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GROWTH PERFORMANCE, FEED CONVERSION EFFICIENCY OF GILTS AND PRE WINNING GROWTH RATE OF PIGLETS FROM SOWS FED DIETS CONTAINING GRADED LEVELS OF MORINGA OLEIFERA LEAF MEAL (MOLM)

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ABSTRACT

The dietary effect of inclusion of Moringa oleiferaleaf meal (MOLM) on growth performance and mortality rate of piglets were investigated. A thirteen months feed trial experiment was carried out on twenty four (24) large white weaner pigs, twenty females and four males which were 10-11 weeks. The females were randomly grouped into five treatments and four replicates with each animal constituting a replicate in a randomized complete design. The four boars were used to cross the gilts when on heat. The control diet was (0%) MOLM, while treatment 2, 3, 4 and 5 were 5, 7.5, 10 and 12% MOLM, respectively. There were no significant differences ($P > 0.05$) in initial body weight, final body weight, total weight gain and daily growth rate of gilts. However, daily feed intake of pigs fed 5, 10 and 12% MOLM (1.05, 1.07 and 1.08 respectively) were significantly higher than those fed 7.5% MOLM (0.99). Similarly, total feed intake of pigs feed 7.5% MOLM were significantly lower (150.57) than those fed 12% MOLM (166.37). Feed conversion efficiency was significantly better for pigs fed 7.5% MOLM (0.26) than 12% MOLM (0.23).Piglet growth rate at 0% MOLM (0.12) and 5% (0.12) were significantly higher than those fed 10% MOLM (0.08).There were no significant ($P > 0.05$) differences in piglet birth weight, weaning weight and mortality rate. In conclusion, up to 7.5 % MOLM could be included in the diets of gilt without any negative effect on total feed intake and daily feed intake. There may be no negative effect on feed conversion efficiency at 7.5% MOLM inclusion. Piglet growth rate may not be affected negatively at 5% MOLM inclusion.

Keywords: Moringa oleiferaleaf meal (MOLM), pig, gilt growth rate, piglet growth rate, inclusion level.

INTRODUCTION

The production of pigs is a major component of livestock production in most West African countries especially in parts of the countries where there are no cultural or religious inhibitions to pork production and consumption (Ewuziem, Nwosu, Amaechi, Aniebo & Anyaegbu, 2009). The relative advantages of the pig are its high rate of survival and the ability to utilize a variety of agro-industrial by-products and crop residue (Okai & Bonsi, 2005). The nutrition of animals is an important component of livestock production not only on the bases of the cost of feeding, but also for the fact that nutrition has a serious influence on the animal's growth, health and reproduction (Bhat, Mohan & Deo, 2010). The efficiency with which pigs convert feed into live weight has a great impact on the profitability of pig production (Barbut, Sosnicki, Lonergan, Knapp, Ciobanu, Gatcliffe, Huff-Lonergan & Wilson, 2008). Despite the advantages of pig production, the increasing costs and unpredictable availability of conventional feed stuffs notably fish meal (FM) and soya bean meal (SBM) as a source of protein for monogastric livestock, has been a limiting factor to pig production. Feed cost alone in pig production is estimated to represent 65 to 75% of total cost of production (Ameral, Ravindra, Lentel & Thomas, 2007). Consequently, many commercial farmers and institutional farms are not able to produce to full capacity. This has necessitated the search for non-conventional feed stuffs which are relatively cheap in cost and readily available (Robinson & Menghe, 2007). The use of non-conventional sources of feedstuff to feed livestock has effectively moderated and reduced the cost of non-ruminant animal production (Ekenyem & Madueke, 2007).Recent research trends indicate that there is an increase interest towards the search for alternative protein sources to meet the increasing demand for protein sources for the expanding livestock industry, especially, in the developing countries (Janardhanan, Vadivel & Pugalenthi, 2003). Moringa oleifera leaf meal with significant crude protein levels between 19.3% and 26.4% (Aregheore, 2002) can be a suitable alternative non-conventional feed stuff to conventional feed staff to be used as an ingredient in pig diet to reduce the cost of production and to expand pig production. Moringa oleifera from the Moringaceae family is a fast growing plant widely available in the tropics and sub-tropics with several economic uses for both industrial and medicinal purposes (Richter, Siddhuraju & Becker, 2003). The edible parts of the Moringa tree are exceptionally nutritious (Teketay, 2001). Despite the characteristic good nutritional value of Moringa, there is little information regarding its utilization in pig diet. Oduro-Owusu, Kagya-Agyemang, Annor & Bonsu, (2015) used MOLM to investigate the growth performance of pigs but did not investigate its effect on piglet growth rate and mortality rate. The present study therefore seeks to investigate the effect of MOLM on both the growth performance of gilts, piglet growth rate and mortality rate. The study was therefore conducted to determine the optimum inclusion level of Moringa oleifera leaf meal (MOLM) that will maximize growth performance of gilts, piglets and reduce piglet mortality rate.

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METHODOLOGY

Experimental design and management of animals

A total of twenty four (24) Large White weaner pigs, made up of twenty females and four males were used for the experiment. The weaner pigs were between 9-11 weeks of age. The twenty female weaner pigs were balanced by body weight and randomly allocated to five (5) treatments with four replicates in a Completely Randomized Design (CRD). Each replicate had one animal (female weaner pig). Each animal (males and females) were housed in a single pen with

concrete floor. At puberty (second heat), the boars were used to cross the gilts. Each boar was made to cross one gilt in each treatment. Thus male one crossed gilt one in treatment one, gilt one in treatment two, gilt one in treatment three, gilt one in treatment four and gilt one in treatment five. Male two crossed gilt two in treatment one, gilt two in treatment two, gilt two in treatment three, gilt two in treatment four and gilt two in treatment five. Male three crossed gilt three in treatment one, gilt three in treatment two, gilt three in treatment three, gilt three in treatment four and gilt three in treatment five. Male four crossed gilt four in treatment one, gilt four in treatment two, gilt four in treatment three, gilt four in treatment four and gilt four in treatment five. A pig stall had the following dimension: Length 240cm Width 210cm and Height 120cm. Thus it had an area of 50, 400 cm^2. Feed and water trough had the following dimensions: Length 45cm, Width 30cm and Height 16 cm giving an area of 1,350 cm^2. Water was offered ad libitum in concrete water trough and feed was also offered in concrete feed trough in the morning but restricted. Pigs were given 3.30% feed of their body weight as recommended by (Fasuyi, Ibitayo & Alo, 2013). A daily routine of cleaning the pig stalls was keenly observed. Prior to the experiment, the pig stalls were cleaned and later disinfected with quincide, a broad spectrum disinfectant. The pigs were also dewormed using Piperazine. The piglets were also given 2ml of exogenous iron the third day after farrowing through injection in the neck.

Table 1: Composition and analysis of experimental grower's diets

Ingredients	% Composition of Ingredients per Treatment (As Is)				
	0% MOLM	5% MOLM	7.5% MOLM	10% MOLM	12% MOLM
Maize	49	49	49	48	50
Tuna fish meal	6	6	6	5.5	5.5
Soybean meal	8.5	8	7	6.5	6.5
Wheat bran	35.5	31	29.5	29	25
Premix	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
MOLM	0	5	7.5	10	12
Total	100	100	100	100	100
Calculated levels of some nutrients and energy					
Crudeprotein	17.17	17.31	17.14	17.03	17.17
Methionine	0.33	0.33	0.33	0.32	0.41
Lysine	0.93	0.91	0.90	0.98	0.83
Crude fibre	4.61	4.95	5.08	5.3	5.43
DE (MJ kg^{-1})	12.78	12.67	12.57	12.42	12.48

The vitamin premixprovided the following per kilogram of diet: Fe 100 mg, Mn 110 mg, Cu 20 mg, Zn 100 mg, Se 0.2 mg, Co 0.6 mg, Senoquin 0.6 mg, retinal 2000mg, cholecalciferol 25 mg, α-tocopherol 25 mg, menadione 1.33 mg, cobalamin 0.03 mg, thiamin 0.83 mg, riboflavin 2 mg, folicacid 0.33 mg, biotin 0.03 mg, pantothenicacid 3.75 mg, macin 23.3 mg, pyridoxine 1.33mg. The DE energy was calculated using the DE values for the various ingrédients as recommended by (National Research Council, 1998). The DE for the moringa which is the test ingrédient was also calculated using the proximate values obtained after the analysis using the formula, DE (MJ/kg DM) = 17.47+0.0079CP+0.0158oil-0.0331ASH-0.0140NDF as recommended by (McDonald, Edwards& Greenhalgh, 1998). The composition and analyses of the experimental diets that were used to feed the pigs during the gestation period are shown in Table 3.2.

Table 2 : Composition and analysis of expérimental gestation diet

Ingredient	% Composition of Ingredients per Treatment (As Is)				
	0% MOLM	5% MOLM	7.5% MOLM	10% MOLM	12% MOLM
Maize	66	66	64.5	63	62
Tunafishmeal	5	5	5	5	4.5
Wheat bran	24	19.5	19	19	19
Soyabeanmeal	4	3.5	3	2	1.5
Premix	0.5	0.5	0.5	0.5	0.5
MOLM	0	5	7.5	10	12
Total	100	100	100	100	100
Calculated levels of some nutrients and energy					
Crude protein	14.2	14.34	14.44	14.37	14.23
Methionine	0.29	0.29	0.29	0.28	0.27
Lysine	0.72	0.69	0.67	0.65	0.62
Crude fibre	3.67	4.01	4.28	4.57	4.81
DE(MJ/Kg^{-1})	13.29	13.03	12.81	12.60	12.40

The vitamin premixprovided the following per kilogram of diet : Fe 100 mg, Mn 110 mg, Cu 20 mg, Zn 100 mg, Se 0.2 mg, Co 0.6 mg, Senoquin 0.6 mg, retinal 2000mg, cholecalciferol 25 mg, α-tocopherol 25 mg, menadione 1.33 mg, cobalamin 0.03 mg, thiamin 0.83 mg, riboflavin 2 mg, folicacid 0.33 mg, biotin 0.03 mg, pantothenicacid 3.75 mg, macin 23.3 mg, pyridoxine 1.33mg. The composition and analysis of the experimental diets that were used to feed the pigs at the lactating period are shown in Table 3.

Table 3: Composition and analysis of experimental lactating diets

Ingredients	% Composition of Ingredients per Treatment (As Is)				
	0% MOLM	5% MOLM	7.5% MOLM	10% MOLM	12% MOLM
Maize	49	49	49	48	50
Tuna fish meal	6	6	6	5.5	5.5
Soybean meal	8.5	8	7	6.5	6.5
Wheat bran	35.5	31	29.5	29	25
Premix	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
MOLM	0	5	7.5	10	12
Total	100	100	100	100	100
Calculated levels of some nutrients and energy					
Crudeprotein	17.17	17.31	17.14	17.03	17.17
Methionine	0.33	0.33	0.33	0.32	0.41
Lysine	0.93	0.91	0.90	0.98	0.83
Crude fibre	4.61	4.95	5.08	5.3	5.43
DE (MJ kg^{-1})	12.78	12.67	12.57	12.42	12.48

The vitamin premixprovided the following per kilogram of diet: Fe 100 mg, Mn 110 mg, Cu 20 mg, Zn 100 mg, Se 0.2 mg, Co 0.6 mg, Senoquin 0.6 mg, retinal 2000mg, cholecalciferol 25 mg, α-tocopherol 25 mg, menadione 1.33 mg, cobalamin 0.03 mg, thiamin 0.83 mg, riboflavin 2 mg, folicacid 0.33 mg, biotin 0.03 mg, pantothenic acid 3.75 mg, macin 23.3 mg, pyridoxine 1.33mg. The following growth parameters were measured: Initial body weight (kg/pig), final body weight (kg/pig), daily feed intake (kg), total feed intake (kg), daily weight gain (kg) and feed conversion efficiency. Data on feed intake were taken on individual animals on weekly basis. Since feed was restricted the animals consumed all their daily allocations. The weekly feed intake therefore was the kilograms of feed given to the individual animal multiplied by seven days. Each animal was weighed at the end of each week. The final weight gain of each animal was then calculated by subtracting the initial weight from

their final weights. Based on this, the mean weight gain per treatment was calculated as the difference between the final mean weights and the initial mean weights of each of the five (5) treatments. Arithmetically, Weight gain (kg) = Final weight (kg) – Initial weight (kg). Mean weight gain (kg) = Final mean weight (kg) – Initial mean weight (kg). Growth rate was calculated as the ratio of total weight gain before pregnancy to the experimental period before pregnancy. This was expressed in kilograms (kg).

$$\text{Arithmetically, Growth rate} = \frac{\text{Total weight gain (kg)}}{\text{Total experirmental period (days)}}$$

Feed conversion efficiency is the ratio of the total weight gain in kg throughout the experimental period to total feed intake in kg. It was expressed as gain to feed ratio. That is,

$$\text{FCE} = \frac{\text{Total weight gain (kg)}}{\text{Total feed intake (kg)}}$$

RESULTS

The growth performance of gilts fed varying levels of MOLM in the experiment is shown in Table

Table 4. Growth performance of pigs fed different levels of MOLM

PARAMETERS	0% M	5% M	7.5% M	10% M	12% M	L S D	S E
I B W (kg)	11.00	11.00	11.00	11.00	11.00	0.01	3.53
D F I (kg)	1.03^{ab}	1.05^{a}	0.99^{b}	1.07^{a}	1.08^{a}	0.06	0.01
T F I (kg)	155.23^{ab}	155.65^{ab}	150.57^{b}	160.72^{ab}	166.37^{a}	15.47	5.00
F B W (kg)	50.25	50.25	50.25	50.00	50.05	0.73	0.23
T W G (kg)	39.25	39.25	39.25	39.00	39.05	0.73	0.23
D G R (kg)	0.26	0.27	0.26	0.26	0.25	0.02	0.006
F C E	0.25^{ab}	0.25^{ab}	0.26^{a}	0.24^{ab}	0.23^{b}	0.03	0.007

Means bearing the same superscript in the same row are not significantly different (P > 0.05)

LSD = Least significant difference
SE = Standard error of means
M = MOLM

NB: I B W = Initial body weight. D F I = Daily Feed Intake. T F I =Total Feed Intake. F B W = Final Body Weight. T W G = Total Weight Gain. D G R = Daily Growth Rate. F C E = Feed Conversion Efficiency.

The initial body weights of the weaner pigs at the start of the experiment were the same for all the dietary treatments (P > 0.05). Daily feed intake for pigs fed diets containing 5%, 10% and 12% MOLM were significantly (P<0.05) higher than those fed diets containing 7.5% MOLM but similar (P>0.05) to those fed diets containing 0% MOLM. The daily feed intake values for pigs fed diets containing 0% MOLM were also similar (P>0.05) to those fed diets containing 7.5% MOLM (Table 4). Total feed intake for pigs fed diets containing 12% MOLM were significantly (P<0.05) higher than those fed diets containing 7.5% MOLM but similar to those fed diets containing 0%, 5% and 10% MOLM. The total feed intake for pigs fed diets containing 7.5% MOLM were also similar to those fed diets containing 0%, 5% and 10% MOLM (Table 4. 5). Final body weights, total weight gain and daily growth rate for pigs in all treatments were similar (P>0.05). There was significant (P < 0.05) difference between feed conversion efficiency values, thus, feed conversion efficiency for pigs fed diets containing 7.5% MOLM were significantly (P<0.05) higher than those fed diets containing 12% MOLM but similar to those fed diets containing 0%, 5%, and 10% MOLM.

DISCUSSION

Growth performance of pigs

The similarites in final body weight, total weight gain and daily growth rate indicates that the ingredient use (MOLM) did not have significant influence on the above growth parameters. The findings are in agreement with those reported by (Mukumbo, Maphosa, Hugo, Nkukwana, Mabusela & Muchenje, 2014), when MOLM was fed to pigs. In that research no differences were observed in the above mentioned growth parameters. Olayeni, Farinu, Togun, Adedeji & Aderinola, (2006), in a similar research fed weaner pigs using wild sunflower (Tithoniadiversifolia) leaf meal and observed no difference in final live weight and weight gain. Nuhu, (2010) in another study used moringa to feed weaner rabbits and observed that the final body weight and the total weight gain increased with increasing levels of MOLM in the diets but they were not significantly different among the dietary treatments. Adeniji & Lawal, (2012) however, investigated the growth performance of grower rabbits fed different levels of groundnut cake replaced with moringa leaf meal and observed differences in final body weight. This probably was because the rabbits were able to better digest fibre in the moringa because of the bacterial activities in the caecum. The differences in the total feed intake and the daily feed intake could be attributed to the high fibre content of the MOLM. According to (Souffrant,2001), dietary fibre is a heterogeneous mixture of structural and non-structural polysaccharides and lignin and is not digested by endogenous secretions by the pig. Fibre also dilutes dietary energy, increases bulkiness and reduces overall nutrient digestibility (NRC, 1998). The reduction in the energy concentration by the MOLM in the diets possibly made the animals to eat more to satisfy their energy requirement. However,(Oduro-Owusu et al.2015) in a feed trial used MOLM to feed pigs and observed no differences in total feed intake and daily feed intake among dietary treatments probably because the MOLM levels were comparatively lower. In that experiment the MOLM inclusion levels were from 1 to 5% MOLM which could not possibly dilute the dietary energy compared to the levels in this study which was from 5 to 12%MOLM which possibly diluted the dietary energy. The feed intake for the 7.5% MOLM was a little lower than the rest of the MOLM diets possibly because its energy was a little higher than the rest. Similarly, (Nuhu, 2010) used moringa to feed weaner rabbit and observed no significant differences in the daily feed intake. The differences in feed conversion efficiency could be attributed to the poor availability of nutrients to the sows in some of the diets. Díaz, González & Ly, (1997) and Díaz, (1998) reported that poorer availability of nutrients may result in a poor efficiency of feed utilization by animals. The FCE in this finding however did not show any particular trend. The result of this study is in agreement with the findings reported by (Oduro-Owusu et al.2015) when MOLM was fed to pigs. In that research, differences were observed in FCE among the treatment means which also did not show any trend. Similarly, (Adegun & Aye, 2013) researched into the effect of moringa on the performance of West African dwarf rams and observed differences in feed conversion ratio (FCR). Nuhu, (2010) used moringa to feed weaner rabbits and observed that feed conversion ratio (FCR) values were improved with increasing levels of MOLM. This probably was because the rabbits were able to better digest fibre in the moringa because of the bacterial activities in the caecum. Results of piglet growth performance and mortality rate are shown in the Table 5.

Table 5. Piglet growth performance of sows fed different levels of MOLM

PARAMETERS	0%M	5%M	7.5%M	10%M	12% M	L S D	S E
P B W (KG)	1.10	1.19	1.14	1.22	1.10	0.21	0.05
W W (KG)	4.62	4.57	3.65	3.78	3.87	1.28	0.41
P G R (KG)	0.12^{A}	0.12^{A}	0.10^{AB}	0.08^{B}	0.10^{AB}	0.03	0.01
M R (%)	9.72	29.33	13.96	22.86	18.77	27.72	8.99

Means bearing the same superscript in the same row are not significantly different (P > 0.05)

LSD = Least significant difference
SE = Standard error of means
M = MOLM

P B W = Piglet Birth weight. L S W = Litter Size at Weaning. W W = Weaning Weight. P G R = Piglet Growth Rate. M R = Mortality Rate.

There were no significant (P>0.05) differences among the various treatment means for weight at birth, weaning weight and mortality rate. There was a significant (P<0.05) difference among treatment means for piglet growth rate for the thirty days period. Piglets from sows fed diets containing 0% and 5% MOLM significantly (P<0.05) grew faster than those from sow fed diets containing 10% MOLM but similar to those from sows fed diets containing 7.5% and 12% MOLM. The growth rates of piglets from sows fed diets containing 10% MOLM were also similar to piglets from sows fed diets containing 7.5% and 12% MOLM (Table 4. 8).

Growth performance of piglets

There were similarities in piglet's birth weight, weaning weight and mortality rate for all the piglets from sows fed the various diets. These findings did not agree with the findings reported by (Duyet, Nguyen, Nguyen & Truong, 2004) where sweet potato leaves, water spinach and fresh cassava leaf were used to replace soya bean meal to investigate the growth performance of piglets. In that research, differences were observed in birth weight and weaning weight of the piglets. However, no differences were observed for litter size at birth and litter size at weaning which suggests that there was no deleterious effect of the MOLM on the piglets. The differences in piglet's growth rate could not be attributed to the MOLM or the control diet since the difference did not show any particular trend. However, it was best for 0 and 5% MOLM. The similarity in mortality rate in this study indicates that the moringa leaf meal did not have any negative effect on the piglets. This finding was not in agreement with that reported by (Gyebi, 2014) when moringa was fed to rabbit to investigate their reproductive performance. In his findings differences were observed in mortality rate of the kits.

Conclusions and Recommendations:

The results of this study indicated that inclusion of 7.5 % MOLM in the diets of the sows had no detrimental effects on feed conversion efficiency, total feed intake and daily feed intake. While these three parameters were best at 7.5 % MOLM inclusion, they did not have any significant effect on total weight gain, final body weight and daily growth rate. Piglet growth rate will not be affected negatively at 5% MOLM inclusion. It is recommended that 7.5 % MOLM could be included in the diets of grower and finisher pigs while 5% MOLM could be included in pig diet during lactation.

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REFERENCES

1. Adegun, M.K. and Aye P.A. (2013). Growth performance and economic analysis of West African Dwarf Rams fed Moringa oleifera and cotton seed cake as protein supplements to Panicummaximum. AmericanJournal of Food and Nutrition. 3(2): 58-63.
2. Adeniji, A.A. and Lawal, M. (2012).Effects of replacing groundnut cake with Moringa oleifera leaf meal in the diets of grower rabbits. International Journal of Molecular Veterinary Research.2(3): 8-13.
3. Ameral, A.M., Ravindra, V., Lentel, R.G. and Thomas, D.G. (2007). Feed particle size: implication on the digestion and performance of poultry. Poultry Science Journal. 63: 439-455.
4. Aregheore, E.M. (2002). Intake and digestibility of Moringa oleiferabatiki grass mixtures by growing goats. Small ruminant Research, 46: 23-28.
5. Barbut, S., Sosnicki, A.A., Lonergan, S.M., Knapp, T., Ciobanu, D.C., Gatcliffe, L.J., Huff- Lonergan, E. & Wilson, E.W., 2008. Progress in reducing the pale, soft and exudative (PSE) problem in pork and poultry meat. Meat Sci. 79, 46-63.
6. Bhat, P.N., Mohan, N.H. & Deo, S., 2010. Pig Production, Global Media, Delhi, India.
7. Díaz I., González, C. and Ly, J. (1997). Determination of effect of inclusion of 3 levels of foliage of sweet potato (Ipomoea batata (L.) Lam.) on the speed of transitohasta the ileum. ArchivosLatinoamericanos of Animal Production, 5 (Supplement):291.
8. Díaz, I. (1998). Evaluation of cuatrometodos (faecal, ileal, in situ and in vitro) para determination digestion of foliage of sweet potato (Ipomoeabatatas L.) in pigs.MSc. Thesis.Faculty of Agronomy.Central University of Venezuela. Maracay.
9. Duyet, N.H., Nguyen, D.S., Nguyen, V.A and Truong T.T. (2004) Effects on sow reproduction and piglet performance of replacing soybean meal by a mixture of sweet potato leaves, water spinach and fresh cassava foliage in the gestation and lactation diets of MongCai and Yorkshire sows. Livestock Research for Rural Development(15)6.
10. Ekenyem, B.U.andMadubuike, F.N. (2007). Haematology and serum biochemistry of grower pigs fed varying levels of ipomoea asarifolialeaf meal. Pakistan Journal of Nutrition, 6 (6): 603-606.
11. EwuziemJ.E.,Nwosu, A.C.,Amaechi,E.C.C.,Aniebo,A.O . and Anyaegbu, P.O (2009) piggerywaste management and profitability of pig farming in Imostate Nigeria. Niger Agricultural Journal. 40 (1) pp. 29 – 36
12. Fasuyi , A.O., Ibitayo , F.J and Alo, S.O. (2013). Histopathology, haematology and serum chemistry of growing pigs fed varying levels of wild sunflower (Tithoniadiversifolia) leaf meal as protein supplements. Bionutritional evaluation Journal of Central European Agriculture, 9(1): 23- 34.
13. Janardhanan, K.,Vadivel, V. and Pugalenthi, M. (2003). Biodiversity in Indianunder-exploited/tribal pulses. In: Improvement strategies for Leguminosae Biotechnology (editors: P K Jaiwal and R P Singh), pp.353-405. Kluwer Academic Publishers, Britain.
14. McDonald, P., Edwards, R.A. and Greenhalgh, J.F.D. (1998). Animal nutrition: 4th Edition. Produced by Longman Group (EE) Ltd. Hongkong. Pg. 8-320.

15. Mukumbo, F.E., Maphosa, V., Hugo, A., Nkukwana, T.T., Mabusela. T.P. andMuchenje, V. (2014).Effect of Moringa oleifera leaf meal on finisher pig growth performance, meat quality, shelf life and fatty acid composition of pork South African Journal of Animal Science. 44 (4).pp.92-98.
16. National Research Council (NRC, 1998).Nutrient requirement of swine, 9th Rev. Ed. National Acad. Press., Washington D.C. 3-127.
17. Nuhu, F. (2010).Effect of moringa leaf meal (MOLM) on nutrient digestibility, growth, carcass and blood indices of weaner rabbits. MSc. Thesis Kwame Nkrumah University of Science and Technology Kumasi.
18. Oduro-Owusu, A. D., Kagya-Agyemang, J. K., Annor, S. Y and Bonsu, F. R K. (2015) Growth performance, carcass characteristics and economic efficiency of using graded levels of moringa leaf meal in feeding weaner pigs. American Journal of Experimental Agriculture. 7(3): 190-196.
19. Okai, D.B. and Bonsi, M. L. K. (1994). Pigs production: In: Okai, D. B., Bonsi, M. L.K., Olympio, O.S. and Sam, E. (eds.), Poultry and Pig Production Handbook for the Ghanaian Farmer. Degraft Graphics and Pub., Kumasi, Ghana. Pp. 30-66.
20. Olayeni, T.B., Farinu, G.O., Togun, V.A., Adedeji, S.O. and Aderinola, A.O. (2006). Performance and haematological characteristics of weaner pigs fed wild sunflower(TithoniadiversifoliaHemsl. A gray leaf meal.Journal of Animal and Veterinary Advances. 5(6): 499-502.
21. Richter, N., Siddhuraju, P. and Becker, K. (2003). Evaluation of nutritional quality of Moringa(Moringa oleifera Lam.) leaves as an alternative protein source for Nile tilapia. Aquaculture, 217: 599-611.
22. Robinson, E.H. and Menghe, H.L. (2007).Catfish Protein Nutrition (Revised).Bulletin 1153.Office of Agricultural Communications, Mississippi State University, USA.
23. Souffrant, W.B. (2001). Effect of dietary fibre on ileal digestibility and endogenous nitrogen losses in the pig. Animal Feed Science and Technology, 90: 93-102.
24. Teketay, D. (2001). The Effect of Temperature on the Germination of Moringa Setenopetala: A Multi-purpose Tree. Trees for Life Journal. Vol. 1(1).

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