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Anti-Endo Parasitic Effects of Garlic (*Allium sativum*) as Supplement in the Diets of Rabbits Reared under Deep Litter System

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ABSTRACT

This study was carried out to determine anti-endo parasitic effects of garlic (Allium sativum) in the diets of male (buck) and female (doe) weaner rabbits reared under deep litter system. Twenty-four cross bred weaner (8 weeks old) rabbits comprising twelve each of bucks and does were randomly allocated according to sex and feed supplement (conventional anticoccidia drug and garlic) in a 2x2 factorial arrangement. Data were collected on growth performance, faecal microbial population and carcass yield and analysed using ANOVA. Result showed that neither sex nor feed supplement had significant (P>0.05) effect on the growth performance of weaner rabbits. Coccidial load was progressively and completely eliminated in bucks and does from the baseline population of 1680epg and 600epg, respectively with rabbits fed diet supplemented with garlic. Also, does fed diet supplemented with commercial coccidiostat had complete coccidial load elimination from 5200epg at 8th week to the 16th week. Helminthic load (3800epg) recorded with bucks fed diet supplemented with garlic at the beginning of study were totally eliminated at the end of the study (56d). Helminthic load reduced from 6450epg at base line (0 week) to 950epg in the 4th week and was totally eliminated at 56d with bucks fed diet supplemented with the commercial coccidiostat. From the finding of this study, it could be concluded that sex, garlic or conventional anti-coccidiostat had no effect on growth performance and carcass yield of rabbits. However, garlic could be used as natural additive in rabbit production without adverse effects on growth and carcass yield where effective preventive measure for helminth and coccidiosis is paramount in deep litter housing type.

Keywords:coccidiosis; commercial coccidiostat; garlic; helminth,; rabbit

INTRODUCTION

Rabbits, beside their use as laboratory animals are equally reared for a variety of commercial purposes: for their meat and fur (wool). Rabbit meat production among other products has developed into an important industry that attracts high economic returns to the rabbit farmers (Samkol and Lukefahr, 2008; Fanatico and Green, 2012). Often times, the returns are affected by the outbreak of various diseases such as coccidiosis and helminths. Coccidiosis is mainly observed in animals that are managed under intensive production system (Amy, 2005). Coccidiosis is caused by Eimeriaspp, and it results in tremendous economic losses in poultry industry worldwide. Currently, it is an emerging disease of increasing economic importance in commercial rabbit production (Liciou*set al*., 1992; Kusto*set al*., 2003; Szendro*et al*., 2009).

Healthy rabbits often may be carriers of the organism (Eimeria) causing coccidiosis, but show no symptoms of the disease. The severity of the disease depends on the number of oocysts ingested by the rabbit. The entrance ofEimeria spores into the intestinal and liver cells ofyoung rabbit scauses cells to malfunction and expand in size.

Erosion and ulceration occur in the epithelial lining of the intestine, which result in poor absorption of nutrients, electrolyte imbalance, anemia and dehydration of the cells. Consequently, reduced appetite, depression, abdominal pain, retarded growth, diarrhea and pale mucous membranes ensue. Feaces may contain blood or mucous particularly in young rabbit (Amy, 2005). Similarly, helminths or worms are common parasites in the digestive tract of livestock including poultry and rabbit and result in high economic loss or marginal profit (Besier*et al.*, 2003).

Studies have shown that the continuous and indiscriminate use of drugs have caused a growing problem of parasite resistance to conventional commercial treatments (Devendra*et al*., 2006). However, plant essential oils (and/or active components) can be used as alternatives to conventional commercial anti-hel¬minth and anti-coccidial drugs. Garlic has been used to treat animals that suffer from gastrointestinal parasitism (Guarrera, 1999). There are
numerous reports indicating the efficacy of garlic in the prevention and treatment of a variety of diseases and for validating its traditional uses. For instance, garlic has

been described to exhibit antimicrobial activity (Chowdhury *et al*., 1991; Yoshida *et al*., 1998; Fleischauer*et al*., 2000), antitumor activity (Sundaram and Milner, 1996; Karasaki*et al*., 2001), as well as antithrombotic, antiarthritic, hypolipidemic, and hypoglycemic activities (Duraka*et al*., 2002; Kumar *et al*., 2003). Moreover, garlic has been reported to be effective against diverse parasites such as Amoeba (Peyghan*et al*., 2008). However, there is dearth of information on use of garlic supplement in the prevention and control of coccidiosis and worms in male and female weaner rabbits. This is therefore the focus of this study.

MATERIALS AND METHODS

Study location

The study was carried out at the Rabbit Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture Abeokuta, Ogun state, Nigeria. The site is located in the rain forest vegetation zone of south-western Nigeria on latitude7˚ 13' 49.46" N, longitude 3˚ 26' 11.98" E and at an altitude of 76m above sea level. The climate is humid with a mean annual rainfall of 1037mm and mean temperature and humidity of 27˚C and 83%, respectively (Obot*et al*., 2011).

Experimental Pen

This housing was a typical movable, raised floor deep litter type. It has a dwarf wall with the sides covered with chicken net. The size was 1.2m x 3m x 1.7m in breadth, length and height respectively. The experimental pen was divided into 12 cells. It had individual internal cell dimension of 45cm x 60cm that ran both the length of the cage to the left and to the right sides to accommodate 24 rabbits comprising of 12 males (Bucks) and 12 females (Does) at 2 animals per cell; 2 Bucks, 2 females Does, respectively.

Experimental Animal and Management

Twenty-four 8 weeks old cross-bred rabbits comprising 12 bucks and 12 does were used for the study. The animals' weight ranged between 621.67g and 939.00g. They were divided into four treatment groups according to their sexes and anti-endo parasite feed additives and balanced for weight. Treatment 1 (male rabbits fed with commercial coccidiostat); treatment 2 (male rabbits fed with garlic supplement); treatment 3 (female rabbits fed with commercial anticocciodia preparation); and treatment 4 (female rabbits fed with garlic supplement). There were 6 replicates in all and each animal served as replicate. The rabbits were sourced from a reputable farm within Abeokuta metropolis. The hutch was washed and disinfected and wood shavings were spread as bedding materials. The animals were fed with grower diet that contain crude protein of 18% and Metabolizable Energy (ME) of 11.0MJ/KG and water ad-libitum. Rabbits on garlic supplement were fed with grower diet that contained 1.25g of garlic per kilogram of the animal diet (Ari *et al*., 2012). The treatment groups on convectional anticoccidia diets were administered according to manufacturer recommendation (0.6g per kilogramme feed).

Data collection

Feacal samples were collected from each animal per treatment and replicate. The samples were collected through the rectum using swab stick. The swab stick was inserted into the rectum and rolled round the internal lining of the rectum to gather sample. The clogged was thereafter transferred into the sterile casing for analysis in the laboratory. Samples were collected at the beginning (base line) of the study, mid-stream (4th week = 28d) and at the end (8th week = 56d) of the study. At the 56th day, 6 bucks and 6 does comprising 50% of the population were sacrificed for carcass evaluation. The live weight of the animal per treatment was taken before slaughtering. The animals were slaughtered through neck decapitation. The fur was removed by singeing, washed and eviscerated. The eviscerated weight was taken and then hot carcass was stored in a refrigerator at about 0˚C - 4˚C for 24hrs. Carcass was prepared according to the norms of the World Rabbit Science Association (Blasco and Ouhayoun, 1996). Then the cooled carcass was weighed and expressed in percentage relative to live weight as described by Lukefahr*et al*., (1982). Record of cut parts (fore-limbs, hind limbs, loin, head), organs (heart, liver, kidney, lungs) was taken.

Statistical analysis

Data generated were subjected to analysis of variance (ANOVA) in 2x2 factorial (randomized complete block design) using SAS (2000). Significant mean at 5% was separated using Duncan's multiple range test (Duncan 1955) as contained in SAS.

RESULTS AND DISCUSSION

Table 1 shows effect of sex and anti-coccidia type on growth performance of the weaner rabbits. Male rabbits (bucks) had the least final weight (859.17g) while the females (does) had the highest (1122.50g). Though bucks recorded higher numeric daily weight gain (4.24g) compared with females (3.92g), final weight which ranged from 859.17g-1122.50g and daily weight gain were not significantly different (P>0.05) among rabbits of different sexes. This observation was consistent with the findings of Ortiz and Rubio (2001) and Bello *et al*. (2015) who reported that no significant difference in weight gain and final weight of rabbits of different sexes. Also, feed intake and feed conversion ratio were not significant (P>0.05) with sex of rabbits.

Furthermore, the result revealed that all growth parameters measured were neither significant (P>0.05) with convectional commercial anticocciodia nor with garlic inclusion in the diet. These findings were at variance with earlier result of Onu and Aja (2011) on weaned rabbits who reported that herbs controlled and limited the growth and colonization of numerous pathogenic and non-pathogenic species of bacteria in the gut leading to improved translation of feed to meat. Though wide range of herbs are available and used as

alternative natural growth promoters (Samkol and Lukefahr, 2008) in animal agriculture, no particular mention was made of the particular herbs as reported by Onu and Aja (2011) therefore the findings could not be compared with garlic.

Ramakrishna *et al*. (2003) suggested that garlic supplementation enhances the activity of pancreatic enzymes and provides the environment for better absorption of nutrients. Also, Pourali*et al*. (2010) suggested that allicin in garlic promotes the performance of the intestinal flora thereby improving digestion and enhancing the utilization of energy, leading to improved growth. The variations obtained in this result could also be as a result of mode of administration and the experimental animal species. Feeding garlic in powder and through infusion, resulted in a significant difference ($P<0.05$) in the final body weight, and feed conversion ratio (Oleforuh-Okoleh*et al*., 2014) while digestive morphology of rabbit and poultry are not necessarily the same. Demir*et al*. (2003); Ademola*et al*. (2005); Javendel*et al*. (2008) reported significant increase in daily body weight gain and final body weight of birds fed ginger and garlic as growth promoters in broiler diets and observed a pronounced improvement in their body weight gain and feed conversion ratio.

Table 2 shows the effects of sex and anticoccidia supplementation on carcass yield of rabbit. Eviscerated percentage was 49.45% for buck and 50.17% for doe while it was 50.62% and 48.99% with rabbits fed diets supplemented with commercial anti-coccidiostat and garlic, respectively. However, there was no significant ($P>0.05$) difference in the carcass yield of rabbits fed with garlic and those fed with conventional commercial coccidiostat. This result was consistent with that of Singh (1997) who reported no significant ($P>0.05$) difference in carcass quality among different breeds and sex of rabbits. And this gave credence to the result obtained. The result also showed that sex of rabbits had no significant ($P>0.05$) effect on the relative weights of different cuts. This result was in agreement with the findings of Salroo*et al* (1989), Farghaly and El-Mahdy (1999), and Sen and Bhagwan (1999) who reported no significance in the carcass traits of rabbits of different breeds.

The result of the organ weights of the two sexes of rabbits is shown in Table 2. There were no significant ($P>0.05$) differences in organ weights. Table 2 also shows effect of anticoccidial supplementation on carcass performance of rabbit reared under deep litter system. There were no significant ($P>0.05$) differences in all the parameters of killing out, cut-parts and organs of the experimental animals. These results were similar to that of Sen and Bhagwan (1999) who reported non-significant effect of sex on carcass performance except ($P<0.05$) alimentary canal and its contents in does. However, the value of the alimentary canal reported by Sen and Bhagwan (1999) was higher than that of others Rao *et al*. (1978) and Nofal*et al*. (1995).

Equally, the result of this study was consistent with that of Farghaly and El-Mahdy (1999) who reported non-significant effect of sex on different organ weights except liver which was significantly more ($P<0.01$) in females than males.Furthermore, this result was consistent with the finding of Hossian*et al*. (2015) who reported no significant ($P>0.05$) differences in the carcass weight and dressing percentage among the rabbit groups treated with either 0%, 0.25% and 0.5% mixture of garlic powder.

Table 3 shows the type of coccidial and helminth organisms present in weaner rabbits fed diet supplemented with commercial anti-endo parasitic preparation and garlic. *Eimeria*spp was present in bucks fed with both commercial anticoccidial drug and Garlic. *Eimeria*spp incidence was also recorded in does fed with convectional anticoccidial drug while it was absent in does fed with garlic. This result was consistent with the finding of Piyush*et al*. (2013) who reported that a number of plants of the local flora are used for curing various ailments and diseases. Garlic was probably responsible for the elimination of *Eimeriaspp* in female rabbits.In addition, the result revealed incidence of *Ascaridiagalli* in bucks fed with garlic but absent among bucks fed with diet supplemented with commercialanticoccidial drug.

Table 1: Effects of sex and anti-coccidial supplements on growth performance of weaner rabbits reared under deep litter system

Parameter	Sex		Feed supplement	
	Male	Female	Conventional Anticoccidial	Garlic
Initial weight (g)	621.67±39.92	939.00±97.48	771.67±103.02	759.00±47.46
Final weight (g)	859.17±37.41	1122.50±90.63	1027.08±86.82	921.00±52.27
Total weight gain (g)	237.50±40.09	219.40±40.09	255.50±44.98	198.00±40.27
Weight gain (g/day)	4.24 ±0.71	3.92 ±0.88	4.56 ±0.80	3.54 ±0.71
Feed intake (g/day)	58.69 ±2.15	60.23 ±0.29	61.04 ±1.08	57.40 ±2.12
FCR	13.84 ±3.64	15.36 ±4.11	13.39 ±3.22	16.21 ±4.12

Table 2: Effects of sex and anticoccidial supplementation on carcass Performance of weaner rabbits reared under deep litter system

Parameter	Sex		Anti-endo parasite feed supplement	
	Male	Female	Commercial Drug	Garlic
Killing out				
Live weight(g)	1652.08±228.05	1598.50±169.74	1724.08±134.32	1526.50±243.22
Bled weight (%)*	72.45±3.26	76.38±1.68	72.08±2.01	76.75±2.95
Plucked (%)	69.10±2.53	70.17±1.45	69.33±1.20	69.95±2.67
Eviscerated weight (%)*	49.45±1.06	50.17±0.40	50.62±0.16	48.99±1.02
Cut-Part (%)				
Head	7.29±0.52	7.48±0.28	7.32±0.25	7.45±0.53
Fore limb	6.97±0.31	7.22±0.16	7.29±0.26	6.89±0.19
Hind limb	10.99±0.52	10.93±0.40	11.24±0.52	10.69±0.37
Loin	5.10±0.31	5.53±0.39	5.27±0.41	5.37±0.32
Organ (%)				
Liver	1.94±0.14	2.25±0.20	2.13±0.23	2.07±0.12
Heart	0.18±0.01	0.17±0.01	0.18±0.00	0.18±0.01
Kidney	0.43±0.02	0.48±0.04	0.48±0.04	0.43±0.03
Lungs	0.49±0.08	0.45±0.05	0.44±0.05	0.50±0.07

*These are percentages of animal live weight.

Table 3: Coccidial and Helminthic types present in weaner rabbits fed conventional anti-microbial drug and garlic supplement

Parameter	Males (Bucks)		Females (Does)	
	Commercial anti-endo parasitic drug	Garlic	Commercial anti-endo parasitic drug	Garlic
Eimeriaspp	+	+	+	-
Ascaridiagalli	-	+	+	+

+ = Present; - = Absent; *Eimera*spp = Coccidiosis causal organism; *Ascaridiagalli* = Helminthic causal organism

However, the result revealed incidence of *Ascaridiagalli* (helminth organism) in does fed diet supplemented with either garlic or commercial anti-parasitic preparation. This result was similar to the finding of Sadzikowski*et al.* (2008), who reported presence of *Eimeria species* in rabbits from south-eastern Poland. Protozoon from genus *Eimeria* was recognized in 94.80% of the experimental rabbits' population. Therefore, *Eimeria*sppcould be the commonest coccidiosis causing organism in rabbit production. Wide range of *Eimeria*spp probably suggested the reason for occurrence of coccidiosis in rabbits (Amy, 2005).

Figure 1 shows population of coccidial organisms (*Eimeria spp*.) present in bucks and does fed with conventional anticoccidia drug and garlic. The result showed that bucks and does fed with garlic supplement had reduced coccidial load from 1650epg and 600epg, respectively at the beginning of the study to no incidence at the 4th week (progressive load) and 8th week (final load) of the study. This trend therefore revealed the effect of garlic as an anticoccidial that could be used as herbal supplement instead of convectional anticoccidial drug. This finding was consistent with that of Toulah and Al-Rawi (2007) who reported the efficacy of garlic on coccidia infections in rabbits.

The result on the does fed with convectional anticoccidial drug revealed a decline in coccidial population from 5500epg at the beginning to zero (0epg) at the 4th week (progressive load) to 8th week (final load) of the study. Though commercially available antibiotics with proven efficacy had been reported to engender growth and treat sick animals (WHO 2001), they had also been reported to result in resistance as use increased in both animals and humans while concerns about this have generated many international reports and recommendations (WHO 2000; WHO 2001). Therefore, herbal supplement instead of conventional anticcocidial drug could be explored in rabbit production for prevention and control of coccidiosis.Figure 2 shows population of helminth organism present in the rabbits (bucks and does) fed with conventional anti-coccidial drug. The result showed that buck fed with garlic supplement had reduced helminth population. The helminth load of 1650epg at the beginning of the study faced-out at the 4th and 8th week. This could be an indication of the efficacy of garlic to reduce helminth population in rabbit production. This opinion was supported by the findings of Orr (1998) who

reported that garlic has an anti-helminthic property. Erol*et al*. (2008) also reported that garlic has anti-helminthic effect in mice.

Figure 2 shows population of helminth organism present in the rabbits (bucks and does) fed with conventional anti-coccidial drug. The result showed that buck fed with garlic supplement had reduced helminth population. The helminth load of 1650epg at the beginning of the study faced-out at the 4th and 8th week. This could be an indication of the efficacy of garlic to reduce helminth population in rabbit production. This opinion was supported by the findings of Orr (1998) who reported that garlic has an anti-helminthic property. Erol*et al*. (2008) also reported that garlic has anti-helminthic effect in mice. The result of female rabbits (does) fed with conventional anti-coccidial drug and garlic was also showed in Figure 1. Both supplements were able to reduce helminth population in does from baseline values of 550epg (garlic supplementation) and 5500epg (commercial drug supplementation). It was also further revealed that does on garlic supplement recorded no helminth population at the 4th and 8th week of the study while those on conventional anti-coccidial drug recorded no helminth population at the 8th week.

CONCLUSION

From the findings of this study it could be concluded that sex of rabbits, Commercial anticoccidial drug (coccidiostat) and garlic supplements in diets had no effect on growth performance and carcass traits of rabbit. However, Garlic had potential to reduce coccidial and helminth populations in rabbits without any detrimental effect on performance and carcass and therefore could be utilized as an effective preventive measure in deep litter rabbit rearing production system.

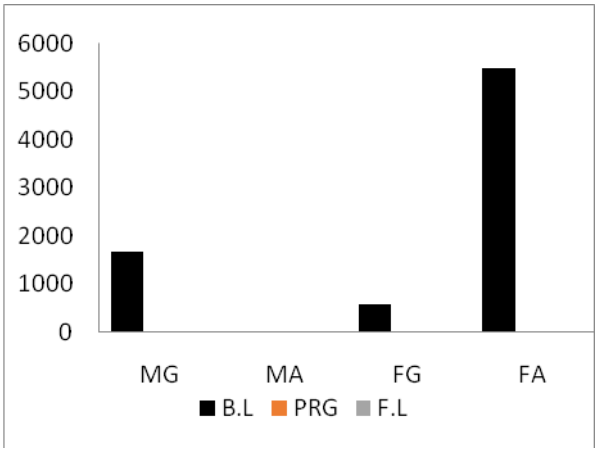

Figure 1: Coccidial Load of Weaner Rabbits Fed Diet Supplemented with Conventional Anti-microbial Drug and Garlic.

Where MGB.L- Male Rabbits (Bucks) fed diet supplemented with Garlic = 1650epg base-line, MGPRG - Male Rabbits (Bucks) fed diet supplemented with Garlic = 0epg progressive, MGF.L - Male Rabbits (Bucks) fed diet supplemented with Garlic = 0epg final load, MAB.L - Male Rabbits (Bucks) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg base-line, MAPRG – Male Rabbits (Bucks) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg progressive, MAF.L – Male Rabbits (Bucks) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg final load, FGB.L- Female Rabbits (Does) fed diet supplemented with Garlic = 600epg base-line, FGPRG - Female Rabbits (Does) fed diet supplemented with Garlic = 0epg progressive, FGF.L - Female Rabbits (Does) fed diet supplemented with Garlic = 0epg final load, FAB.L - Female Rabbits (Does) fed diet supplemented with Conventional Anti-Coccidial Drug = 5500epg base-line, FAPRG – Female Rabbits (Does) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg progressive , FAF.L – Female Rabbits (Does) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg final load, BL – Base-line Load of Helminth organism, PRG – Progressive Load of Helminth organisms.

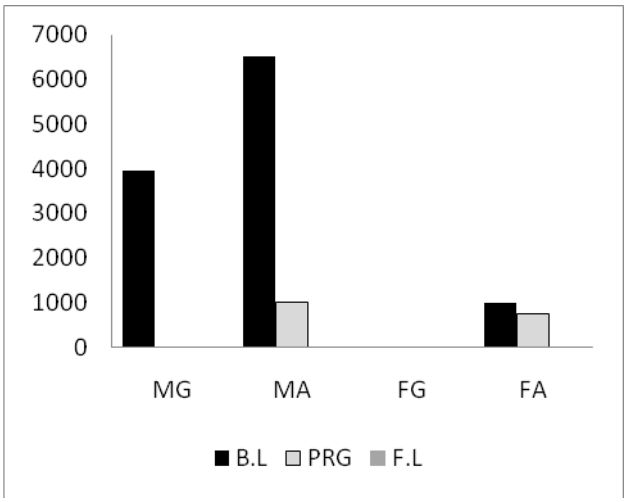

Figure 2: Helminthic Load of Weaner Rabbits Fed Diets Supplemented with Conventional Anti-coccidial Drug and Garlic.

Where MGB.L- Male Rabbits (Bucks) fed diet supplemented with Garlic = 1650epg base-line, MGPRG - Male Rabbits (Bucks) fed diet supplemented with Garlic = 0epg progressive, MGF.L - Male Rabbits (Bucks) fed diet supplemented with Garlic = 0epg final load, MAB.L - Male Rabbits (Bucks) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg base-line, MAPRG – Male Rabbits (Bucks) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg progressive, MAF.L – Male Rabbits (Bucks) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg final load, FGB.L- Female Rabbits (Does) fed diet supplemented with Garlic = 600epg base-line, FGPRG - Female Rabbits (Does) fed diet supplemented with Garlic = 0epg progressive, FGF.L - Female Rabbits (Does) fed diet supplemented with Garlic = 0epg final load, FAB.L - Female Rabbits (Does) fed diet supplemented with Conventional Anti-Coccidial Drug = 5500epg base-line, FAPRG – Female Rabbits (Does) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg progressive , FAF.L – Female Rabbits (Does) fed diet supplemented with Conventional Anti-Coccidial Drug = 0epg final load, BL – Base-line Load of Helminth organism, PRG – Progressive Load of Helminth organisms

REFERENCES

Ademola S.G., Farinu, G.O., Adelowo, O.O., Fadade, M.O. and Babatunde, G.M. (2005). Growth performance antimicrobial activity of garlic and ginger mixture fed to broiler. Proceedings of the 2005 Nigerian Society for Animal Production, 71-74.

Amy H. (2005). Coccidiosis in rabbit; Nutrition news and Information Update

Ari, M.M., Barde, R.E., Ogah, D.M. Agade, Y.I., Yusuf, N.D., Hassan, I.D. and Muhammed, M.M. (2012). Utilization of Garlic (*Allium sativum* L.) as supplementary phytogenic feed additive for broilers fed commercial feeds. Egypt. Poult. Sci. 32(1): 13-21

Bello, K.O., Kareem, S.O. and Jimoh, B.Z. (2015). Sex and frequency of litter change: effects on growth performance, carcass yield and haematology of rabbits raised on deep ltter system. Nig. J. of Anim. Prod. 43 (1): 102 - 110

Besier, R.B. and Love, S.C.J. (2003). Anthelmintic resistance to sheep nematodes in Australia: the need for new approaches, Australian J. Expt. Agric. 43:1383–1391.

Blasco, A. and Ouhayoun, J. (1996). Harmonization of criteria and terminology in rabbit meat research. Revised proposal. World Rabbit Sci. 4: 93-99

Chowdhury, A.K., Ahson, M., Nazrul Islam, S. K. and Ahmed, Z. U. (1991). Efficacy of aqueous extract of garlic and allicin in experimental shigellosis in rabbits. Indian J. Med. Res. 93: 33–36.

Demir, E., Sarica, S., Ozcan, M.A. and Suicmez, M. (2003). The use of natural feed additives as alternatives for an antibiotic growth Promoter in broiler diets. Br. J. Poultry Sci. 44: 44-45.

Devendra, B., Nancy, M. and Mahajan, R. C. 2006. Drug resistance in amoebiasis: Review. Indian Journal of Medical Research, 123:115-118

Duncan, D. B. (1995). Multiple range and F-test. Biometrics 11: 1- 42

Duraka, A., Ozturk, H. S., Olcay, E. and Guven, C. (2002). Effects of garlic extract supplementation on blood lipid and antioxidant parameters and atherosclerotic plaque formation process in cholesterol-fed rabbits. J. Herbal Pharmacotherapy. 2: 19–32.

Fanatico, A. and Green, C. (2012). Small-scale sustainable rabbit production. A project of the National Center for Appropriate Technology. www.attra.ncat.org.

Farghaly, H. M. and El-Mahdy, M. R. M. (1999). Genetic and non-genetic factors affecting live, carcass and non-carcass traits of New Zealand White rabbits in Egypt. Indian Journal of Animal Science 69(8): 596-603

Fleischauer, A. T., Poole, C. H. and Arab, L. (2000). Garlic consumption and cancer prevention: meta-analyses of colorectal and stomach cancers. Am. J. Clin. Nutr. 72: 1047–1052.

Guarrera, P. M. (1999). Traditional anti-helminthic, anti-parasitic, and repellent uses of plants in Central Italy. J. Ethnopharmacol. 68: 183-192

Hossian, M. J., Kamruzzaman, M., Akbar, M. A. and Haque, M. A. (2015). Feeding garlic powder on growth performance, nutrient digestibility and carcass characteristics of rabbit. International Journal of Natural and Social Sciences, 2(5): 74-81.

Javendel, F., Blaridshad, B., Seifarati, J., Pourrahimi, A. H. and Baniyaghoub, S. (2008). The favorite dosage of garlic meal as a feed addictive in broiler chickens ration. Pak. J. Biol. Sci., 11(13): 1746-1749

Karasaki, Y., Tsukamoto, S., Mizusaki, K., Sugiura, T. and Gotoh, S. (2001). A garlic lectin exerted an antitumor activity and induced apoptosis in human tumor cells. Food Res. Int. 34: 7–13

Kumar, V. G., Surendranathan, K. P., Umesh, K. G., Gayathri Devi, D. R. and Belwadi, M. R. (2003). Effect of onion (Allium cepa Linn.) and garlic (Allium Sativum Linn.) on plasma triglyceride. Indian Journal of Experimental Biology, 41(1):88-90

Kustos, K., Tóbiás, G., Kovacs, D., Eiben C. and Szendro Z. 2003. Effect of stocking density, the material of botton and feeding on performance of growing rabbits in Hungary. In Proceedings of 15th Hungarian Conference on Rabbit Production, May 2003, Kasposvar, Hungary, 123-128

Licious, D., Coudert, P., Bahagia, S. and Rossi, G. L. (1992). Endogenous development of Eimeriaintestinalis in rabbits (*Oryctolaguscuniculus*). J. Parasitol. 78: 1041–1048.

Lukefahr, S. D., Hohenboken, W. D., Cheeke, P. R. and Patton, N. M. (1982). Carcass and meat characteristics of Flemish Giant and New Zealand white pure bred and terminal cross rabbit. J. Anim. Sci., 54(6): 1169-1174

Nofal, R.Y., Toth, S. and Virag, G. Y. (1995). Carcass traits of purebred and crossbred rabbits. World Rabbit Science 3: 167-170

Obot, N. I.; Emberga, T. T. and Ishola, K. S. (2011). 22 Years characterized trends of rainfall in Abeokuta, Nigeria. Research Journal of Applied Sciences 6(4): 264-271

Oleforuh-Okoleh, V. U., Chukwu G. C. and Adeolu, A. I. (2014). Effect of ground ginger and garlic on the growth performance, carcass quality and economics of production of broiler chickens. Global Journal of Biosciences and Biotechnology. 3(3): 225-229.

Onu, P. N. and Aja, P. M. 2011 Growth performance and haematological indices of weaned rabbits fed garlic (*Allium sativum*) & ginger (*Zingiberofficinale*) supplemented diets. Inter. J. Food, Agric. and Vet. Sci. 1: 51-59

Orr C. (1998). Comparing alternative for controlling internal parasite in dairy goat, Herbal wormers

versus chemical wormer. www.fiascofarm.com/goats/wormers.htm

Ortiz, H. J. A. and Rubio, L. M. S, (2001). Effect of breed and sex on rabbit carcass yield and meat quality. World Rabbit Science 9:51-60.

Peyghan, R., Powell, M. D. and Zadkarami, M. R. (2008). In vitro effect of garlic extract and metronidazole against *Neoparamoebapemaquidensis* and isolate amoebae from Atlantic salmon. Pak. J. Biol. Sci. 11: 41–47.

Pourali, M., Mirghelenj, S.A. and Kermanshashi, D. (2010). Effect of garlic powder on productive performance and immune response of broiler chickens challenged with Newcastle disease virus. Global Veterinaria 4:616-621

Piyush, J., Seema, S., Sandeep, K.S., Verma, S. K., Kharya, M.D. and Sanjeev, S. (2013). Anthelmintic potential of herbal drugs. International Journal of Research and Development in Pharmacy and Life Sciences. 2(3): 412-427.

Ramakrishna, R.R., Platel, K. and Srinivasan, K. (2003). In-vitro influence of species and spice active principles on digestive enzymes of rat pancreas and small intestine. Nahrung 47:408-412

Rao, D. R., Chen, C. P., Sunki, G. R. and Johnson, W.M. (1978). Effect of weaning and slaughter ages on rabbit meat production II: Carcass quality and composition. Journal of Animal Science 46: 578-583

Sadzikowski, A. B., Szkucik, K., Szczepaniak, K. O. and Paszkiewicz, W. 2008. Pre-valance of protozoon genus Eimeria in slaughter rabbits. (In Polish). Med. Wet., 64 (12): 1426–1429.

Salroo, G. M., Prasad, V. S. S. and Gupta, S. C. (1989). Effect of age on carcass traits of the SC rabbit. Indian J. Anim. Sci., 59: 890-892.

Samkol, P. and Lukefahr, S. D. (2008). A challenging role of organic rabbit production towards poverty alleviation in South East Asia. 9th World Rabbit Congress, Verona, Italy

SAS. (2000). SAS/STAT Software: Changes and Enhancements through Release 8.1, SAS Institute Inc., Cary, NC.

Sen, A. R. and Bhagwan, P. S. K. (1999). Appraisal of two genetic groups of rabbits for carcass and meat quality traits in males and females. Indian Journal Animal Science 69(8): 631- 633

Singh, G. (1997). Performance of rabbits in semi-arid tropical regions in Indian. Proceedings of a Workshop on Integrated Angora rabbit Development Project, April 1997, KVK Bajaura, Himachal Pradesh, Pp. 51-60.

Sundaram, S. G. and Milner, J. A. (1996). Diallyl disulfide inhibits the proliferation of human tumor cells in culture. Biochem. BiophysActa, 1315:15–20.

Szenrdő, Z., Matric, Z., Nagy, I., Odermatt, M., Gerenser, Z., Szendrő, E., Radnai, I. and DalleZotte, A. (2009). Examination of growing rabbit house in pen without or with platform. 16th Intern. Symp. Housing and Diseases of Rabbits: Fur providing Animals and Pet Animals, Celle,Germany, pp. 3–12.

Toulah, F. H. and Al-Raw, M. M. 2007. Efficacy of garlic extract on hepatic coccidiosis in infected rabbits (*Oryctolaguscuniculus*): histological and biochemical studies. J. Egypt Soc. Parasitol. 37 (3): 957-968

WHO 2000. WHO Global Principles for the Containment of Anti-microbial Resistance in Animals Intended for Food: Report of a WHO Consultation, Geneva, Switzerland, 5-9 June 2000, WHO/CDS/CSR/APH/200

WHO 2001. Monitoring Anti-microbial Usage in Food Animals for the Protection of Human Health: Report of a WHO Consultation, Oslo, Norway, 10-13 September 2001

Yoshida, H., Iwata, N., Katsuzaki, H., Naganawa, R., Ishikawa, K., Fukuda, H., Fujino, T., Suzuki, A. 1998. Antimicrobial activity of a compound isolated from an oil-macerated garlic extract. Biosci. Biotechnol. Biochem. 62: 1014–1017.

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