Egyptian Journal of Rabbit Science, 34(1): 35-46 (2024)

EFFECT OF DIETARY PHYTOBIOTICS BLEND (TURMERIC, GARLIC, GINGER AND CLOVE) ON GROWTH PERFORMANCE, CARCASS YIELD, HAEMATOLOGY AND SERUM BIOCHEMISTRY OF RABBITS

E.O. Okanlawon[1*], K.O. Bello[2], O.S. Akinola[1]. and A.A. Adeola[2]
1- Department of Animal Production and Health, Faculty of Agricultural Science, Federal University of Agriculture Abeokuta, Nigeria
2-Institute of Food Security, Environmental Resources and Agricultural Research, Nigeria
[*]Corresponding Author: edenokanlawon@gmail.com, +2348056813070

ABSTRACT

This study was carried out to evaluate the effect of phytobiotic blend on growth, carcass, haematology and serum biochemistry of rabbits. A total of forty eight (48) unsexed rabbits at 7-8 weeks old was used. They were allotted T1- 0g inclusion as control group and T2- 10g inclusion of blend at the rate of 2.5g of each turmeric, garlic, ginger and clove in a one way analysis of variance. Data were collected on growth, carcass, cost benefit, haematology and serum parameter and were analysed using ANOVA.

The results revealed higher (P<0.05) bled weight (96.53%), singeing weight (92.80%) and head (19.53%) were recorded with rabbit fed diet containing the 10g of the blends while rabbit fed diet without the inclusion had the least bled weight (93.71%), singeing weight (89.36%) and head (15.70%). Higher liver weight (6.37%) was recorded with rabbit fed diet without inclusion and least (4.97%) with rabbit fed diets with the inclusion of blend. Higher (P<0.05) white blood cell (6812.50cell/ul) was recorded with rabbit fed diet without the inclusion of the blend while rabbit fed diet with the inclusion of the blend had the least (5156.3050cell/ul). Higher (P<0.05) cost per kg diet (₦153.06) was recorded with rabbit fed diet with the blend while rabbit fed diet without the blend had the least cost per kg diet (₦146.34).

***Conclusively,** this study concluded that inclusion of phytobiotic blend in the diet at 10g can be added to the diet for improved growth performance, carcass yield, cost benefit, haematology and serum biochemistry in rabbits production.*

Key words: Rabbit, growth performance, carcass, haematology and serum .

INTRODUCTION

The domestic rabbit (*Oryctolagus cuniculus*) presents favorable biological characteristics such as small body size, high growth rate, high conversion rate, short gestation period, high prolificacy, relatively low cost of production, acceptability by consumers and high nutritional quality of its meat (Sorhue *et al*. 2013; Petrescu *et al.* 2013). Rabbit meat has advantages that support the increase of its use for human consumption. Some of them are simply economic while others are related to the human health. Rabbit production can function as a sustainable system, as it involves the use of renewable on-farm resources, such as local breeds, feedstuffs from forage or garden plots, local materials for hutches and other equipment, and family labour (Petrescu *et al.* 2013). The blood components like red blood cells, white blood cells and others are important in determining the health status of the animal. According to Melillo 2007, rabbits can mask signs of illness or show very few of it, and as such, the results of haematology and serum biochemical test of the animals will aid in reaching a definite diagnosis. Haematology and serum biochemistry profiles are the basic tools used in the diagnosis of disease or confirmation of health. This is because blood is a readily accessible tissue to collect and analyze,

Due to ban and raise in antimicrobial resistance to the conventional drugs it there's need to find an alternative reduce diseases incidence and to improve growth performance with the use of phytobiotics and they include (turmeric, garlic, ginger and clove). In Kikusato 2021, review, the health benefits of ingesting phytobiotics can be attributed to their antioxidant activity, however, extensive investigations have shown that these products also have anti-inflammatory, antimicrobial and transcription-modulating effects. Phytobiotics are non-nutritive constituents, and their bioavailability is low, nonetheless, their beneficial effects have been observed in several growth performance, carcass yield and tissues or organs. Garlic, ginger, turmeric, clove and their components have shown various pharmacological effects including immune-modulatory, anti-tumorigenic, anti-inflammatory, anti-apoptotic, anti-hyperglycemic, anti-lipidemic, hepatoprotective, neuroprotective, cardioprotective and antiemetic effects (Hossian *et al*. 2015; Mbaveng *et al.* 2017 and Okanlawon *et al.* 2020a). Meanwhile, phytobiotics are limited in action due to plant species, soil type, location, weather condition, processing, and storage conditions among others and may affect the composition of the plant and potency of the active ingredients (Vispute 2019).

Due to variation in nutrient composition of turmeric, garlic, ginger and clove combination of the blends could be of great research interest on growth performance, carcass yield, haematology and serum biochemistry of rabbits.

MATERIALS AND METHODS

The study was conducted at the Rabbitary unit of Institute of Food Security, Environmental Resources and Agricultural Research Federal University of Agriculture Abeokuta, Nigeria.

Preparation of test ingredients

Fresh turmeric, garlic, ginger and clove were purchased from Bode Market, Ibadan, Oyo State. Each sample was washed (except garlic and clove) using clean water to remove the dirt completely. They were poured into clean basket to drain off water and later sliced into flakes in order to increase the surface area to aid drying. Thereafter each of the test ingredients were dried (under the shade) until the weight remains constant. The test ingredients were reduced into lentil-size part with the aid of mortar and pestle and milled into fine powdery form with the use of electric blender following method described by Jayaprakasha *et al.,* (2002) and Okanlawon, *et al.,* (2020b). Thereafter it was sieved and stored in air tight container until use.

Experimental design and management

A total of forty eight (48) unsexed rabbits at 7-8 weeks old was used. The animals were purchased from a reputable farm and were acclimatized for two weeks. They were weighed and allotted to 2 treatments on equal weight basis in a one way analysis of variance. T1- 24 unsexed rabbit fed diet with no inclusion of blend and T2- 24 unsexed rabbit fed with the diet containing inclusion of phytobiotic blend at inclusion rate is 2.5g of turmeric, 2.5g of garlic, 2.5g of ginger and 2.5g of clove making it 10g into 1kg of feed as an additive. Each treatment having 12 replicates of 2 rabbits each.

Before stocking, the pen was cleaned thoroughly and disinfected. The animals were fed with experimental diet containing 17.25% crude protein (CP) and 2829.2 kcal/g metabolizable energy supplemented according to NRC (1977).

Feed and water were supplied *ad libitum* daily. All other routine management practices will be observed. The feeding trial lasted for 10 weeks. Rabbits were weighed individually at the beginning of the experiment and subsequently on weekly basis.

Data collection

Body weight gain

Each rabbit was weighed separately before the experiment started and then once a week after

That. The difference between the final and initial body weights was used to calculate weight gain for a period of 1 week to 10thweek.

Total weight gain (g) = Final body weight (g) − Initial body weight (g)

Feed intake

Feed intake was recorded on weekly basis for each replicate per treatment. Leftover feed was

subtracted from the total feed supplied to the rabbits to determine feed intake.

Feed intake (g) = Total feed supplied (g) − Feed left over(g)

Cost per kilogram feed (₦) and total feed intake per animal (kg/rabbit) was calculated using prevailing market price.

Carcass yield

At the end of 10th week of dietary treatment 5 animals per treatment whose weights were close to the average of the rabbits were selected, fasted for 12 hours and slaughtered for carcass analysis. Before slaughtering inspection of animals were carried out to ensure animal are in good condition at slaughter.

The percentage dressed weight will be expressed as;

$$\text{Dressing percentage} = \frac{\text{Empty carcass weight}}{\text{Live body weight}} \times 100$$

After evisceration, the internal organs such as liver, heart, kidney and lungs will be carefully excised and weighed using electronic weighing scale. The measurements were expressed as percentage relative to the live weight.

Haematology and serum analysis

Blood samples were collected through the vein in the ear at 10thweeks for haematology and serum chemistry. About 2.5 ml of blood were collected in tubes containing EDTA anticoagulant to determine the values of haemoglobin concentration, packed cell volume, red blood cells count, total white blood cells count, differential white blood cell count, platelets count and red cell indices as describe by (Iranloye *et al*., 2002 and Venkatesan *et al*., 2006). The blood was slowly expressed into EDTA tubes to reduce the risk of haemolysis after removing the needles from syringes (Haen, 1995).

Serum parameters include, total protein was obtained by biuret method in the assay as described by Kohn and Allen (1995).The globulin

concentration was obtained by subtracting albumin from the total protein. Albumin was determined using Bromocresol Green (BCG) method as described by Peter *et al*,. (1982)**.** Aspartate transferase (AST) activities were determined using spectrophotometric methods as described by Rej and Hoder (1983). Alanine transferase (ALT) activities were determined using spectrophotometric methods as described by Rej and Hoder (1983). Serum urea was determined using a kit (Quinica clinical spam) having a linear measurement of about 566.6 ml per litre of urea concentration. The serum urea will determine calorimetrically. The serum cholesterol was determined using enzymatic endpoint method as described by Roeschlau *et al*. (1974).

Statistical analysis

Data collected were analysed using ANOVA as contained in SAS (2002). Significant means were separated using Duncan Multiple Range Test (Duncan, 1955) as contained in SAS (2002).

RESULTS AND DISCUSSION

Growth performance of rabbit

Table 1: Shows effect of phytobiotic blend (turmeric-garlic-ginger-clove) on growth performance of rabbit. Significant ($P<0.05$) differences were obtained on cost per kg diet. weight were not significantly ($p>0.05$) influenced by blend. Higher ($P<0.05$) cost per kg diet (₦153.06) was recorded with rabbit fed diet with the blend while rabbit fed diet without the blend had the least cost per kg diet (₦146.34). Final weight gain, total weight gain, average daily weight gain, average daily feed intake, cost per average daily feed intake and cost of feed per kg body were not significantly ($P>0.05$) influenced by phytobiotic blend.

The result in this study as shown that blend had no significant effect on body weight gain, feed intake and feed conversion ratio. The improvement in body weight gain and feed intake achieved with mixture of turmeric, garlic, ginger and clove as sole agent in rabbit diets suggest the positive beneficial growth enhancing synergetic effects of these herbs. It could be that a mixture of these herbs may have 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. The enhanced body weight observed in this study strengthens the findings of Ademola *et al*., (2009) who reported significant increase in body weight gain of rats and broilers fed a mixture of garlic and ginger. This result also in line with the result of Onu *et al*. (2011)

who indicated that ginger and garlic could effectively be added to rabbit ration to improve the quality of the feed and the performance of the animals.

The enhanced body weight gain of the rabbits fed blend in the diets indicates the positive nutritive effects of these natural feed additive. The increased feed intake recorded for rabbits fed diet containing the blend may be due to improved flavor, palatability and taste of the feed. This may have enhanced the appetite of the rabbits thereby stimulating increased consumption. This observation implies that the level of inclusion of these herbs were within the tolerable limits of the rabbits.

It also suggests that the odor of the diets were not extremely pungent to clamp down feed intakes. The increased feed intake observed in this study is in agreement with the reports of Okoye *et al*. (2006); Omage *et al*. (2007) and Adeniyi and Balogun (2002). Effect of phytobiotic blend had significant effect on cost per kg diet (₦/kg) is as a result of the additional cost of the blend that was included in the diets and this is in agreement with the report of Okanlawon *et al.* (2020a) who also recorded significant increase the price of diets as the level of inclusion of turmeric in the diet of rabbit increases.

Table 1: Effect of phytobiotic blend (turmeric-garlic-ginger-clove) on growth performance of rabbits

Parameter	**Without blend**	**With blend (10g)**	**SEM**	**P-value**
Initial live weight (g)	1464.80	1466.50	76.60	0.98
Final weight gain (g)	2044.00	2073.80	62.26	0.81
Total weight gain (g)	579.19	607.33	29.85	0.66
ADWG (g/r/d)	11.00	11.82	0.67	0.56
ADFI (g/r/d)	77.83	79.73	1.80	0.54
FCR	8.41	8.76	0.63	0.83
Cost per kg diet (₦/kg)	146.34^{b}	153.06^{a}	1.36	0.0001
Cost per daily feed intake (₦)	11.43	12.21	0.31	0.14
Cost of feed per kg body weight gain (₦/kg)	1242.70	1341.40	101.56	0.68

abc: Means in the same row with different superscripts differ significantly (P<0.05), **ADWG:** Average daily weight gain, **ADFI**: Average daily feed intake, **FCR** Feed conversion ratio.

Carcass yield of rabbits

Table 2: Shows effect of phytobiotic blend (turmeric-garlic-ginger-clove) on carcass yield of rabbits**.** Significant (P<0.05) differences were obtained on the bled weight, singeing weight, head and liver. Highest (P<0.05) bled weight (96.53%) was recorded with rabbit fed diet containing the blends while rabbit fed diet without the inclusion blends had the least bled weight (93.71%). There was significant difference (P<0.05) on singeing weight. Highest singeing weight (92.80%) was recorded with rabbit fed diet containing the blends and lowest (89.36%) with rabbit fed diets without the inclusion of the blends. Head weight was significant (P<0.5). Highest head weight (19.53%) was recorded with rabbit fed diet without the inclusion of the blend and lowest (15.70%) with rabbit fed diets with the inclusion of the blends. There was significant difference (P<0.05) on liver weight. Highest liver weight (6.37%) was recorded with rabbit fed diet without the inclusion of the blend and lowest (4.97%) with rabbit fed diets with the inclusion of the blends. However, live weight, evicesrated weight, dreesed weight, neck, forelimb, hindlimb, loin kidney, heart and lungs of male and female rabbits were not significantly (p>0.05) influenced by blends inclusion.

Table 2: Effects of phytobiotic blend (turmeric-garlic-ginger-clove) on carcass yield of rabbits

Parameters	**Without blend (0g)**	**With blend (10g)**	**SEM**	**P-Value**
Live weight (g)	1593.80	1737.50	70.67	0.39
Bled weight (%)	93.71[b]	96.53[a]	0.55	0.01
Singeing weight (%)	89.36[b]	92.80[a]	0.75	0.01
Eviscerated weight (%)	68.02	73.61	2.15	0.21
Dressed weight (%)	53.47	57.31	1.67	0.33
Cut part (%)				
Head	19.53[a]	15.70[b]	1.16	0.04
Neck	3.92	3.23	2.19	0.17
Fore limb	40.18	33.97	2.73	0.13
Hind limb	44.92	39.43	0.23	0.28
Loin	30.27	26.54	1.93	0.35
Organ (%)				
Liver	6.37[a]	4.97[b]	0.26	0.01
Kidney	1.41	1.32	0.07	0.87
Heart	0.64	0.61	0.05	0.87
Lungs	1.06	1.21	0.08	0.30

abc: Means in the same row with different superscripts differ significantly (P<0.05).

There was significant (P<0.05) effect of blend on bled weight, singeing weight, head and liver of rabbits fed diet containing turmeric, garlic, ginger and clove. This finding agrees with the report of Raghdad *et al.* (2012); Okanlawon *et al.* (2020b) that stated that supplementation of phytoboitic in rabbit and broiler chicken significantly effect on bled weight, singeing weight, head and liver. The inclusion of the blend experimental diet causes a decrease on weight of cut part and internal organs of rabbits. This result was in close agreement with the results of Al-Sultan (2003), who also concluded that feeding of high level of photobiotic alters the size of some major organs that are involved in nutrient metabolism.

Hematological parameters of rabbits

Table 3: Shows main effect of blend on haematological parameter of rabbit fed diet containing turmeric-garlic-ginger-clove. Significant (P<0.05) differences were obtained on white blood cell.

Table 3: Effects of phytobiotic blend (turmeric-garlic-ginger-clove) on haematological parameter of rabbits

Parameter	**Without blend (0g)**	**With blend (10g)**	**SEM**	**P-value**
Pack cell volume (%)	36.13	34.63	0.42	0.09
Red blood cell ($X10^6$cell/ul)	5.44	5.18	0.07	0.14
White blood cell (X^{10}cell/ul)	6812.50[a]	5156.30 [b]	354.43	0.004
Neutrophils (%)	57.13	54.63	2.97	0.74
Lymphocyte (%)	41.50	44.00	2.77	0.73
Eosinophils (%)	1.25	1.00	0.24	0.54
Monocyte (%)	0.75	0.25	0.20	0.24
Haemoglobin centration (mg/dl)	12.00	11.53	0.14	0.12
MCH (pg/cell)	22.00	21.36	0.54	0.51
MCV (fl)	64.99	66.85	0.63	0.14
MCHC (g/dl)	31.90	31.73	0.23	0.67
Platelet (X 10^3cell/ul)	489.88	470.63	16.82	0.57

abc: Means in the same row with different superscripts differ significantly (P<0.05)
(MCH): Mean corpuscular haemoglobin, **(MCV):** Mean corpuscular volume, **(MCHC):** Mean corpuscular haemoglobin concentration.

Higher (P<0.05) white blood cell (6812.50 cell/ul) was recorded with rabbit fed diet without the inclusion of the blend while rabbit fed diet with the inclusion of the blend had the least (5156.3050 cell/ul). No significant (P>0.05) difference were recorded on pack cell volume, red blood cell,

neutrophils, lymphocyte, eosinophils, monocyte, haemoglobin centration, mean corpuscular hemoglobin, mean corpuscular volume, mean corpuscular hemoglobin concentration and platelet.

Blend had no significant (P>0.05) effect on haematological parameter of rabbit except for white blood cell. The haematological of this experiment falls within the range reported by Merck Manual (2012) for healthy rabbits.

The general decrease in the haematolgical parameter of rabbits fed turmeric, ginger, garlic and clove in the diets indicates that the blend had no effect in stimulating blood production. This is not in line with the report of Ademola *et al.* (2009); Zomrawi *et al.* (2011); Suha (2014); who suggested that these herbs may have helped in boosting the immune system of the rabbits. This might be as a result of combination of the four blend at which might not meet up in increasing the blood component.

Serum biochemistry of rabbit

Table 4: Shows effect of blend on serum biochemistry of rabbit fed diets containing turmeric-garlic-ginger-clove blend. No significant (P>0.05) difference were recorded on total protein, albumin, globulin, creatinine, aspartate transaminase, alanine transaminase, cholesterol and urea.

Table 4: Effects of phytobiotic blend (turmeric-garlic-ginger-clove) on serum biochemistry of rabbits

Parameter	**Without blend (0g)**	**With blend (10g)**	**SEM**	**P-value**
Total protein (g/dl)	6.96	6.64	0.14	0.32
Albumin (g/dl)	3.86	4.00	0.07	0.26
Globulin (g/dl)	3.09	2.65	0.15	0.19
Creatinine (mg/dl)	2.46	2.89	0.43	0.67
Aspartate transaminase (U/L)	69.88	64.50	2.80	0.37
Alanine transaminase (U/L)	68.75	64.38	2.28	0.26
Cholesterol (mg/dl)	60.61	49.81	7.23	0.44
Glucose (mg/dl)	121.65	124.61	4.95	0.70
Urea (mg/dl)	19.26	15.96	1.70	0.37

The result of the experiments falls within the normal range reported by Merck Manual (2012) for healthy rabbits. This result is not in line with report of Ademola *et al.* (2005); Onu *et al.* (2011) who reported that the inclusion of the blend had significant (P<0.05) effect on serum biochemistry of rabbit and this might be due to the level of combination use in this study. Decrease in the value urea below the normal value for healthy rabbit in this experiment is in

line with report of Adebisi (2018) who reported a drop in urea value as the age of the animal increases.

CONCLUSION

This study concluded that inclusion of phytobiotic blend in the diet at 10g had no detrimental effect on growth performance, carcass yield, cost benefit and it also help to maintain the good health status in terms of haematology and serum biochemistry in rabbit production.

REFERENCE

Adebisi, K. A. (2018). Age –Related changes in serum biochemical parameter in domestic Rabbits.

Ademola, S.G., Farimu, G.O. and Babatunde, G.M. (2009). Serum lipid, growth and haematological parameters of broilers fed garlic, ginger and their mixtures. *World Journal of Agricultural Science,* 5(1): 99-104.

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.

Adeniyi, A. A. and Balogun, O. O. (2002). Utilization of flavour treated rumen content mixture in the diets of laying hens. *Nigeria Journal of Animal Production,* 29:34-39.

AL-Sultan, S.I. (2003). The Effect of *Curcuma longa* (Turmeric) on Overall Performance of Broiler Chickens. *International Journal of Poultry Science,* 2(5):35–353.

Duncan, (1955). Multiple range and multiple F tests. *Biometrics*, 11: 1–42.

Haen, P. J. (1995). "Principles o Hematology", Brown Communications, Dubuque, 454 pp,

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

Iranloye, B.O. (2002). Effect of chronic garlic feeding on some haematological parameters. *Africa Journal Biomedical Research.*, 5: 81- 82.

Jayaprakasha, G.K., Rao, L.J.M. and Sakariah, K.K. (2002). Improved HPLC method for the determination of curcumin, demethoxycurcumin, and bisdemethoxycurcumin. *Journal of Agriculture and Food Chemistry.* 50, 3672-3668

Kikusato, M. (2021). Phytobiotics to improve health and production of broiler chickens: functions beyond the antioxidant activity. *Animal Bioscience*. 34(3):345-353.

Kohn, R.A. and Allen, M.S. (1995) Enrichment of proteolitic activity relative to Nitrogen in preparation from the rumen for *in vitro* studies. *Animal Feed Science Technology, 52(1/2): 1-14.*793937ja

Mbaveng, A. T. and Kuete, V. (2017). Syzygium aromaticum, Chapter 29. Editor(s): Victor Kuete, Medicinal Spices and Vegetables from Africa, Academic Press, 2017, Pages 611-625, ISBN 9780128092866.

Melillo, A. (2007). Rabbit Clinical Pathology. *Journal of exotic pet medicine,* 16(3), 135–145. https://doi.org/10.1053/j.jepm.2007.06.002.

Merck Veterinary Manual, (2012). 11th Edition Susan E. Aiello, Michael A. Moses ISBN: 978-0-911-91061-2 July. Whitehouse Station, NJ :Merck & Co., Inc.

NRC (1977). National Research Council. *Nutrient Requirements of Rabbits*, 2nd Revised Edition, Washington, DC: The National Academies Press .

Okanlawon, E. O., Bello, K. O., Akinola, O. S., Oluwatosin, O. O., Irekhore, O. T. and Ademolue, R. O. (2020a). Evaluation Of Growth, Reproductive Performance And Economic Benefits Of Rabbits Fed Diets Supplemented With Turmeric (*CurcumaLonga*) Powder. *Egyptian Poultry Science Journal http* Vol. (40) (III): (701-714) (2020).

Okanlawon, E.O., Bello, K.O., Akinola, O.S., Oluwatosin, O.O., Irekhore, O.T. and Ademolue, R.O. (2020b). Carcass yield and intestinal morphology of male rabbits fed diets supplemented with turmeric (Curcuma Longa) powder. *Ghana Journal Agricultural of Science.* 55(2):97–106.

Okoye, F.C., Ugwueme, M.C. and Mbarah, J.U. (2006). Effects of local spices on the utilization of cassava peel meal based diets by weaver rabbits. *Pakistan Journal of .Nutrition.* 5(3):202- 205.

Omage, J. J., Onimisi, P.A., Adegbite E.A. and Agunbiade, M.O. (2007). The effect of Ginger (Zingiber officinale Roscoe) waste meal on growth performance,carcass characteristics, serum lipid and serum cholesterol profiles of Rabbit. *Pakistan Journal of Nutrition* 6(4):359-362.

Onu, P.N. and Aja, P.M. (2011). Growth Performance and Haematological indices of Weaned Rabbits Fed Garlic (Allium Sativum) and Ginger (Zingiber Officinale) Supplemented Diets *International Journal of Food, Agriculture and Veterinary Sciences* ISSN: 2277-209.

Peter, T., Biamonte, G.T. and Doumas, B.T. (1982). Protein (Total protein) in serum, urine and cerebrospinal fluids; Albumin in serum. In: Selected method of clinical chemistry. Volume 9 (Paulkner WR, Meites S Eds) American Association for clinical chemistry, Washington, D.C.

Petrescu, D. C., Oroian, I.G., Mihaiescu, T., Paulette, L., Varban, D. and Patrutoiu, T.C. (2013). Rabbit statistics overview: production, trade, market evolution. *Rabbit Gen* 3(1):15-22.

Raghdad, A. and Al-kassie, A. (2012). Use of turmeric (Curcuma longa) on the performance and some physiological traits on the broiler diets. *The Iraqi Journal of Veterinary Medicine* 36 (1): 51 − 57.

Rej, R. and Hoder, M. (1983). Aspartate transaminase. In: Methods of Enzymatic Analysis. 3rd ed. (H.U.Bergmeyer, J. Bergmeyer and M. Grassl, Eds). *Weinhein Verlag-Chemie*, 3: 416-433.

Roeschlau, P., Beru,T. E. and Gruber, J.W. (1974). *Clinical Chemistry*, 12: 403.

Sorhue, G. U., Akporhuarho, P.O. Udeh, I. and Mmereole, F.C.U. (2013). Estimates of Genetic parameters of litter size traits at birth and weaning in domestic rabbits (*Oryctola guscuniculus*) raised in Anwai community, South Nigeria. Rabbit Gen 3(1):7-14.

Statistical Analysis System User's guide (SAS,2002). Statistics. SAS Institute Inc,cary. No 27513 U.S.A.

Suha Abdul-khaliq., (2014). Effect of Garlic Powder (Allium sativum) on Blood Constituents in Male Rabbits. *Journal of Al-Nahrain University Science*.17 (3):132-137 Statistical Analysis System User's guide SAS, 2002. Statistics. SAS Institute Inc,cary. No 27513 U.S.A.

Venkatesan, R., Nagarajan, P. Rajaretnam, R.S and Majumdar, S.S. (2006). "Hematologic and serum biochemical values in aged female bonnet macaques (Macaca radiata) anesthetized with ketamine hydrochloride", *J. Amer. Assoc. Lab. Anim. Sci.,* 45 (2): 45-48.

Visput, M.M., (2019). Improvement in poultry performance through application of phytobiotics. www.side share.net.

Zomrawi, W.B., Abdel, A. and Dousa, B.M. (2012). The effect of ginger root powder (Zingiber officinale) supplementation on broiler chicks performance, blood and serum constituents. *Online J. Anim. Feed Res.*, 2(6): 457-460.