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PERFORMANCE AND SEMEN QUALITY OF RABBIT BUCKS FED *Moringa oleifera* LEAF MEAL DIET SUPPLEMENTED WITH GARLIC, GINGER AND BLACK PEPPER

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ABSTRACT

This study was carried out to evaluate the performance and semen quality of rabbit bucks fed *Moringa oleifera* (MOLM) diets supplemented with garlic, ginger and black pepper. The diets were formulated to contain 6% MOLM and supplemented with garlic, ginger or black pepper at 700g/100kg diet. 25 mature crossbred rabbit bucks were randomly allocated to five treatment groups in a completely randomized design in the study which lasted for three months. Results showed that the least feed intake ($p<0.05$) was obtained among bucks fed MOLM+BP based diet. Total feed intake decreased in the order Control>MOLM>MOLM+GR>MOLM+GG>MOLM+BP while daily feed intake was only significantly ($p=0.001$) greater on the control than MOLM+BP. Weight gain was similar for all treatment groups. Reaction time was significantly ($p<0.05$) longer in rabbit bucks fed MOLM+GR than those on the control, MOLM, MOLM+GG and MOLM+BP. Semen volume was significantly ($P<0.05$) higher among rabbits fed MOLM diet and least for those fed MOLM+GR diet. Compared to other rabbits sperm motility was significantly ($P<0.05$) lower in bucks fed MOLM and MOLM+GR diet. Spermatozoa concentration was significantly ($P<0.05$) higher among rabbits fed the control diet while others showed lower values. Spermatozoa morphology was similar for rabbits in all treatment groups except percentage live spermatozoa which was significantly ($P<0.05$) least among rabbits on MOLM+GR diet. It is concluded that supplementation of MOLM with garlic, ginger or black pepper significantly reduced sperm concentration and motility. It is recommended that Moringa should not be supplemented with garlic but rather with ginger or black pepper for higher libido and better sperm quality of rabbit bucks.

Keywords: Semen, Moringa, Garlic, Ginger, Black pepper.

INTRODUCTION

Nutrition plays a major role in the optimum expression of reproduction (Sudhir *et al*., 2010). Phytochemicals are natural bioactive and non-nutritive plant chemicals that have protective or disease preventive properties (Adesuyi*et al.*, 2012).Some amount of reactive oxygen species is needed for normal cell functions (Chandra *et al*., 2009). Excessive production of reactive oxygen species however, may overpower the body's natural antioxidant defense system, creating an environment unsuitable for normal physiological reactions (Al-Guboryet *al*., 2010). Oxidative stress is caused by an imbalance between pro-oxidants and antioxidants (Al-Guboryet *al*., 2010). Reactive oxygen species are a wide group of materials that oxidize DNA and cell

membrane causing infertility (Chi *et al*., 2008).

Spermatozoa contain high levels of polyunsaturated fatty acid which make them vulnerable to reactive oxygen species. There is a correlation between excessive generation of reactive oxygen species in the semen and infertility (Hsieh *et al*., 2006). Antioxidants are a group of compounds that resist against oxidant formation (Erguder*et al*., 2007). Antioxidants may mitigate or prevent generation of free radicals or reactive oxygen species (El-Demerdash*et al*., 2005; Ahmad *et al*., 2006; Ali *et al*., 2008).

The temperature comfort zone for rabbits is 15 to 20°C, as such rabbits can withstand cold weather better than warmer one (Sabah *et al*., 2016). Rabbits are more susceptible to high than low ambient temperatures especially in the tropics (Dyavolova *et al*., 2014). Temperature above the comfort zone can cause oxidative stress which can affect the fertility and other physiological traits of rabbits (Askar and Ismail, 2012).

Antioxidant supplementations in diets is a means by which rabbit reproduction can be improved (Mangiagili*et al*., 2012). Antioxidants have positive effects on productive and reproductive performance (Fazaeli and Talebian-Masoudy, 2009). *Moringa oleifera* leaf meal (MOLM) acts as a natural antioxidant due to the presence of compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (Anwar *et al.*, 2005). Garlic (GR) reduces lipid peroxidation and increases antioxidant defense mechanism in animals (Mansouri and Abdennour, 2011). Garlic scavenges reactive oxygen species by amplification of intercellular antioxidant enzymes such as superoxide dismutase, glutathione peroxidase and catalase (Corzo-Martínez *et al*., 2007). Ginger (GG) is also strong anti-oxidant substance which mitigate or prevent generation of free radicals (Ahmad *et al*., 2006; Ali *et al*., 2008). Ginger powderis reported to exert useful effect on spermatogenesis and sperm parameters (Shanoon, 2011). Ginger also has profertility properties (Morakinyo *et al*., 2008). Black pepper (BP) stimulates the digestive enzymes produced by the pancrease and intestines which increases biliary bile acid secretion thereby enhancing the bioavailabilty of nutrients like amino acids, vitamins, beta-carotene and selenium (Ahmad *et al*., 2006). It is also reported to increase gastric acid secretion (Manoharan *et al*., 2009), reduce oxidative stress (Muhtaseb*etal*., 2008) and enhance performance of animals (Abou-Elkhair*et al*., 2014). The study aims to evaluate the performance and semen qualityof rabbit bucks fed *Moringa oleifera* leaf meal diet supplemented with garlic, ginger or black pepper.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Rabbitry Unit of the Swine and Rabbit Research Programme, National Animal Production Research Institute (NAPRI), Shika, Zaria. NAPRI is located in the Northern Guinea Savanna ecological zone (10°11´ N, 7°8´E, 650 m above sea level). The area receives an annual rainfall of 1100 mm between April to October (wet season). The mean minimum and maximum temperatures are 20 and 34°C, respectively (Iyeghe-Erakpotobor *et al*., 2006).

Source and Processing of Test Ingredients

Fresh garlic (GR), black peppe (BP) and *Moringa oleifera* leaf meal (MOLM) were sourced from Sokoto central market while fresh ginger (GG) was purchased at Sabon Gari market, Zaria. The GR, GG, BP and MOLM were obtained fresh, sun dried and ground.

Experimental Animals, Housing and Experimental Design

Twenty- five crossbred mature (age between 6 and 7 months) rabbit bucks of similar weight (1580 ± 110 g) were used for the experiment. The bucks were individually housed in metal cages of 0.6m x 0.5m x 0.4m. There were five treatments with five bucks per treatment arranged in a completely randomized design. The experiment lasted for three months (July to September, 2016).

Management of Rabbit Bucks

The rabbits were quarantined for two weeks before the onset the experiment. During the quarantine period, 1g Oxytetracycline antibiotic powder and 1g Vitalyte powder were administered to the rabbits via drinking water for five days against possible bacterial infections and to alleviate stress. Thereafter, 3 mg of ivermectin tablet per rabbit was dissolved in 5 ml of clean fresh water and a 5 ml syringe was used to drench the rabbits against internal and external parasites. Embaxin Forte ® was administered against coccidiosis at 0.6g per litre of water for three days.

Experimental Diets and Procedure

Five diets were formulated with diet one having no *Moringa oleifera* leaf meal (MOLM) or spices (Control). Diet two had 6% MOLM without supplementation of spices while diet three had 6% MOLM with supplementation of garlic (GR) at 700g/100kg diet. Diet four had 6% MOLM with supplementation of ginger (GG) at 700g/ 100kg diet. Diet five had 6% MOLM with supplementation of black pepper at 700g/100kg dirt. .The gross composition and calculated analyses of the experimental diets is shown in table 1. The bucks were offered 150g feed/buck daily in the morning at 08.00 and 50 g/buck of *Brachiaria decumbens* hay in the evening. Left over feed was measured daily before feeding. Clean water was offered ad libitum daily. The rabbit bucks were weighed at the onset of the study and fortnightly.

Table 1: Composition of experimental diets fed to rabbit bucks

Ingredient (%)	**Control**	**MOLM**	**MOLM+GR**	**MOLM+GG**	**MOLM+BP**
Maize	48	50.5	50.5	50.5	50.5
Wheat offal	30.2	22.2	22.2	22.2	22.2
MOLM	-	6	6	6	6
Soya cake	18	17.5	17.5	17.5	17.5
Salt	0.25	0.25	0.25	0.25	0.25
Bone	2.8	2.8	2.8	2.8	2.8
Lysine	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
*Mineral/vitamin premix	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100** *+700g GR*	**100** *+700g GG*	**100** *+700g BP*
Calculated Analyses					
ME (Kcal/Kg)	2707	2705	2705	2705	2705
CP (%)	18.35	18.46	18.46	18.46	18.46
Ether Extract (%)	3.61	4.10	4.10	4.10	4.10
Crude Fibre (%)	4.70	4.58	4.58	4.58	4.58
Calcium (%)	1.08	1.15	1.15	1.15	1.15
Available P (%)	0.66	0.67	0.67	0.67	0.67
Methionine (%)	0.52	0.52	0.52	0.52	0.52
Lysine (%)	1.13	1.13	1.13	1.13	1.13

*Bio-mix Broiler starter premix supplied per kg of diet: vitamin A: 5,000 I.U.; Vit D3: 1,000 I.U.; Vit E: 20mg; Vit K3: 1mg; Vit B1: 0.2mg; Vit B2: 2.4mg; Vit. B6: 2.4mg; Niacin: 16mg; Calcium Pantothenate: 4mg; Biotin: 0.032; Vit B12: 0.01mg; Folic acid: 0.4mg; Choline Chloride: 120mg; Manganese: 40mg; iron: 5mg; Zinc: 18mg; Cobalt: 0.1mg; Iodine: 0.62mg; Selenium: 0.04mg. MOLM= *Moringa oleifera* leaf meal; GR= Garlic; GG= Ginger; BP= Black pepper. Available P= Available Phosphorous.

Reaction Time
Reaction time (libido) was determined as the time lapse between the introduction of the teaser doe into the buck's cage and collection of the ejaculate (Luzi*et al*., 1996; El-Harairy*et al*., 2016).

Semen Collection
The bucks were trained for semen collection using artificial vagina for a period of two weeks prior to semen collection. Semen was collected forthnightly between 8 and 10 a.m with an artificial vagina using a teaser non-pregnant mature rabbit doe. The collection was done for a period of three months for each of the experiments.

Semen Analyses
Immediately after collection the semen pH was examined using a 1-14 graded pH paper inserted in to the semen and the corresponding colour changes were observed and recorded. Semen volume was monitored from the graduated collection tube. The colour was observed as creamy (very good) = 1; milky (good) = 2 and watery (poor) = 3. Also, for each collection, gross motility was immediately examined using a drop of undiluted semen on a pre-warmed slide under a light microscope at ×100 magnification. There after the samples were carried to the laboratory for further analyses. For sperm concentration, Micropipette was used to aspirate 10 µl of semen and diluted with 1 ml of 3% NaCl. The exterior of the pipette was wiped to remove any adhering semen. A cover slip was placed on the haemocytometer and one drop of the diluted semen was placed under the cover slip on one side of the haemocytometer and counted in the cell counting chamber (Azawi and Ismaeel 2012).

A thin smear of each semen sample, on clean grease-free glass slide and stained with eosin-negrosin was done for the determination of % live sperm and sperm abnormalities. One hundred sperm cells were counted per slide using hand counter tally under light microscopy at ×40 magnification. Five cell types were recorded: normal cell, detached head, free tail, coiled tail and bent tail (Rekwot *et al.*, 1987). Morphology of sperm cells, dead and live sperm was viewed in stained slides under a microscope at magnification of ×100 (Hafez, 1986).

Data Analyses
Data obtained were analyzed using the general linear model procedure of SAS while means separation was done using pairwise difference method (SAS, 2001).

RESULTS AND DISCUSSION

Performance of Rabbit Bucks Fed MOLM Diets with and without Supplementation
Table 2 shows the performance of rabbit bucks fed MOLM based diets with or without supplementation with garlic, ginger or black pepper. Rabbit bucks showed similar (P>0.05) weight gain across all treatment groups. Onuand Aja (2011) reported that garlic and ginger supplementation produced significant effects on weight gain, feed intake and feed conversion ratio of rabbits. It is however not unlikely that the significant difference (P>0.05) on weight gains among rabbits in all treatments could be due to their age as they were mature and probably not actively growing. Total feed intake of rabbits decreased in the order Control>MOLM>MOLM+GR>MOLM+GG> MOLM+BP. Daily feed intake was significantly (P<0.01) greater for rabbits on the control diet than those MOLM+BP based diet. The significantly (P<0.05) lower total feed intake obtained among the MOLM fed bucks compared those fed the control diet disagrees with the reports of Ewuola *et al*. (2012) and El- Tazi (2012). The authors reported increased feed consumption among rabbits and chickens on diets containing MOLM. These differences might be attributed to the age and or species of animals used in this study. Reduction in feed intake with garlic ginger and black pepper supplementation on MOLM diets could be indicative of pungency to taste.

Table 2: Performance of Rabbit Bucks Fed MOLM or MOLM Diets Supplemented with Garlic, Ginger or Black Pepper

Parameter	Control	MOLM	MOLM+GR	MOLM+GG	MOLM+BP	SE	P
IW (g)	1780	1600	1738	1810	1600	219.75	0.56
FW (g)	2160	2100	2020	2020	1990	312.05	0.95
TWG (g)	380	500	282	210	390	235.81	0.52
ADG(g)	4.6	6.0	3.4	2.5	4.6	2.81	0.52
TFI (g)	9070^{a}	8580^{b}	8250^{bc}	8140^{c}	7120^{d}	210	0.01
DFI (g)	110^{a}	102^{ab}	100^{ab}	100^{ab}	83^{b}	12.46	0.01

^{abc}Means across rows with different superscripts are significantly different (P<0.05); IW= Initial Weight;. FW= Final weight; TWG= Total Weight Gain; ADG= Average Daily Gain; TFI= Total Feed Intake; DFI= Daily Feed Intake SE= Standard Error; P.= Probability.

Reaction Time and Semen Characteristics and of Rabbit Bucks fed MOLM Based Diets with or without Supplementation of Garlic, Ginger or Black Pepper

Table 3 shows the reaction time and semen characteristics of rabbit bucks fed MOLM based diets with or without supplementation of garlic, ginger or black pepper. Reaction time was significantly (P<0.05) longer among rabbits fed MOLM+GR compared to those on the control, MOLM, MOLM+GG and MOLM+BP. The significantly shorter reaction time observed for the MOLM fed bucks compared with the MOLM + GR fed bucks could be related to the report of Hammami *et al*., (2008) that garlic compromise testosterone level which is essential for enhancing libido/reaction time in male animals. MOLM improve reaction time through enhancement of testosterone level by reducing corticosterone level (Prabsattroo *et al*., 2015). Black pepper contains piperine which increases plasma testosterone levels (Vijayakumaar and Nalini, 2008), resulting to increased libido in bucks.

Semen volume was significantly (P<0.05) higher among rabbits on MOLM based diet and least for those fed diet containing MOLM+GR. *Moringa* induces spermatogenesis which may be due to its tendency to relatively increase testicular and epididymal weights (Cajuday and Pocsidio, 2010). Unlike rabbits fed the control diet there was significantly (P<0.05) higher semen volume observed among rabbits fed MOLM based diet. This could be attributed to reports that MOLM increases sperm count which adds to semen volume (Priyadarshani and Varma, 2014). It is expected that the addition of these phytogenics to *Moringa* leaf meal might increase semen volume. However this was not the case observed in this study. This could imply that spices may have semen volume lowering potential.

Sperm motility was significantly (P<0.05) lower in bucks fed MOLM and MOLM+GR based diets compared to others. This disagrees with the report of Priyadarshani and Varma (2014) who stated that MOLM increased spermatozoa motility in mice. This could be as a result of differences in species of animals used. The significantly (P<0.05) higher spermatozoa motility among rabbits fed MOLM+GG and MOLM+BP based diets compared to those on diets containing MOLM and MOLM + GR compared with the MOLM and MOLM+GR could be related to the study of Khaki *et al*. (2012) and Arash *et al.* (2009) that ginger increased sperm motility in male rats. Other studies have shown that sperm motility increased in cocks fed diets containing ginger (Saeid*et al*., 2011). Mice treated with piper species were also reported to have increased spermatozoa motility (Mohammadi *et al*., 2013).

Spermatozoa concentration was significantly (P<0.05) higher among rabbits on the control diet compared to others. The significantly (P<0.05) lower spermatozoa concentration observed among rabbits in treatments apart from the control inconsistent with the report of Priyadarshani and Varma (2014) .The authors reported that spermatozoa concentration increased in male mice fed diet containing MOLM. This could be as a result of species difference or duration of feeding. Salah *et al*. (2014) observed significant (P<0.05) increase in spermatozoa concentration of mice on diet containing garlic. Shinkut *et al*., (2016) also reported that inclusion of garlic at 2.5 and 5.0% improved sperm concentration in rabbit bucks.

Table 3: Semen Characteristics and Reaction Time of Rabbit Bucks fed MOLM, MOLM Supplemented with Garlic, Ginger or Black Pepper

Parameter	Control	MOLM	MOLM+ GR	MOLM+ GG	MOLM+ BP	SE	P
Reaction time (sec.)	26^{a}	23^{a}	52^{b}	31^{a}	35^{a}	10.9	0.05
Semen Colour	2.1	2.2	2..4	2.1	2.1	1.41	0.37
Semen volume (ml)	1.1^{b}	1.3^{a}	0.9^{d}	1.0^{c}	1.0^{c}	0.04	0.02
Semen motility (%)	81.2^{a}	68.7^{b}	60.6^{b}	72.4^{a}	79.9^{a}	5.6	0.04
Semen pH	7.8	7.5	7.8	7.6	7.4	0.55	0.23
Sperm Conc. ($x10^{6}$)	199^{a}	134^{b}	139^{b}	163^{b}	149^{b}	16.2	0.03

^{abc}Means across rows with different superscripts are significantly (P< 0.05) different. SE= Standard Error; P= Probability. Conc = Concentration.

Spermatozoa Morphology of Rabbit Bucks fed MOLM Based Diets with and without Supplementation with Garlic, Ginger or Black Pepper

Table 4 shows the spermatozoa morphology of rabbit bucks fed MOLM based diets with and without supplementation with garlic, ginger or black pepper. Spermatozoa morphology did not show significant (P<0.05) difference among rabbits in all treatment groups except for percentage live spermatozoa. Percentage live spermatozoa was least (P<0.05) among rabbits on MOLM+GR diet than the other treatments. It would appear as if garlic has a depressing effect on live spermatozoa based on the result of this study. However, Matthew (2009) reported that inclusion of garlic at 2.5 and 5% levels in rabbit bucks diet had no significant effect on the percent live spermatozoa. This difference might be because of the interaction garlic with MOLM as lower level (0.7%) supplemental garlic was used in this study. The high percentage live spermatozoa observed in this study is at variance with the report of Dalal *et al*., (2013) who observed that black pepper powder significantly showed anti-spermatogenic and anti-fertility effects in orally treated male mice.

Table 4: Spermatozoa Morphology of Rabbit Bucks fed MOLM, MOLM Supplemented with Garlic, Ginger or Black Pepper

Parameter	Control	MOLM	MOLM+GR	MOLM+GG	MOLM+BP	SE	P.
Live (%)	83[a]	77[a]	69[b]	76[a]	77[a]	3.19	0.02
NC (%)	87.8	86.8	83.1	86.1	88.4	2.80	0.55
DH (%)	4.7	5.0	4.8	5.6	4.2	1.50	0.43
FT (%)	3.8	3.9	4.7	5.2	3.2	1.52	0.19
CT (%)	0.7	0.7	1.0	0.5	0.9	0.69	0.91
BT (%)	2.9	3.2	2.5	2.7	3.3	1.20	0.90
MPD (%)	0.1	0	0.2	0	0	0.12	0.48

[abc]Means across rows with different superscripts are significantly ($P \leq 0.05$) different. NC= normal cells; DH= Detached Head; FT= Free Tail; CT= Coiled Tail; BT= Bent Tail; MPD = Midpiece Droplet.SE= Standard Error; P. = Probability.

CONCLUSION

Based on the results obtained in this study, it is concluded that supplementation of MOLM with garlic, ginger or black pepper significantly reduced sperm concentration. Also, 6% MOLM + 700g GR significantly increased reaction time, reduced sperm motility and depressed % live spermatozoa. Garlic supplementation at 700g in diet containing *Moringa oleifera* leaf meal depressed semen quality more than ginger and black pepper. It is however recommended that 6% MOLM should not be supplemented with garlic as the MOLM+GR bucks but rather with 700g ginger or 700g black pepper for higher libido and better sperm quality of rabbit bucks.

REFERENCES

Abou-Elkhair, R., Ahmed, H.A and Selim, S (2014). Effects of Black Pepper (*Piper nigrum*), Turmeric Powder (*Curcuma Longa*) and Coriander Seeds (*Coriandrum sativum*) and their Combinations as Feed Additives on Growth Performance, Carcass Traits, Some Blood Parameters and Humoral Immune Response of Broiler Chickens. *Asian-Australian Journal of Animal Science*, 27(6):847–854. doi: 10.5713/ajas.2013.13644.

Adesuyi, A.O., Elumm, I.K., Adaramola F.B., and Nwokocha, A.G.M (2012). Nutritional and Phytochemical Screening of *Garcinia kola*, *Advance Journal of Food Science and Technology*, 4(1): 9-14.

Ahmad, N., Sulaiman, S., Mukti, N. A., Murad, N. A., Hamid, N. A. A., Yusof, Y. A. M. (2006). Effects of Ginger Extract (*Zingiberofficinale* Roscoe) on Antioxidant Status of Hepatocarcinoma induced Rats. *Malaysian Journal of Biochemistry and Molecular Biology*, 14:7–12.

Al-Gubory, K. H, Fowle, P. A and Garrel, C (2010). The roles of cellular reactive oxygen species, oxidative stress and antioxidants in pregnancy outcomes. *International Journal of Biochemistry and Cell Biology*, 42:1634–1650.

Ali, B. H., Blunden,G., Tanira, M. O and Nemmar, A (2008). Some Phytochemical,Pharmacological and Toxicological Properties of Ginger (*Zingiberofficinale* Roscoe): A review of Recent Research. *FoodChemical Toxicology*, 46(2):409–20.

Anwar, F., Ashraf, M and Bhanger, M.I (2005). Interprovenance Variation in the Composition of *Moringa oleifera* Oilseeds from Pakistan. *Journal of American Oil Chemical Society*, 82: 45–51.

Arash, K., Fatemeh, F., Mohammad, N., Amir, A.K., Chelar, C.O., Marefat, G. and Mohammad, H (2009). The Effects of Ginger on Spermatogenesis and Sperm Parameters of Rat. *Iranian Journal of Reproductive Medicine*, 7 (1): 7 – 12.

Askar, A. A and Ismail, E. l.I (2012). Impact of Heat Stress Exposure on Some Reproductive and Physiological Traits of Rabbits Does. *Egyptian Journal of Animal Production.* 49(2):151-159.

Azawi, O. I. and Ismaeel, M. A. (2012). Effects of seasons on some semen parameters and bacterial contamination of Awassi ram semen. *Reproduction in Domestic Animals*, 47: 402-406.

Cajuday L. A. and Pocsidio, G (2010). Effects of *Moringa Oleifera* Lam. on theReproduction of Male Mice (*Mus musculus*). *Journal of Medicinal Plant Research*. 4(12): 1115-1121.

Chandra, A., Surti, N., Kesavan, S and Agarwal, A. (2009). Significance of Oxidative Stress in Human Reproduction. *Arch Med*; 5:528–542.

Corzo-Martínez, M., Corzo, N and Villamiel, M (2007). Biological Properties of Onions and Garlic. *Trends in Food Science and Technology*, 18:609-625.

Dalal, P. K. Tripathi,A and Gupta, S. K (2013). "Vajikarana: Treatment of Sexual Dysfunctions Based on Indian Concepts," *Indian Journal of Psychiatry*, 55 (Suppl 2): S273 - S276.

Dyavolova, M., Gudev. D., Yanchev, I., Moneva, P., Marinova, P and Popova, T (2014). Effect of Acute Heat Stress on Some Hematological Parameters, Trace Elements and Meat Quality In Rabbits. Proceedings of the International Symposium on Animal Science, September 2014, Belgrade-Zemun. 417-422pp.

El -Demerdash, F. M., Yousef, M.I and Abou El Naga, N.I. (2005). Biochemical study on the hypoglycemic effects of onion and garlic in alloxan-induced diabetic rats. *Food Chemistry Toxicology*, 43:57-63.

El-Harairy, M. A.; Sh. M. Shamiah and A. E. Ghodaia (2016). Influence of Oral Whole Extract from *Moringa Oleifera* on Semen Characteristics of Rabbits. *Journal of Animal and Poultry Production, Mansoura University*, 7 (6): *217 – 224.*

Erguder, B., Avci, A., Devrim, E and Durak, I (2007). Effects of cooking techniques on antioxidant enzyme activities of some fruits and vegetables. *Turkish Journal of Medical Science*, 37:151-156.

Ewuola, E.O., Jimoh, O.A., Atuma, O.V and Soipe ,O.D. (2012). Haematological and Serum Biochemical Response of Growing Rabbits Fed Graded Levels of *Moringa oleifera* Leaf Meal. Proceedings 10th World Rabbit Congress – September 3 - 6, 2012– Sharm El- Sheikh –Egypt, 679 – 683

Fazaeli, H and Talebian-Masoudy, A. R (2009). Effect of selenium and vitamin E supplement on the performance of sheep in central Iran. FAO/IAEA International symposium on sustainable improvement of animal production and health. 8-11 June synopses Vienna, Austria 45- 46.

Hafez, E. S. E. (1986). Reproduction in Farm Animals.PublisherPhiladelphia: Lea &Febiger, 85-189

Hammami, I., Nahdi, A., Mauduit C., Benahmed, M., Amri, M., Amar, A.B., Zekri, S., El May, A and El May M.V (2008). The inhibitory effects on adult male reproductive functions of crude garlic (*Allium sativum*) feeding. *Asian Journal of Andrology*, 10(4): 593 – 601.

Hsieh Y, Chang C, Lin C (2006). Seminal malondialdehyde concentration but not glutathione peroxidase activity is negatively correlated with seminal

concentration and motility.*International Journal of Biological Sciences,* 2:23-29.

Iyeghe-Erakpotobor, G.T., Oyedipe, E.O., Eduvie, L. O and Ogwu, D (2006).

Nutrient digestibility of rabbit does in different stages of reproductive cycle under tropical conditions. *Journal of Animal Physiology and Animal Nutrition*, 91: 74–82. DOI: 10.1111/j.1439-0396.2006.00645.x

Khaki, A., Farnam, A., Davatgar, B. A. and Nikniaz, H.(2012). Treatment effects of onion (*Allium cepa*) and ginger (*Zingiberofficinale*) on sexual behavior of rat after inducing an antiepileptic drug (Lamotrigine). *Balkan Medical Journal,* 29:236-242.

Luzi, F., Maertens, L., Mijen, P and Pizzi, F (1996). Effect of feeding level and dietary protein on libido and semen characteristics of bucks. Proceedings of 6th World Rabbit Congress, July, Toulouse, France, pp 87-92.

Mangiagili, M.G., Cesari, V., Cerolini, S., Luzi, F and Toschi, I (2012). Effect of Lycopene supplementation on semen quality and reproductive performance in rabbit. *World rabbit Science*, 20:141-148. Doi:10.4995/wrs.2012.1160.

Manoharan, S., Balakrishnan, S., Menon, V.P., Alias, L.M and Reena, A.R (2009). Chemopreventive efficacy of curcumin and piperine during 7, 12-dimethylbenz[a]anthracene-induced hamster buccal pouch carcinogenesis. *Singapore Medical Journal,* 50: 139-146.

Mansouri , O and Abdennour, C (2011).Evaluation of the therapeutic efficiency of raw garlic onreproduction of domestic rabbits under lead induced toxicity. *Annals of Biological Research*, 2 (3):389-393.

Matthew, S (2009). Semen Characteristics, Gonadal Sperm Reserves and Haematological Parameters of Rabbit Bucks Fed Diets Supplemented with *Allium Sativum* (Garlic). A Master of Science Dissertation, Department of Theriogenology and Production, Ahmadu Bello University, Zaria, Nigeria.

Mohammadi, F., Nikzad, H., Taherian, A., Mahabadi, J.A and Salehi, M (2013). "Effects of herbal medicine on male infertility," *Anatomical Science*, 10(4): 3-15.

Morakinyo, A.O., Adeniyi, O.S and Arikawe, A.P (2008). Effects of *Zingiberofficinale* on Reproductive Functions in the Male Rat. *African Journal of Biomedical Research*, 11: 329-334.

Muhtaseb, M.S., El Talwar, D., Duncan, A., St J O'reilly. D., Mckee, R.F., Anderson, J.H and Foulisa, F.I.G (2008). Free radical activity and lipid soluble anti-oxidant vitamin status in patients with long-term ileal pouch-anal anastomosis. *Colorectal Disease*, 11: 67-72.

Onu P. N and Aja, P.M (2011). Growth performance and Heamatological indices of Weaned Rabbits fed Garlic (*Allum Sativum)* and Ginger (*Zingiberofficinale*) Supplemented diets. *International Journal of food Agriculture and Veterinary Science*, 1 (1): 51-59.

Prabsttroo, T., Jintanaporn, W., Sitthichai, I., Pichet, S., Opass, S., Wipawee, T and Supaporn, M (2015). Moringa oleifera extract enhances sexual performance in stressed rats. J. Zhejiang Univ. Sci B 16 (3): 179-190. Doi: 10.1631/jzus.B1400197.

Priyadarshani, N and Varma, M.C (2014). Effect of *Moringa oleifera* leaf powder on sperm count, histology of testis and epididymis of hyperglycaemic mice Mus musculus. *American International Journal of Research in Formal, Applied & Natural Sciences*, 7(1): 7-13.

Rekwot, P. I., Voh Jr., A. A., Oyedipe, E. O., Opaluwa, G. I., Sekoni, V. O. and Dawuda, P. M (1987). Influence of season on characteristics of the ejaculate from bulls in an artificial insemination center in

Nigeria. *Animal Reproductive Science*, 14:187-194.

Saeid, J.M., Shanoon, A.K and Marbut, M.M (2011). Effects of *Zingiberofficinale*Aqueous Extract on Semen Characteristic and Some Blood Plasma, Semen Plasma Parameters in the Broilers Breeder Male. *International Journal of Poultry Science*, 10 (8): 629-633.

SAS (2001). Statistical Analysis user guide version 8. SAS institute Inc. Carry, North Carolina U.S.A.

Sabah, A.H.A andDalal, A. A B (2016). Effect of the Thermal Changes on Physiological, Biochemical and Histological Traits In Pregnant and Embryo of New Zealand White Rabbits. *International journal of Advanced Biological Research*. 6(2): 313-327.

Salah, M. M. A., Rashaa, F. A. and Dalia, A. S. (2014). Physiological and histological effect of aqueous and alcoholic extract of garlic (*Allium sativum*) on testicular function of albino male mice treated with lead acetate. *Journal of Biotechnology Research Centre (*Special edition), 8(2): 41-48

Shinkut, M., Rekwot, P. I., Nwannenna, I, A and Bugau, J. S.(2016). Spermiogram of Rabbit Bucks Fed Diets Supplemented with *Allium sativum* (garlic). *IOSR Journal of Agriculture and Veterinary Science*, 9 (2 Ver. II): 20-26.

Shanoon, A.K (2011). Effects of *Zingiberofficinale*Powder on Semen Characteristic and Blood Serum Sex Hormones Concentration in Broilers Breeder Male. *International Journal of Poultry Science*, 10 (11): 863-866.

Sudhir, K., Pandey,A.K., Mutha, M and Razzaque W.A.A (2010). Role of BetaCarotene/Vitamin A in Animal Reproduction. *Veterinary World*, 3(5): 236-237.

Vijayakumar, R.S and Nalini (2008). Piperine an active principle from *Piper nigrum*, modulates hormonal and apolipoprotein profiles in hyperlipidemic rats. *Journal of Basic Clinical Physiology and Pharmacology*. 17: 71 – 88.