

Data collection

Growth performance parameters
Daily feed intake (g) was calculated by difference between feed offered and the left over, feed conversion ratio was determined as feed intake divided by body weight gain, water consumption and mortality were recorded daily.

Statistical analysis

All data obtained were subjected to analysis of variance (ANOVA) using the linear models Statistical Package for Social Sciences (SPSS version 15.0) software. Significant difference between means were separated using Duncan's multiple range test (Duncan, 1955).

Table 1. Percentage composition (%) of experimental diets

Ingredients	Treatments				
	1	2	3	4	5
Maize	30.0	30.0	30.0	30.0	30.0
Wheat offal	20.0	20.0	20.0	20.0	20.0
Soya meal	16.25	13.25	10.25	7.25	4.25
Groundnut cake	10.0	10.0	10.0	12.0	12.0
Palm kernel meal	20.0	20.0	20.0	25.0	30.0
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
[1]Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50
MCML	0	3.00	6.00	9.00	12.0
	100	100	100	100	100

Calculated Analysis

Crude protein (%)	17.25	18.19	18.14	18.08	18.04
Crude fibre (%)	11.25	12.34	12.53	13.01	13.03
Ether extract (%)	3.02	3.02	3.02	3.01	3.00
Ash (%)	5.05	6.33	6.36	6.40	6.43
Energy (MEkcal/kg)	2576.5	2569.1	2566.3	2552.6	2552.1

[1]Premix supplied per kg diet :- Vit A, 8,500 I.U; Vit E, 5mg; Vit D3, 3000I.U, Vit K, 3mg; Vit B2, 5.5mg; Niacin, 25mg ; Vit B12, 16mg ; Choline chloride, 120mg ; Mn, 5.2mg ; Zn, 25mg ; Cu, 2.6g ; Folic acid, 2mg ; Fe, 5g ; Pantothenic acid, 10mg ; Biotin, 30.5g ; Antioxidant, 56mg

Table 2. Proximate composition of MCM and MLM

Nutrients	% DM (MCM)	% DM (MLM)
Dry matter	92.18±0.01	93.67±0.05
Crude protein	18.48±0.02	28.49±0.04
Crude fibre	13.31±0.12	10.11±0.01
Ether extract	6.11±0.01	8.09±0.02
Ash	12.61±0.13	10.88±0.13
Minerals (mg/100 g)		
Phosphorus	330±0.11	429±0.00
Magnesium	571±0.55	732±0.05
Calcium	210±3.91	178±2.07
Copper	0.41±0.11	0.67±0.01
Zinc	4.77±0.11	6.33±0.32
Manganese	9.81±0.00	11.19±0.21
Iron	13.3±0.71	18.65±0.22
Sodium	333±2.14	208±1.11
Potassium	352±0.44	404±0.34
Selenium	211±0.21	351±0.10
Boron	20.10±0.08	49.34±0.04
Vitamin A	4.31±0.22	12.13±0.00
Vitamin B1	1.31±0.01	7.95±0.32
Vitamin B2	3.22±0.06	4.98±0.01
Vitamin C	1.04±0.00	7.11±0.43

Table 3. Phytochemical analysis of MCM and MLM

Parameters	MCM (%)	MLM (%)
Saponin	1.09±0.00	4.12±0.10
Tannin	1.52±0.01	3.01±0.12
Phenols	5.22±0.02	12.02±0.00
Flavonoids	2.11±0.00	7.08±1.13
Alkaloids	1.06±0.01	2.11±1.05
Oxalate	0.15±0.01	0.10±0.13

Table 4. Growth Performance of Rabbits fed varying levels of MCML

Parameters	Treatments 1	2	3	4	5	SEM
Initial body weight (g)	622.0	620.8	625.0	621.5	620.0	4.03
Final body weight (g)	1706.1	1777.8	1780.1	1770.2	1770.1	7.02
Final weight gain (g)	1084.1	1157.0	1155.1	1148.7	1150.1	3.12
Mean daily weight gain (g)	11.1	11.8	11.8	11.7	11.7	1.03
Feed intake (g/day)	87.71	87.12	87.10	87.08	87.04	1.47
FCR	8.09	7.53	7.53	7.58	7.56	0.07
Daily water intake (mL/day)	803.1	800.6	806.0	800.9	800.1	6.51
Mortality	3	0	0	0	0	-

[abc] means different superscript along rows differ significantly at $p<0.05$

Results and Discussion

The results on the proximate analysis of Morinda citrifolia meal (MCM) and Moringa olifera leaf meal (MLM) are presented in Table 2. Dry matter content of MCM was 92.18% while those of crude protein, crude fibre, ether extract and total ash are 18.48%, 13.31%, 6.11% and 12.61% respectively. The proximate constituents of MLM are 93.67%, 28.49%, 10.11%, 8.09% and 10.88% for dry matter, crude protein, crude fibre, ether extract and ash respectively. Both leaf meal contain tangible quantity of minerals and vitamins like phosphorus, calcium, potassium, magnesium, selenium, manganese, copper, iron, zinc, boron, vitamin A, B and C. The present study regarding the proximate analysis of MCM and MLM was in agreement with the findings of (Rubanza *et al*., 2005; Moyo *et al*., 2011; Rweyemamu, L. 2006, Kamiya *et al*., 2004) who reported that MCM and MLM are highly digestible in animals because of their rich nutritional composition.

Phytochemical components of MCM and MLM are presented in Table 4. Saponin, tannin, phenol, flavonoids, alkaloids and oxalate content of MCM was 1.90%, 1.52%, 5.22%, 2.11%, 1.60% and 0.15% respectively while those of MLM are 4.12%, 3.01%, 12.02%, 7.08%, 2.11% and 0.10% for saponin, tannin, phenol, flavonoids, alkaloids and oxalate. Both MCM and MLM have a high level of phenol confirming the reports of (Makkar *et al*., 1999; Krishnaiah *et al*., 2011; Mohammed *et al*., 2001; Wang *et al*., 2002; Zin *et al*., 2002, Siddhuraju *et al*., 2003). The presences of phytochemicals in the plants makes them important in pharmacological roles, for instance the antimicrobial, antibacterial, antioxidant and antiviral properties of MCM have been reported by (Locher *et al*., 1995; Mckoy *et al*., 2002; Moure *et al*., 2001; Pietta *et al*., 1998; Saludes *et al*., 2002; Sang *et al*., 2001a; Shovic Whistler, 2001; Nayak *et al*., 2011; Bussmann *et al*., 2012).

(Mekonnen *et al*., 2003) also confirmed that MLM contains benzylsothiocyanate, 4-(4'-O-acetyl-a-L-rhamnopyranosyloxy) benzyl, isothiocyanate and other substance which gives them anticancer, antibacterial, antioxidant and antiviral properties. The retained phenol in both MCM and MLM could also be attributed the processing method after collection. According to (Bhuvaneshwari *et al*., 2017) phenol can easily be destroyed by excessive heat. Flavonoids are known to act against activity of gram positive and gram negative bacteria, performs anti-viral, anti-inflammatory and antioxidant roles (Terashima *et al*., 2002).

The effect of feeding different levels of MCML in weaner rabbits is shown in Table 3. The initial body weight ranges between 620. G –625 g while those of final live weight is between 17701 g –1780.1 g. The result showed the effect of partially replacing soya meal with MCML on the final weight gain was not significant (p>0.05). However rabbits in Treatment 3 had the highest final body weight (1780.1 g) followed by Treatment 2 with (1777.8 g), Treatment 1 had the lowest weight with (1706.1 g). No significant (p>0.05) differences were observed between the treatment in terms feed intake, rabbits in treatment 1 consumed more in compared to treatment 2, 3, 4 and 5. Feed conversion ratio (FCR) were not significantly (p>0.05) different among the treatments. This was similar with the finding of (Wogar, 2011) when grass cutter were fed cassava based diets with graded protein levels. (Attanayaka *et al*., 2015) noted that the cotton seed meal can be used to replace soya bean meal at 10% in broiler chicken but contrary to the reports of (Banjo *et al*., 2012) when maize was replaced with brewer's dry grain (BDG) in the diet of weaner grass cutters.

Similarly, (Wogar, 2012) reported that substituting palm kernel meal (PKM) at 9% in the diet of growing grass cutters improved their final body weight though not at a significant level when compared with maize sievates and wheat offal.

There was a significant difference (p<0.05) in the mortality rate of the animals. Treatment 1 recorded the highest number of 3 rabbits, no mortality was recorded in treatment 2, 3, 4 and 5. This could possibly be due to the presence of secondary metabolites (phytochemicals) in MCML. For instance, saponins and phenolic compounds prevents bacterial infections (Dussossoy, 2011), parasites (Fahey, 2001).

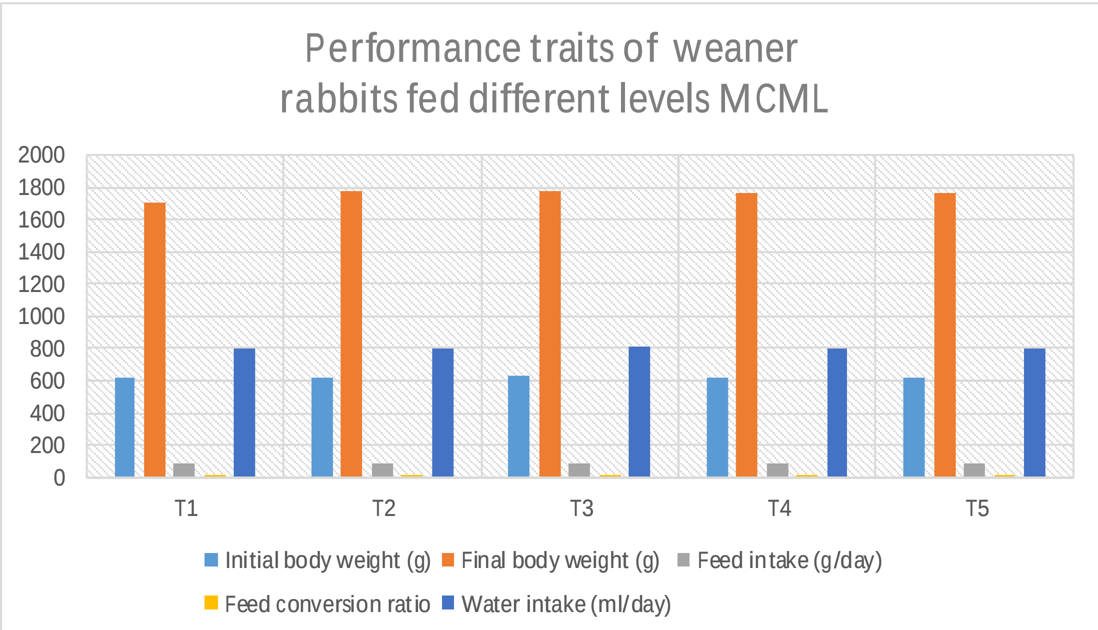

Figure 1. Performance traits of weaner rabbits fed different levels of MCML

Conclusion

It can be concluded that MCML could be included up to 12% in the diets of rabbits without any deleterious effect on their health and general performance, MCML have proven to be loaded with vital nutrients that are necessary for the growth of animals, however, 3% substitution gave the highest weight gain for the animals. MCML can also be used as an herbal supplement or phytobiotics.

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