EFFECT OF COMMERCIAL VITAMIN-MINERAL PREMIXES AND MORINGA OLEIFERA LEAF MEAL ON PERFORMANCE AND NUTRIENT DIGESTIBILITY OF GROWING RABBITS

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ABSTRACT
Rabbit farming largely depends on nutritional status of the diet fed. Like energy and protein, vitamin and mineral are also important in the rabbit diet. This study was conducted to examine the effect of Vitamin Mineral Premix (VMP) and Moringa oleifera leaf meal (MOLM) on the growth performance and nutrient digestibility of growing rabbits. Forty-eight (48) growing crossbred rabbits of mixed sexes with age range 5-7 weeks were used for this experiment. The rabbits were divided into eight dietary treatments of six rabbits as replicate in a Complete Randomized Design, which are Diet 1(0% of VMP and MOLM); Diet 2 (MOLM at 0.25kg/100kg); Diet 3 (VMP "grower" at 0.25kg/100kg); Diet 4 (VMP "Broiler starter" at 0.25kg/100kg); Diet 5 (VMP "Broiler finisher" at 0.25kg/100kg); Diet 6 (VMP "grower" +MOLM at 0.125kg/100kg); Diet 7 (VMP "Broiler starter" +MOLM at 0.125kg/100kg); Diet 8 (VMP "Broiler finisher" +MOLM at 0.125kg/100kg). The result obtained showed that daily feed intake, feed conversion ratio was significantly ($p < 0.05$) influenced across the treatments. Rabbit fed Diet 8 had higher value for daily feed intake (DFI) than other treatments at $p<0.05$ but rabbit fed control diet utilized the feed most than other treatments which reflect in the feed conversion ratio (4.93). Digestibility result showed that dietary treatments had significant ($p<0.05$) effect on dry matter, crude fibre, ash and nitrogen free extract except crude protein and crude fat that were not significantly ($p>0.05$) influenced. Conclusively, addition of Vitamin-mineral premixes and/or Moringa oleifera leaf meal will not affect performance of growing rabbits.
Keywords: Growing rabbits, Vitamin-mineral premix (VMP), *Moringa oleifera,* Performance, Digestibility.

INTRODUCTION

Rabbit farming is a rewarding business with high probability of recouping initial investment (Bello et al., 2022). It is a veritable way of alleviating animal protein deficiency in Nigeria (Bakam et al., 2024). The rabbit has immense potentials and good attributes which include high growth rate, high efficiency in converting forage to meat, high prolificacy, relatively low cost of production, short gestation period and high nutritional quality of rabbit meat which includes low fat, sodium and cholesterol levels. It also has a high protein level of about 20.8% and its consumption is devoid of both cultural and religious bias (Mailafia *et al.*, 2010). Rabbit is a monogastric herbivorous animal, adapted to high intake of plant, the dietary fibres are the main constituent of a rabbit complete feed even in intensive production. However, like energy and protein is needed in a profitable rabbit farming which to some extent depends on nutritional status of diet fed to the animals, vitamin, mineral and amino acids are also important in rabbit diets.

It has been established that vitamins and minerals play an important role in the growth of animals, reproductive performance and helps to mitigate the role of oxidative stress in the initiation and progression phases of various disease since it is a major contributor of degenerative pathologies (Rapa et al., 2019). Vitamin and minerals are used as feed supplements in animal feeds and due to the uses of these vitamins and minerals in animal production, it is important to establish the level which these supplements can be effectively and economically used to improve reproduction in micro-livestock. Recently, there has been interest in the utilization of moringa (*Moringa oleifera)* commonly called horse-radish, miracle tree or drum stick bee, it is in the group of high-yielding nutritious browse plants with every part having food value (Duke, 1998). The advantages of using moringa are numerous and include the fact that it is a perennial plant that can be harvested several times in one growing season with the potential to reduce feed cost, as a source of protein for livestock (Su and Chen, 2020; Kholif *et al.*, 2016). The leaves are fully packed with nutrient needed by human and animals, nutrients as vitamins, minerals and it is rich in amino-acids (Su and Chen, 2020).

Moringa has been identify with the treatment of diseases such as obesity due to the fact that it is capable of reducing the cholesterol level in the body (Islam et al., 2021). The calcium composition of the leaf is equivalent to that of four glasses of milk (Odinakachukwu et al., 2014), the iron is 3 times of that of spinach and the vitamin A content is quadra of that in carrot (Nur et al., 2020). Despite the high minerals and vitamin content of moringa leaf, there is still little information available on the use of this unconventional feed resource, especially as an alternative mineral-vitamin supplement for rabbit production. This study was carried out to investigate the performance and nutrient digestibility of rabbit fed with vitamin-mineral premix and/or Moringa oleifera leaf meal supplement.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at the rabbit production unit of Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso, Oyo state, Nigeria, located in the derived savannah zone of Nigeria.

Test ingredients

1. *Moringa oleifera* leaves were harvested at the Teaching and Research Farm. The leaves were air-dried until dry to touch under shade to prevent being denatured, crushed with grinding machine and incorporated into the experimental diets.
2. Vitamin Mineral Premixes (VMP) used are-They are obtained through product support from Bio-Organics nutrient systems LTD.
3. Grower, Broiler Starter, Broiler Finisher were formulated according to the method of Ojebiyi *et al*., (2013).

Experimental diet and feeding method

Eight (8) experimental diets were prepared, which are Diet 1 (0% VMP and 0% Moringa oleifera (control diet)), Diet 2 (Moringa oleifera at 0.25kg/100kg), Diet 3 (VMP(Grower) at 0.25kg/100kg), Diet 4 (VMP(Broiler starter) at 0.25kg/100kg), Diet 5 (VMP (Broiler finisher) at 0.25kg/100kg), Diet 6 (VMP(Grower) + *Moringa oleifera* leaf meal at 0.125kg/100kg), Diet 7 (VMP(Broiler starter) +*Moringa oleifera* leaf meal at 0.125kg/100kg) and Diet 8 (VMP(Broiler finisher) + *Moringa oleifera* leaf meal at 0.125kg/100kg).

Table 1: Gross composition of the experimental diet (g/100g)

Ingredients	T1	T2	T3	T4	T5	T6	T7	T8
Rice husk	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
Corn Bran	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
PKC	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Wheat offal	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Maize	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
SBM	20.75	20.50	20,50	20.50	20.50	20.50	20.50	20.50
Cassava meal	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
VMP	0.00	0.00	0.25	0.25	0.25	0.125	0.125	0.125
MLM	0.00	0.25	0.00	0.00	0.00	0.125	0.125	0.125
Total	100	100	100	100	100	100	100	100
Calculated Values								
ME(Kcal)	2449.57	2442.67	2442.67	2442.67	2442.67	2442.67	2442.67	2442.67
Crude Protein (%)	16.85	16.74	16.74	16.74	16.74	16.74	16.74	16.74
Crude Fibre (%)	9.79	9.77	9.77	9.77	9.77	9.77	9.77	9.77
Cost/kg(#)	135.00	135.00	135.00	135.00	135.00	135.00	135.00	135.00

T1= Control diet, T2=Diet 1+ *Moringa oleifera* leaf meal, T3=Diet 1 + Vitamin mineral premix (Grower), T4=Diet 1+ Vitamin mineral premix (Broiler starter), T5=Diet 1 + Vitamin mineral premix (Broiler finisher), T6= Diet 1 + Vitamin mineral premix (Grower) + *Moringa oleifera* leaf meal, T7=Diet 1 + Vitamin mineral premix (Broiler starter) + *Moringa oleifera* leaf meal, T8=Diet 1 + Vitamin mineral premix (Broiler finisher) + Moringa oleifera leaf meal, M.E= Metabolizable energy, PKC= Palm Kernel Cake, SBM= Soya Bean Meal, VMP= Vitamin Mineral Premix, MLM= Moringa Leaf Meal.

Experimental animals and management

Forty-eight (48) growing crossbred rabbits of mixed sexes with age range of 5-7 weeks were purchased from a reputable rabbit farm and randomly allotted to eight dietary treatments of six rabbit each after weight balancing. They were housed individually in cages meaning each rabbit served as replicate and fed twice daily. The experiment lasted for 12 weeks.

Data collections

Feed intake= Weight of feed given – weight of left over

Weight gain= Weight of rabbits in previous weeks were deducted from the weight of rabbit at present week
Feed Gain Ratio= Total feed intake by the animal divided by the total weight of the animal.
Digestibility trial= Nutrient in feed intake – Nutrient in faecal output x 100%
Nutrient in feed intake

Laboratory Analysis
The test ingredients, Moringa leaf meal, experimental diets and faecal sample were analysed for proximate composition.

Statistical Analysis
Data collected were analysed using one-way analysis of variance (ANOVA) of the General Linear Model procedure (GLM) of SAS (2003). Means were separated using Duncan Multiple Range Test of the same statistical package.

Table 2: Growth performance of rabbit fed commercial vitamin-mineral premix and/or *Moringa oleifera* leaf meal

Parameters	T1	T2	T3	T4	T5	T6	T7	T8	SEM	P-Value
ILW(g)	975,80	984.20	995.60	991.60	1000.00	986.00	983.20	990.80	31.92	1.00
FLW (g)	2060.20	2074.00	2008.20	1965.40	1946.80	2045.20	2052.20	1983.00	34.76	0.98
TWG (g)	1084.40	1089.80	1012.60	973.80	946.80	1059.20	1069.00	992.20	32.22	0.94
DWG (g)	19.36	19.46	18.08	17.39	16.80	18.91	19.10	17.72	0.57	0.94
TFI (g)	5303.40^{c}	5620.40^{bc}	5305.60^{c}	4955.60^{d}	5729.60	5504.00^{bc}	5611.20^{bc}	6149.60^{a}	63.63	0.01
DFI (g)	94.70^{c}	100.36^{bc}	94.74^{c}	88.49^{d}	102.31^{b}	98.29^{bc}	100.20^{bc}	109.81^{a}	1.14	0.01
FCR	4.93^{b}	5.27^{ab}	5.24^{ab}	5.11^{ab}	5.72^{ab}	5.30^{ab}	5.26^{ab}	6.45^{a}	0.15	0.03
FC/Kg	135.00^{h}	133.25^{g}	138.00^{c}	138.60^{b}	138.80^{a}	136.63^{f}	136.93^{e}	137.03^{d}	0.21	0.02
FC/KgWgs(N)	665.58^{c}	713.91^{b}	723.61^{b}	708.57^{b}	794.32^{b}	723.74^{b}	719.65^{b}	813.88^{a}	21.05	0.02

a,b,c,d,e,f,g,h Means in the same row with different superscript are significantly different ($p<0.05$). ILW-initial live weight; FLE-final live weight; TWG-total weight gain; DWG-daily weight gain; TFI-total feed intake; DFI-daily feed intake; FCR-feed conversion ratio; FC/Kg-feed cost per kilogram; FC/KgWgs-feed cost per kilogram weight gain

Table 3: Digestibility study of rabbit fed vitamin-mineral and/or *Moringa oleifera* leaf meal

Parameter (%)	T1	T2	T3	T4	T5	T6	T7	T8	SEM	P-Values
DM	64.96^{c}	72.57^{b}	72.16^{b}	71.91^{b}	73.99^{b}	73.47^{b}	73.47^{b}	80.69^{a}	1.61	0.05
CP	83.43	86.83	86.24	85.84	86.62	86.00	86.68	90.55	0.80	0.70
EE	83.27	86.96	86.40	86.34	88.51	87.49	81.03	89.56	0.74	0.56
CF	69.63^{c}	74.96^{b}	74.52^{b}	74.89^{b}	75.70^{b}	78.26^{b}	79.38^{b}	84.50^{a}	1.46	0.03
Ash	76.03^{c}	80.54^{b}	79.96^{ab}	78.76^{ab}	79.94^{ab}	78.95^{ab}	79.45^{ab}	86.14^{a}	1.19	0.02
NFE	62.48^{b}	57.98^{c}	66.24^{b}	67.91^{b}	68.05^{b}	59.25^{c}	69.09^{b}	76.74^{a}	0.86	0.02

a,b,c,d,e,f,g,h Means in the same row with different superscript are significantly different ($p<0.05$)
DM-dry matter; CP-crude protein; EE-ether extract (crude fat); CF-crude fibre; NFE-nitrogen free extract.

RESULTS AND DISCUSSION
The result of growth performance of rabbit fed vitamin mineral premix (VMP) and Moringa leaf meal presented in Table 2 revealed that the final live weight (FLW), total weight gain (TWG), and daily weight gain (DWG) had no significant ($p<0.05$) differences. The non-significant dietary treatment effect on FLW, TWG and DWG in this study suggests that addition of vitamin mineral premix and Moringa oleifera leaf meal to the diet of growing rabbits neither had any adverse effect nor improve the growth of the rabbits. The final live weight recorded in Diets 2 (2074.00g) is similar to the FLW in Diet 1, it is similar to the observations of Dougnon *et*

al., (2012) who examined growth performance of rabbits fed pellet of Moringa oleifera supplemented diets. However, the daily weight gain in (16.80-19.46g/day) observed in this study were relatively lower than the values of (23.12-29.28g/day) reported by El-Desoky *et al*., (2018), but much higher than (3.65-9.5) reported by Olanbanjo *et al*., (2007) when they fed rabbits with diets containing protein levels similar to those used in this study, the differences in the weight gain could be as a result of different environmental factors associated with the experimental locations and breeds of the rabbits used. Total feed intake, daily feed intake, feed conversion ratio, feed cost per kg, and feed cost per kg per weight gain are influenced by addition of vitamin mineral premix and Moringa oleifera. At ($p<0.05$) rabbits in treatment 8 (T8) show the highest daily feed intake but rabbits fed control diet utilized the feed than other treatments which reflects in feed conversion ratio (4.93). Addition of Moringa oleifera leaf meal and vitamin mineral premix in diets 2-8 increased FC/kg(N) than the control and rabbits fed diets T2-T8 (708.57-813.88) of feed cost per kg per weight gain is significantly ($p<0.05$) higher than rabbits in control diet which had (665.58).

The result of nutrient digestibility study of rabbits fed vitamin mineral premix and Moringa oleifera leaf meal shown in table 3 revealed that the Dry matter, Crude fibre, Ash and Nitrogen free extract (NFE) were significantly ($p<0.05$) different. The dry matter for rabbits fed Diets 2-7 are similar while highest value (80.69) was recorded for rabbits in control diet. Crude protein and Ether extract observed in this study were not significantly ($p>0.05$) affected by the dietary treatments. Treatment 8 had the highest value for Ash than other treatments and rabbits on diets 2 and 6 had similar values for NFE which is significantly ($p<0.05$) lower than other treatments. The digestibility of nutrients observed on growing rabbits in this study is not in line with the report of Sun *et al*., (2018), who observed no effect of growth promoters on nutrient digestibility in growing rabbits. The range of CP digestibility in this study (83.43-90.55) contradicts the observation of Igwebuike *et al.,* (2013), this may be linked to better feed conversion ratio of the diets in this study.

CONCLUSION

It is concluded that addition of *Moringa oleifera* leaf meal and vitamin mineral premixes increased feed cost per kg while the rabbits fed control diets had lower feed cost per kg, also there was no effects of VMP and *Moringa oleifera* leaf meal on the final live weight of the rabbits.

RECOMMENDATION

It can be recommended based on this study that rabbit farmers could feed their animals with or without addition of vitamin mineral premixes so that production cost especially on feeding can be reduced.

REFERENCES

Bakam, J. D., Malgwi, B., Jonathan, J., Asala, O., Shittu, I and Meseko, C. (2024). Rabbitry and Emerging Rabbit Haemorrhagic Disease Virus in Nigeria: A Concern for Food Safety and Security. *Nigerian Veterinary Journal*, *45*(1): 1-12.

Bello, M. A., Adewumi, M. O., Durojaiye, M., Ayeni, G. O. A., Muhammed, I. A. A., & Dauda, J. (2022). Adoption of coping strategies to rabbit haemorrhagic disease outbreak by rabbit farmers in Kwara State, Nigeria. *Agri-Tech Economics for Sustainable Futures*, *19*, 209.). Adoption of coping strategies to rabbit haemorrhagic disease outbreak by rabbit farmers in Kwara State, Nigeria. *Agri-Tech Economics for Sustainable Futures*, *19*: 209.

Dougnon, T. J., Aboh, B. A., Kpodekon, T. M., Honvou, S and Youssao, I (2012). Effects of substitution of pellet of Moringa oleifera to commercial feed on rabbits digestion, growth performance and carcass trait. Journal of Applied Pharmaceutical Science, 2(9): 15-19

Duke, A.J. (1998). Moringaceae. Handbook of energy crops. Available: http://www/hort.purdue/edu./ newcrop/duke-energy/moringa.htm. Accessed on 04/05/2008

El-Desoky, A., Alazab, A., Bakr, E and Elseady, Y. (2018). Effect of adding moringa leaf meal to rabbit diets on some productive and reproductive performance traits. *Egyptian Journal of Rabbit Science*, *28*(2), 263-286. Effect of adding moringa leaf meal to rabbit diets on some productive and reproductive performance traits. *Egyptian Journal of Rabbit Science*, *28*(2): 263-286.

Igwebuike, J. O., Alade, N.K and Anyi, H. D. (2013). Effect of feeding graded levels of sorgum waste on the performance and organ weight of growing rabbits. *Journal of Agriculture*, 60(40):193-200.

Islam, Z., Islam, S. R., Hossen, F., Mahtab-ul-Islam, K., Hasan, M. R and Karim, R. (2021). Moringa oleifera is a prominent source of nutrients with potential health benefits. *International Journal of Food Science*, *2021*(1): 6627265.

Kholif, A. E., Morsy, T. A., Gouda, G. A., Anele, U. Y and Galyean, M. L. (2016). Effect of feeding diets with processed Moringa oleifera meal as protein source in lactating Anglo-Nubian goats. *Animal Feed Science and Technology*, *217*: 45-55.

Mailafia, S., Onakpa, M. M and Owoleke, O. E. (2010). Problems and prospects of rabbit production in Nigeria-A review. *Bayero Journal of pure and applied sciences*, *3*(2): 20-25.

Nur, R., Demak, I. P. K., Radhiah, S., Rusydi, M., Mantao, E and Larasati, R. D. (2020). The effect of moringa leaf extracton increasing Haemoglobin and bodyweight in post-disaster pregnant women. *Enfermería Clínica*, *30*: 79-82.

Odinakachukwu, I. C., Ngozi, N. N., Ngozi, I and Aloysius, N. M. (2014). Analysis of the nutrient content of infant complementary food Fortificant-Moringa oleifera leaves with the commonly consumed local infant foods in Nigeria: Zea mays and Glycine max. *International Journal of TROPICAL DISEASE and Health*, *4*(10): 1111-1122.

Ojebiyi, O.O., Yusuf, A.O., Oladunjoye, I.O and Babarinde, S.A (2013). Nutritional Evaluation of Honey Bee Slum Gum Meal as Replacement for Maize in the Feed of Growing Rabbits. *Journal of Biology, Agriculture and Healthcare,* 3(7): 96-101.

Olabanjo, R. R., Farinu, G. O., Akinlade, J. A and Ojebiyi, O. O (2007). Growth performance haematological characteristics of weaner rabbits fed different levels of wild flower (Tithonia diversifolia) leaf-blood meal mixture. Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production, 18-21 March, Calabar, Nigeria. Pp 207-209.

Rapa, S. F., Di Iorio, B. R., Campiglia, P., Heidland, A and Marzocco, S. (2019). Inflammation and oxidative stress in chronic kidney disease—potential therapeutic role of minerals, vitamins and plant-derived metabolites. *International journal of molecular sciences*, *21*(1): 263.

SAS, (2000). Statistical Analysis System, user's guide. Statistics, 8.6 edition SAS institute incorporated, carry, North Carolina, USA.

Su, B and Chen, X. (2020). Current status and potential of Moringa oleifera leaf as an alternative protein source for animal feeds. *Frontiers in veterinary science*, *7*:53.

Sun, B., Zhang, Y., Ding, M., Xi, Q., Liu, G., Li, Y and Chen, X. (2018). Effects of Moringa oleifera leaves as a substitute for alfalfa meal on nutrient digestibility, growth performance, carcass trait, meat quality, antioxidant capacity and biochemical parameters of rabbits. *Journal of animal physiology and animal nutrition*, *102*(1): 194-203.