Athens Institute for Education and Research
ATINER

ATINER's Conference Paper Series
ZOO2017-2350

Reproductive Performance of Rabbit Does Fed Moringa Oleifera Leaf Meal (Molm) as a Protein Substitute to Soya Bean Meal

Julius Enow Tabot
Researcher
Institute of Agricultural Research for Development
Cameroon

Kingsley Agbor Etchu
Director & Scientific Coordinator
Institute of Agricultural Research for Development
Cameroon

Annabella Abongwa Ngengwi
Researcher
Institute of Agricultural Research for Development
Cameroon

Olivier Sandra Ghomsi
Head
Institute of Agricultural Research for Development
Cameroon

An Introduction to ATINER's Conference Paper Series

ATINER started to publish this conference papers series in 2012. It includes only the papers submitted for publication after they were presented at one of the conferences organized by our Institute every year. This paper has been peer reviewed by at least two academic members of ATINER.

Dr. Gregory T. Papanikos
President
Athens Institute for Education and Research

This paper should be cited as follows:

Tabot, J. E., Etchu, K. A., Ngengwi, A. A. and Ghomsi, O. S. (2017). **"Reproductive Performance of Rabbit Does Fed Moringa Oleifera Leaf Meal (Molm) as a Protein Substitute to Soya Bean Meal",** Athens: ATINER'S Conference Paper Series, No: **ZOO2017-2350.**

Athens Institute for Education and Research
8 Valaoritou Street, Kolonaki, 10671 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209 Email: info@atiner.gr URL: www.atiner.gr
URL Conference Papers Series: www.atiner.gr/papers.htm
Printed in Athens, Greece by the Athens Institute for Education and Research.
ISSN: 2241-2891
14/12/2017

Reproductive Performance of Rabbit Does Fed Moringa Oleifera Leaf Meal (Molm) as a Protein Substitute to Soya Bean Meal

Julius Enow Tabot
Kingsley Agbor Etchu
Annabella Abongwa Ngengwi
Olivier Sandra Ghomsi

Abstract

A study was conducted with 32 mixed breed rabbits averaging 2.35-3.11kg and aged between 7-8 months to evaluate the reproductive performance of rabbit does fed graded levels of *Moringa oleifera* leaf meal (MOLM) in a 12- week feeding trial. Four treatment diets were compounded by MOLM substituted soya bean meal at 0, 25, 50 and 75% respectively. The animals were allotted to the four treatment diets so that each diet had 6 does and 2 bucks housed individually in each cage. Rabbit does were introduced to the bucks for mating in the early morning in the ratio 1:3 (01 male: 03 female) per week during the third week of the study. Feed intake and weight gain were recorded, while the gestation length, percentage conception, litter size at birth, litter weight at birth and survival rate of kids were calculated. The results showed no significant difference ($P>0.05$) in the average weekly weight gain of does, litter size at birth, average litter weight at birth and average survival rate of kids. However, the results revealed a significant difference ($P<0.05$) in the gestation length and average weekly weight gain of kids. The results suggest that MOLM incorporated in the diets of rabbits up to 75% had no detrimental effect on the reproductive performance of rabbit does.

Keywords: Moringa oleifera, Reproductive performance.

Introduction

In Cameroon, poverty affects 40.2% of the population and 85% reside in the rural areas, employing close to 60% of the active population (PNUD, 2006). A large part of the population feeds mostly on bulky starchy food and is unable to satisfy their protein needs, leading to poor nutrition with its attendant consequences (Etchu, 2004). Beef, milk, chicken and eggs have been the major sources of animal protein but are usually insufficient and expensive for the average Cameroonian (Tabot, 2016).

Rabbit (*Oryctolagus cuniculus*) is one of such species that have been reported to contribute significantly to solving the problem of animal protein shortage (Lebas et al., 1986). Rabbits are suitable as meat producing livestock because of attributes like small size, short generation interval, high reproductive potential, rapid growth rate, ability to utilize forages, agricultural and agro-industrial by-products as their major diet components (Etchu et al., 2012) highly nutritive and they are efficient converters of grains to meat (Olabanji et al., 2007).

Increasing cost of commercially produced feeds, arising mainly from the high cost of feedstuffs, especially the conventional ones like cereal grains, oils seed cakes and fish meal is one of the major constraints towards increased animal protein in Africa (Amaefule and Obioha, 2005).

Soya bean meal has been widely and successfully used as a protein source in the diets of livestock, but the price in recent times has been escalating continuously while availability is often erratic. Therefore, researchers have advocated the need to explore the use of non-conventional feed sources that have the capacity to yield the same output as conventional feeds and perhaps at cheaper cost in the diets of livestock (Amaefule et al., 2005; Ufele et al., 2013), such as Moringa. There has been increasing interest in the utilization of Moringa as a protein source for livestock (Adeniji et al., 2012). It is a perennial plant with good potential for forage production and can be harvested several times in one growing season. Moringa leaves have quality attributes that make them potential replacements for soya bean in non-ruminant diets (Ufele et al., 2013).

The variation in the nutritive values of Moringa depend on factors like genetic background, agro-climatic conditions, age of the trees, season of harvesting, leaves collection and drying procedures and the method applied to get the final form of the product.

The proximate analysis of MOLM on air-cured basis is DM=93.4, CP=24.8, CF=11.1, EE=2.1, Ash=8.7and ME=3316.52 as reported by Adeniji *et al*., 2012, on aired dried under the shade is CP=31.68%, CF=4.94%, EE=8.78% and Ash=14.88 as reported by El-Badawi et al. (2014), and CP= 29.25, EE= 2.23, CF=19.25 and Ash=7.13 as reported by Nuhu (2010). These make it a suitable protein source in the diets of livestock.

This study was aimed at evaluating the reproductive performance of rabbit does fed *Moringa oleifera* leaf meal as a substitute to soya bean meal

Materials and Methods

Study Site

The study was carried out at the rabbitory of the Institute of Agricultural Research for Development (IRAD) at Regional Research Centre in Ekona, the South West Region of Cameroon. It is located at longitude: 04^{0} 12' 799''N and latitude: 009^{0} 12' 921''E, at an altitude of about 400m above sea level. It has an average annual rainfall of 2284mm and a humid tropical climate with an average annual humidity of about 90%.

Collection and Processing of Moringa oleifera Leaf Meal

Moringa leaves were harvested from IRAD Ekona forage farm, solar dried for 5 days, compounded to yield Moringa oleifera leaf meal (MOLM) and used as experimental ingredient.

Formulation of Experimental Diets

Four diets were compounded, (Table 1) where the *Moringa oleifera* leaf meal substituted soya bean meal at 0%, 25%, 50% and 75% respectively. The composition of the control diet contained 36.5% maize, 20% palm kernel cake (PKC), 20% wheat bran (WB), 12% soya bean cake (SBC), 6% Groundnut cake (GNC), 3% Fishmeal (FM), 1% Bone meal, 1% sea shell, 0.25 vitamin / premix, and 0.25% salt.

The compounded diets (in mash form) were put separately according to the treatments in a dry pelletiser (Stak-pellet mill) to produce pellets of diameter 8mm. The pellets were aired separately on flour bags for three hours to cool and harden, and used as the experimental diets (Tabot, 2016).

Housing and Equipment

The rabbitory is a wooden house with concrete floor and a roof of corrugated aluminum sheets. It is well ventilated with two large windows covered with wire mesh opposite to one another to allow enough ventilation. The hutches are constructed with wood, wire mesh, iron rods and smooth zinc into a three-tier hutch system raised 50 cm from the ground. Each level had four hutches measuring 100cm by 60cm and each level is separated with smooth zinc. Three sides of the hutches are covered with wood to prevent direct wind.

Each hutch was partitioned with wood and the floor made up of 6mm rods separated a distance of 1.5 mm apart to allow the easy passage of fecal droppings and urine. Each hutch had a hinged door of about 30cm x35cm covered with wire mesh.

The drinkers were plastic cups, while the feeders were adapted from 'Ovaltine' and milk tins bent in the middle, all tied on one side of the hutch and easily detachable.

Table 1. *Ingredient Composition of Experimental Diets*

S/N	INGREDIENT	T_A (0%)	T_B (25%)	T_C (50%)	T_D (75%)
1.	Maize	36.50	36.50	36.50	36.50
2.	Wheat bran	20	20	20	20
3.	Palm kernel cake	20	20	20	20
4.	Soya beans cake	12	9	6	3
5.	Moringa oleifera leaf meal	0	3	6	9
6.	Groundnut cake	6	6	6	6
7.	Fish meal	3	3	3	3
8.	Bone meal	1	1	1	1
9.	Oyster shell	1	1	1	1
10.	Premix	0.25	0.25	0.25	0.25
11.	Salt	0.25	0.25	0.25	0.25
	Total	100.00	100.00	100.00	100.00
CALCULATED VALUES					
Crude Protein (CP) (%)		20.20	19.54	18.97	18.30
Metabolisable Energy (ME) (Kcal/DM kg)		2644.00	2656.55	2669.10	2681.66

$\mathbf{T_A}$ (0% MOLM), $\mathbf{T_B}$ (25% MOLM), $\mathbf{T_C}$ (50% MOLM) and $\mathbf{T_D}$ (75% MOLM)

General Sanitation and Health

Before the start of the study, cages, feeders, drinkers and the environment were washed and disinfected. This helped to eliminate cobwebs, dust, germs and parasites such mites which are disease agents, and also scare away predators like snakes. During the course of the work, the cages and rabbitory were cleaned daily to avoid accumulation of ammonia, which is toxic to the rabbits, while drinkers were washed daily and fresh water provided. The rabbitory was washed weekly with a disinfectant to eliminate odour. Antibiotics, dewormers and anti-stress medicines were administered to maintain the rabbits in good health.

Experimental Animals, Design and Management

Thirty-two mixed breed adult rabbits (24 does and 8 bucks), aged between 7-8 months, were allotted to the four experimental diets in a completely randomized block design, 8 rabbits (6 does and 2 bucks) per treatment housed individually in each cage. The animals had an adaptation period of 7 days. Feed and water were offered *ad libitum*.

Forages (elephant stalk) and Guatemala were fed alternatively in equal quantities (150g/day/animal) as supplements to the diets during the period of study.

Servicing

Rabbit does were introduced to the bucks for mating early in the morning, during the third week of the study. The ratio of bucks to does was 1:3 per week. Pregnancy was detected by abdominal palpation at the 14th day and a nest box was introduced in the cage of each pregnant doe on the 22nd day of the gestation period. The does were closely monitored to take note of stillbirth and immediate mortalities at kindling.

Data Collection

Growth Data

Each treatment feed was weighed weekly using a top scale balance of error 50g and kept in four separate bags one for each treatment feed. Each feed was constantly added in its corresponding feeder to maintain availability *ad libitum*. At the end of the week, the leftover was weighed and subtracted from the total given, to determine the feed intake on a weekly basis.

The rabbits were weighed as individuals. The weighing of the rabbits was done at the beginning of the experiment and subsequently on a weekly basis, usually in the morning (8:00-9:00am) when rabbits have empty stomachs. Weight gain was calculated as final weight minus initial weight

Reproductive Data

The mating and kindling date were registered. The percent conception (PC) was measured as the ratio of pregnant does to non-pregnant does multiplied by 100. The gestation length (GL) was read as the difference between date of last mating and kindling date. Litter size at birth (LSB) was measured by direct counting of kids immediately after kindling. Litter weight at birth (LWB) was measured by carefully transferring kits with gloved hands into the pan of a weighing scale, and their weight was read off from the scale. The average individual kit weight at birth was calculated as the ratio of the weight of litter at birth to the litter size. The average kid weight at weaning (AKW) was calculated as the litter weight at weaning divided by the litter size at weaning. The litter size at weaning was the number of fryers in each litter at the 5th week. The survival rate was calculated as the litter size at weaning divided by the litter size at birth multiplied by 100. Weekly records were kept of morbidity, mortality and clinical disease symptoms.

Chemical Analysis

The experimental diets and ingredients were analyzed for proximate composition using the standard methods of the Association of official Analytical Chemist (AOAC) (2000).

Data Analysis

All data collected were computed into Microsoft Office Excel version 2013 and analysed using the software GraphPad InStat Version 3.10 (2000). Kolmogorov-Smirnov test was used to test for normality. Parametric test Turkey-Kramer test was used for data normally distributed (ANOVA). Where data departed from normal distribution, a non-parametric test (Kruskal-Wallis test) was then used to compare groups for significant differences at 95% confidence interval.

Results and Discussion

The results of the proximate analyses (Table 2) revealed that the crude protein content (27.84%) of *Moringa oleifera* leaf meal in this study was higher than the 25.1% reported by Oduro et al. (2008) and Adeniji et al. (2012) (on air-cured basis) respectively, but lower than the 29.25% reported by Nuhu (2010) and 31.68% by El-badawi et al. (2014). The metabolisable energy (2918.40 Kcal/kg)) was lower than the value (33316.52 Kcal/kg) reported by Adeniji et al. (2012). The crude fibre content (11.79%) in this study was higher than the values (4.94 and 11.1%) reported by Adeniji et al. (2012) and El-badawi et al. (2014) respectfully but lower than 19.25% reported by Nuhu (2010). The differences in the chemical composition of *Moringa oleifera* leaf meal depend on the climatic conditions, age of the trees, season of harvesting, drying procedures and the method applied to have the final form of the product. This agrees with El-badawi et al. (2014).

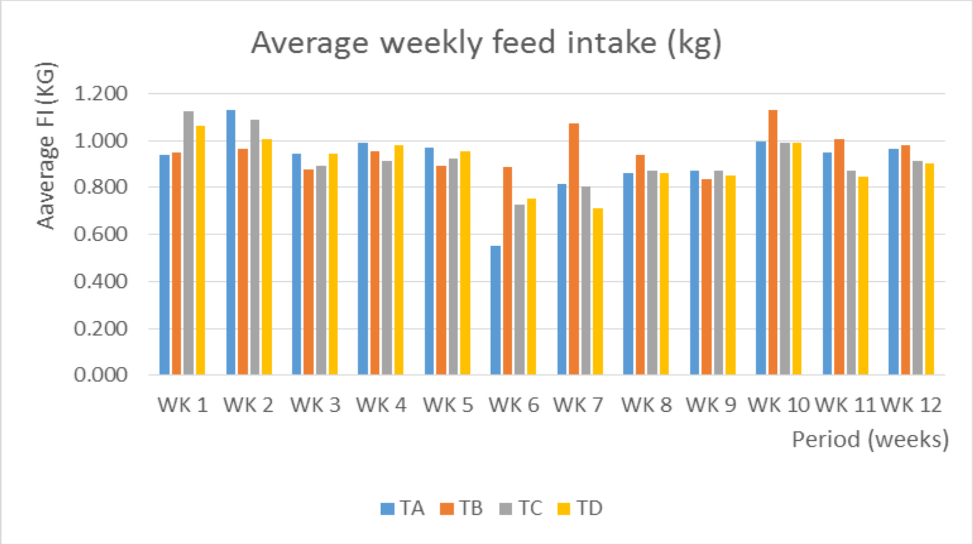
The crude protein content (%) of the experimental diets dropped with increased substitution of *Moringa oleifera* leaf meal but continued to fall within the range (15-18%) reported by Lebas (1987) as the nutrient requirements for rabbits, except T_A, which was slightly above the range. The drop was due to the fact that MOLM had a lower CP content than soya bean meal.

Table 2. *Proximate Analyses of Moringa oleifera Leaf Meal (MOLM) and Experimental Diets (T_A, T_B, T_C and T_D)*

Sample	DM (%)	CP*	ME (Kcal/DM kg)	CF*	EE*	Ash*
MOLM	93.08	27.84	2918.40	11.79	7.73	9.97
T_A	91.65	19.05	2833.30	11.47	3.22	6.74
T_B	93.21	17.42	2363.90	11.35	4.51	7.28
T_C	93.32	17.81	2407.90	16.40	4.42	8.11
T_D	92.36	16.81	2798.00	17.31	2.95	7.52

$\mathbf{T_A}$ (0% MOLM), $\mathbf{T_B}$ (25% MOLM), $\mathbf{T_C}$ (50% MOLM), $\mathbf{T_D}$ (75% MOLM)
*expressed in % of dry matter, DM = Dry Matter, ME = Metabolisable Energy, CP = Crude protein, EE = Ether extract, CF = Crude fibre, MOLM = Moringa oleifera leaf meal.

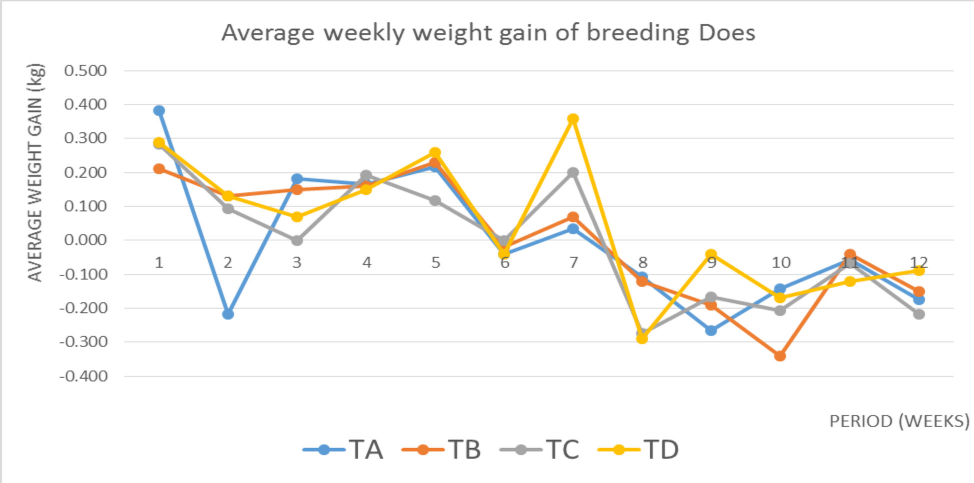
Figure 1. *Comparison of Average Weekly Feed Intake (kg) between Treatments and within Weeks of Adult Rabbits Fed Moringa oleifera Leaf Meal (MOLM) as a Substitute to Soya Bean Meal*



There was no significant difference (P>0.05) in the average weekly feed intake across the treatments and within the weeks as revealed in Figure 1. The values (0.904-0.954kg) obtained in this study were far above the values (0.539-600kg) reported by Etchu et al. (2012) who fed varying levels of brewers dried grain to weaner rabbits. Rabbits generally require high maintenance energy because of their high surface to body ratio which increases with age (Ahamefule et al., 2007). The increase in feed intake in this study could probably be due to the use of pellets fed to the animals instead of mash feed which increased the consumption by rabbits

Figure 2 reveals the average weekly weight gain of breeding does during the study. There was no significant difference (P>0.05) on the average weekly weight gain across the treatments and within the weeks. The dropped in weight gain observed on the 6^{th} week of study might be due to the fact that the animals spent most of their time preparing the nest box for kindling. Most of the forage offered was used to prepare a cushion for the litters. This agrees with the low feed intake recorded in week six. There was a negative weight gain recorded across the treatments between week 8 and 12 (lactation period) because some of the nutrients were used in the production of milk and the kids were feeding directly from the dam for breast milk. The weight gain was not constant during the lactation period and it depends on the litter size. The weight gain increased in week 11 because the kids were not completely dependent to the dam and they started feeding for themselves. The animals placed on MOLM base diets (T_B, T_C and T_D) had better average weekly weight gain compared to the control (T_A). Better performance with MOLM diets might be due a better protein quality as a result of higher methionine and lysine in MOLM than in soya bean meal. This agrees with Ufele et al. (2013).

Figure 2. *Comparison of Average Weekly Weight Gain (kg) between Treatments and within Weeks of Breeding Does Fed Moringa oleifera Leaf Meal (MOLM) as a Substitute to Soya Bean Meal*



Week 1-3 = feeding trial period, week 3-7 = Gestation period and week 8-12 = lactation period.

Figure 3. *Comparison of Average Weekly Weight Gain (g) between Treatments and within Weeks of Kids Fed Moringa oleifera Leaf Meal (MOLM) as a Substitute to Soya Bean Meal*

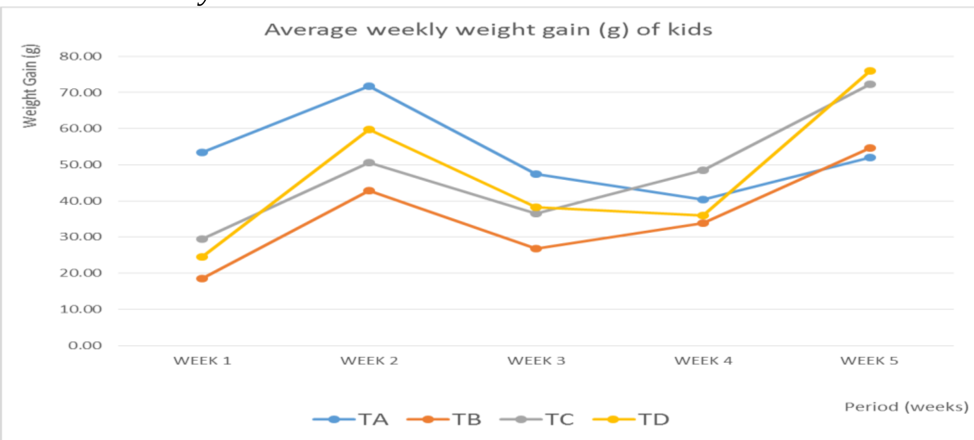


Figure 4. *Comparison of Average Survival Rate (%) between Treatments and within Weeks of Kids Fed Moringa oleifera Leaf Meal (MOLM) as a Substitute to Soya Bean Meal*

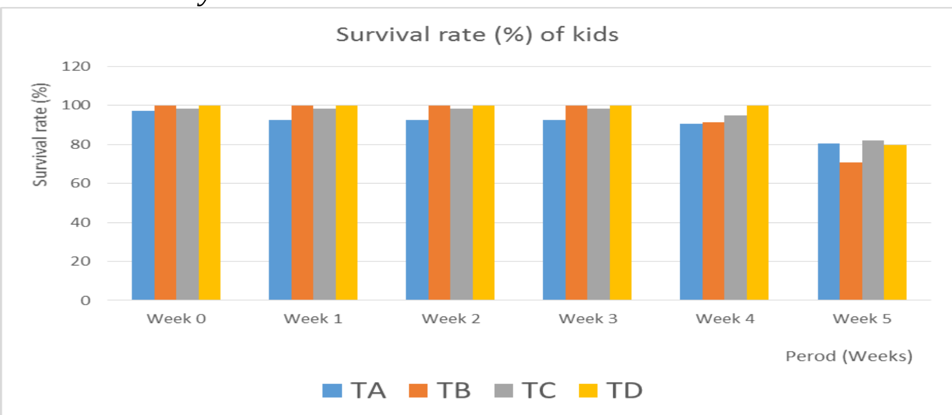


Table 3 revealed that animals placed on diets with 25% MOLM and 75% MOLM had a lower conception percentage (83.33%). The lower conception percentage might be as a result of unsuccessful mating or an intrinsic factor with one of the does in T_B and T_D. Other does placed in 50% MOLM (T_C) compete favorably with those on T_A (0% MOLM) base diets. Based on this fact, it can be predicted that MOLM had no negative implication on the rabbit does' conception. This agrees with the work of Amao et al. (2014).

The gestation length (GL) shows a significant difference ($P<0.05$) across the treatments but the value for the animals placed on 50% MOLM (T_C) had highest numerical value of 32.83. The GL ranges between 31.33 and 32.83.These values were higher than the GL observed by Amao et al. (2014) and slightly above the values (30.43-30.71) observed by Musa-Azara et al. (2014).

The average litter size at birth shows no significant difference ($P>0.05$) among the treatments but the animals placed on 75 % MOLM (T_D) had a higher numerical value of 7.60. This proved that the substitution of soya bean meal (SBM) with *Moringa oleifera* Leaf Meal (MOLM) had no negative influence on the litter size of rabbit does. This agrees with the work reported by Amao et al. (2014).

There was no significant difference ($P>0.05$) on the average weight of litters at birth. The animals placed in the treatments with MOLM had higher values compared to the control (T_A 0%) base diets. The same observation were made by Musa-Azara et al. (2014) who work on oral administration of Moringa seed on the reproductive performance of female rabbits. This result shows that there is a factor in MOLM that contributed to the increase in litter birth weight. This might be the availability of methionine and cysteine in Moringa leaf that is deficient in soya bean meal as documented by Terzungwe et al. (2013) reported by Ufele et al. (2013). Also, El-Badawi et al. (2014) reported that Moringa leaves might contain some photochemical compounds that enhanced dietary crude protein digestibility and absorption.

The average weaning weight of kids (5^{th} week after litter) ranged from 241.40-310.17g. The animals placed on 50% MOLM (T_C) had the highest value of 310.17g but shows no significant difference ($P>0.05$) across the treatments. The values recorded in this study were significantly higher than the values (160.17-225.08g) reported by Amao et al. (2014) at 6^{th} week of weaning. This might be due to increased substitution level of MOLM.

Figure 3 revealed that there was a significant difference among the treatments on the average weekly weight gain (g) of kids especially between the control T_A (0% MOLM) and T_B (25% MOLM).

The average survival rate of the Kids (Figure 4) increased with the increase substitution of MOLM, from T_A (0% MOLM) to T_D (75% MOLM) with T_D had the best survival rate. However, there were no significant differences across the treatments.

Table 3. *Summary of the Reproductive Performance of Breeding Does Fed Moringa oleifera Leaf Meal (MOLM) as a Substitute to Soya Bean Meal*

PARAMETER	**Performance per group**				
	T_A	**T_B**	**T_C**	**T_D**	**ANOVA**
Average weekly feed intake (kg)	0.914±0.040	0.957±0.024	0.915±0.032	0.904±0.030	P=0.672 P>0.05
Average initial weight of does (kg)	3.117±0.122	2.560±0.306	2.575±0.249	2.350±0.259	P=0.072 P>0.05
Average final weight of does (kg)	3.042±0.105	2.810±0.253	2.508±0.096	2.660±0.233	P=0.174 P>0.05
Number of serviced does	6	6	6	6	
Number of pregnant does	6	5	6	5	
Conception percentage (%)	100	83.33	100	83.33	
Gestation length (days)	31.33^{a}±0.211	31.80^{ab}±0.374	32.83^{b}±0.307	31.60^{ab}±0.245	P=0.022 P<0.05
Litter size at birth	44	35	44	38	
Average Litter size at birth	7.33±0.667	7.00±0.316	7.33±0.919	7.60±0.812	P=0.230 P>0.05
Average kid weight at birth (g)	47.33±7.517	61.40±3.487	71.00±7.729	62.60±3.723	P=0.085 P>0.05
Average kid weight at weaning (g)	305.00±28.350	241.40±16.594	310.17±38.345	297.20±28.246	P=0.390 P>0.05
Average weekly weight gain of kid (g)	53.03^{a}±3.986	35.31^{b}±4.456	47.50^{ab}±4.972	46.92^{ab}±5.701	P=0.045 P<0.05
Average survival rate of kids	90.89±2.283	93.69±4.409	95.03±2.657	96.63±3.368	P=0.076 P>0.05
Litter size at weaning	36	25	36	30	

^{ab} pairs with the same letter on the same row are not significantly different at P>0.05
T_A (0% MOLM), T_B (25% MOLM), T_C (50% MOLM), T_D (75% MOLM).

Conclusions

From the results obtained in this study, 91.67% of the rabbits' litter showed no significant differences in the litter size, average initial weight of litters, final weight of bunnies and the survival rate of bunnies. It can thus be concluded that *Moringa oleifera* Leaf Meal (MOLM) could substitute soya bean meal up to 75% without any detrimental effect on the reproductive performance of the rabbits. Treatment (T_C 50%) had the best performance, which could be recommended.

References

Adeniji, A. A. and Laval, M. (2012). Effect of replacing groundnut cake with *Moringa oleifera* leaf meal (MOLM) in the diets of grower rabbits. International Journal of Molecular Veterinary Research, 2(3): 8-13.

Ahamefule, F. O., Ibeawuchi, J. A., Ukweni, I. A. and Umunnakwe, D. U. (2007). Performance of weaner rabbits fed diet containing raw and processed pigeon pea meal (*Cajanus cajan*). *Journal of Animal and Veterinary Advances*, 6(6): 797-801.

Amaefule, K. U. and Obioha, F. C. (2005). Performance of pullet chick feed raw or processed pigeon pea (*Cajanus cajan*) seed meal diets. *Livestock Research for Rural Development*, 17(3).

Amaefule, K. U., Iheukewumere, F. C. and Nwaokoro C. C (2005). A note on the growth performance and carcass characteristics of rabbits fed graded dietary levels of boiled pigeon pea seed (*Cajanus cajan*) *Livestock Research for Rural Development*,17(5).

Amao, E. A., Jimoh, R. A. and Adeoli, T. M. (2014). Reproductive performance of rabbit does fed graded levels of *Moringa oleifera* leaf meal base diet. *International Journal of Sciences*, 3.

AOAC (2000). Association of Official Analytical Chemist. Official methods of analysis, 17th edition Washinton DC, USA.

El-Badawi, A. Y., Omer, H. A. A., Abedo, A. A. and Yacout, M. H. M. (2014). Response of growing New Zealand white rabbits to rations supplemented with different level of *Moringa oleifera* dry leaves. *Global Veterinaria*, 12(4): 573-582.

Etchu, K. A. (2004). Seasonal and processing effect of sweet potato diets fed to Broilers and Breed Cocks in the humid tropics. Ph.D. Thesis. University of Ibadan.

Etchu, K. A., Humbu, M. E., Ndamukong, K. J. N. and Agbor, E. B. (2012). Effect of varying levels of brewer's dried grain on the growth performance of weaner rabbits (*Oryctolagus cuniculus*). *Greener Journal of Agricultural Science*, 2 (6):237-245.

Lebas, F., Coudert P., Rouvier R., and Rochambeau H. D. (1986). The rabbit husbandry, health and production, In: AHPP Series No. 21, FAO, Italy.

Lebas, F. (1987). Reflection on rabbit nutrition with a special emphasis on feed ingredients utilization. Cuniculture, chemin de Lassȇre, 31450 Corronsac, France.

Musa-Azara, S. I., Jibrin, M., Hassan, D. I. and Yakubu A. (2014). Effect of oral administration of *Moringa oleifera* seed on blood chemistry and reproductive performance of female rabbits. International Journal of Agricultural Science and Veterinary Medicine, 2(1).

Nuhu F. (2010). Effect of Moringa leaf meal (MOLM) on nutrient digestibility growth carcass and blood indices of weaner rabbits. Thesis for M.S., Animal Science Department, Faculty of Agriculture and Natural Resources, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Oduro, I., Elis, W. O. and Owusu, D. (2008). Nutritional potential of two leafy vegetables: *Moringa oleifera* and *Impomea batatas* leaves. Scientific Research and Essay, 3(2): 57-60.

Olabanji, R. O., Farinu, G. O., Akinlade, J. A. and Ojebigi, O. O. (2007). Growth performance, organ characteristics and carcass quality of weaner rabbits fed different levels of wild sunflower (*Tithoma diversifolia Hems* (A. Gray) leaf-blood meal mixture. *Journal of Agricultural Research*, 2: 1014-1021.

PNUD (Programme des Nations Unies pour le Développement), 2006. Rapport sur la pauvreté rurale au Cameroun [Report on rural poverty in Cameroon]. Bureau de Yaoundé.

Tabot, J. E. (2016). Effect of processed pigeon pea (*cajanus cajan*) as substitute to maize on the growth performance of weaner rabbits. MSc. Thesis. Animal Science Department, Faculty of Agriculture and Veterinary Medicine, University of Buea, Cameroon.

Terzungwe Ahemen, Adakole H. Abu and Lois K. Iorgilim (2013). Physiological responses of rabbits fed graded levels of Moringa oleifera leaf meal (MOLM): Some aspects of haematology and serum biochemistry. Scholars Research Library Archives of Applied Science Research, 5 (2): 172-176 (http://scholarsresearch library.com/archive.html).

Ufele, A. N., Ebenebe, C. I., Igwe, I. I., Mojbo, T. C., Akeinne, F. C. and Aziagba, B. O. (2013). Drumstick tree (*Moringa oleifera*) leaf meal on the average weight gain of domestic rabbits (*Oryctolagus cuniculus*). The Bioscientist, 1(1): 106-112.