



Effects of Dietary Inclusion of Ginger (*Zingiber Officinale*) and Garlic (*Allium Sativum*) Oil (GGO) Mixtures on Carcass Characteristics and Sensory Evaluation of Broiler Chickens

R. A Oluwafemi¹, Aisha Omolade Lawal¹, Adelowo Samad Adetope¹, J. O Alagbe²

¹Department of Animal Science, University of Abuja, Nigeria

²Department of Animal Nutrition and Biochemistry, Sumitra Research Institute, Gujarat India

*Corresponding Author: Alagbe, J.O

Email: dralagbe@finmail.com



Article Info

Article history:

Received 9 October 2021

Received in revised form 18

November 2021

Accepted 30 November 2021

Keywords:

Broilers

Ginger

Garlic

Sensory Evaluation

Phytochemicals

Abstract

An experiment was conducted to assess the influence of GGO on carcass features and sensory assessment of broiler chickens. 120 1-day-old (*Arbro acre*) birds were separated into five treatments, each with three replicates of 8 birds. Throughout the 8-week trial, clean feed and water were available at all times. NRC's basal diet was designed to suit avian nutritional needs (1994). A 0% GGO meal was given to the birds in treatment 1, whereas GGO levels of 0.1, 0.2, 0.3 and 0.4 percent were given to the birds in treatments 2, 3, 4, and 5. As well as studying the phytochemical content of (*Zingiber officinale*) and garlic (*Allium sativum*) oil, carcass and organ features of birds were also studied. *Zingiber officinale* contains phenols (8.21%), alkaloids (5.12%), flavonoids (7.49%), tannins (6.52%), saponins (3.18%), sterioids (2.38%), glycosides (0.18%), oxalates (0.07%), and phytate (0.07%). (0.02 %). *Sativum* contains flavonoids (10.67%) alkaloids (7.02%) tannins (4.72%) steroids (3.65%) saponin (2) glycoside (0.33%) oxalates (0.26%) and phytate (0.26%). (0.05 %). Dressing %, carcass and relative organ weights differed across treatments ($P < 0.05$). The liver, kidney, spleen, and other internal organs showed no signs of inflammation. GGO altered meat sensory assessment (tenderness, juiciness, taste, and fragrance) except meat color which was not significantly ($P < 0.05$) different across treatments. GGO may be fed to broilers up to 0.4 percent without affecting their health or performance.

Introduction

Poultry has a relatively short life cycle and is thus much more visible than bigger animals such as cattle, for example. Despite their ease of cultivation, they are very adaptable to a broad variety of environmental conditions (Eriksson, 2008). The protein in chicken meat is similar to that found in turkeys, cattle, and swine in terms of amino acids needed by humans, and it is readily digested as a result. When compared to port, which is forbidden by Muslims, poultry meat has a broad acceptability with little or no restriction in terms of cultural and religious taboos, and may be prepared in a variety of ways (Dixon, 2008). However, the industry in developing countries is confronted with a number of challenges, including a high feed to gain ratio and an increase in the cost of feed as a result of high feed ingredient prices, as well as, more recently, multidrug resistance as a result of the widespread use of antibiotics without regard for the intended purpose (Abbas, 2013; Alagbe and Betty, 2019; Olafadehan et al., 2019).

Due to increased consumer pressure on manufacturers to reduce medication usage (antibiotics), researchers are doing more research into antibiotic substitutes. Probiotics, prebiotics, organic acids, and plant extracts (essential oils) are just a few of the possible choices (Bento et al., 2013; Zhang et al., 2005). They are volatile, fragrant oily liquids extracted from plant components that have a distinct scent and chemical makeup that distinguish them from other essential oils. The chemical molecules that make up these complex mixes include terpenes, terpenoids, aldehydes, alcohols, phenols, methoxy-derivatives, and a few others, the most prevalent of which are terpenes (Dorman and Deans, 2000; Kalemba and Kunicka, 2003; Alagbe, 2019). Botslogou and colleagues (2002) cite Alagbe as a source of information (2018), Because of the presence of phytochemicals in essential oils, they help to increase the generation of digestive secretions and nutrient absorption, so boosting gut health and increasing the quality of meat.

Nutmeg, lime, mandarin, orange, rosewood, oregano, mountain savory, fennel, turmeric, rosemary, sage, neem, cinnamon, thyme, ginger, eucalyptus, garlic, pimenta, lemongrass, and clove are some of the major aromatic oils that have the potential to be used in chicken production and processing. It is possible to employ these essential oils as feed additions or drinking water additives, or as anti-bacterial agents in the preparation of chicken products (Yesilbag et al., 2011; Li et al., 2012).

A delicacy, a medicinal, and a spice, ginger is the rhizome of the plant *Zingiber officinale*, which may be eaten raw or cooked. The first findings of preliminary study show that nine chemicals contained in ginger may bind to serotonin receptors, which may have an effect on gastrointestinal function (Botsoglou et al., 2002). Researchers have discovered that ginger extract may be able to regulate the amount of free radicals produced as well as the peroxidation of lipids in vitro testing (Al-Amin et al., 2006). zingerone, shagaols, and gingerols, volatile oils found in small amounts in fresh ginger (one to three percent of the weight of fresh ginger), are responsible for the distinctive odor and taste of ginger. According to Rivlin (2001), gingerols have analgesic, sedative, antipyretic, and antibacterial effects in experimental animals. Gingerols also have analgesic, sedative, antipyretic, and antibacterial characteristics in humans.

Garlic (*Allium sativum*) has been used as a spice and as a traditional remedy for thousands of years in many cultures. It has been shown to have antibacterial, antifungal, antiparasitic, antiviral, antioxidant, anti-cholesteremic, anticancerous, and vasodilator properties, among other things (Khan et al., 2007; Hanieh et al., 2010). Garlic's most important active element is the plant chemical allicin, which decomposes fast to form a number of volatile organosulfur compounds with bioactivities in the body (Chang and Cheong, 2008). Broiler chicken diets including ginger and garlic supplements have become well-known because of the significant stimulation they provide to the immunological and digestive systems of the birds (Gardzielewska et al., 2003).

Aims of the experiment were to determine the effects of dietary inclusions of garlic (*Allium sativum*) and ginger (*Zingiber officinale*) oil combination on the carcass characteristics and sensory assessment of broiler chickens.

Methods

Site of the experiment

In this research, the participants were participants in the Department of Animal Science at the University of Abuja Teaching and Research Farm, located on the Main Campus, along the airport Road in Gwagwalada, Abuja. Gwagwalada is the administrative center of the Gwagwalada Area Council, and it is situated between the latitudes of 8o571 and 8o551N and longitude 7o051 and 7o061E (Balogun, 2001).

Sourcing, authentication and extraction of oil (GGO)

Fresh ginger and garlic rhizomes were acquired at a local market in Gwagwalada, Abuja, Nigeria, and used in this experiment. The samples were screened to exclude the poor ones, then cleaned and peeled by hand with a kitchen knife to remove the outer coating of the rhizomes, which was then dried. It was dried for 14 days before being pulverized into powder using a laboratory blender (Panasonic: Model 07A-08C). The powder was then kept in an airtight properly labeled container for later investigation. Using the soxhlet extraction process, 100g of the sample was put in a reflux condenser, which is comprised of a condenser and a round bottom flask, and the oil was extracted for 24 hours. Petrolatum ether, heated to 65°C to achieve vaporization point before the filtrate was exposed to the environment and the leftover solvent allowed to evaporate before extracting the oil, was employed as a solvent in this procedure. The extracted oil was combined with the garlic oil in a one-to-one ratio to produce the ginger and garlic oil combination (GGO).

Pre-experimental operations

Pens were fumigated two weeks before the start of the trial, the surrounding area was cleaned, and a foot bath was made accessible in order to maintain rigorous biosecurity standards. The feeding and water troughs had been thoroughly cleaned, and all other electrical fittings had been properly repaired.

Experimental Animals and their management

It was decided to conduct the experiment using one hundred and fifty one-day-old (Arbo acre) broiler chicks of mixed sexe. The birds were obtained from a commercial hatchery in the Nigerian city of Ibadan, in the state of Oyo. It was weighed upon arriving on the farm in order to determine their starting body weight, and anti-stress medication was administered in order to alleviate tension and avoid death. The experiment was carried out in a deep litter housing system, and the birds were separated into five treatment groups, each of which had three repetitions of 10 birds, in a totally randomized design. The heat was provided by charcoal pots, while the litter material was made from wood shavings and sawdust. Throughout the trial, which lasted eight weeks, all other management standards were properly adhered to.

Ration formulation

As shown in Table 1, two baseline diets were developed at various phases of production to fulfill the nutritional needs of birds as defined by the National Research Council (1994). Broiler starter's mash (stored for 1-21 days), Gowers mash (stored for 22-35 days), and finishers mash (stored for 1-21 days) (36-56 days). A dietary inclusion of ginger and garlic oil (GGO) at a rate of 0 percent was provided to the birds in Treatment 1 (T1), while T2, T3, T4 and T5 were fed 0.1 %, 0.2 %, 0.3 % and 0.4 % respectively.

Measurements

Carcass evaluation

A total of three birds were randomly picked from each treatment at the conclusion of the eighth week; they were fed fasted overnight and given new clean water before being weighed, murdered, and manually de-feathered. The carcass weight, dressed weight, weight of the visceral organs, and weight of the chopped sections of the birds were all measured and documented. The relative organ weights of the carcass were represented as a percentage (percentage) of the dress weights of the birds in the study.

Sensory evaluation

In this study, 10 panelists assessed the sensory quality of cooked samples of broiler chicken breast minced flesh from three birds per treatment, which included three different treatments.

Color, juiciness, flavor, tenderness, and general acceptability are just a few of the characteristics that the panelists examine. Each sample of meat was coded and then offered one by one to each member of the panel, in this order. After evaluating each beef sample, each member washed his or her mouth with warm water to minimize a carryover effect. The panelists assigned ratings on a nine (9) point hedonic scale, which included the following categories: (i) Dislike extremely (ii) Dislike very much (iii) Dislike moderately (iv) Dislike slightly (v) Intermediate (vi) Like slightly (vii) Like moderately (viii) Like very much (ix) Like extremely

Phytochemical analysis

Harbone's gravimetric and double gravimetric procedures were used to evaluate the presence of flavonoids, alkaloids, saponin, oxalates, and steroids in the samples (1973). Estimations were made using techniques provided by Harbone (1973), Odebiyi and Sofowora (1998), and others. Phenols, terpenoids, and tannins were determined using methods reported by Odebiyi and Sofowora (1978).

Statistical analysis

The results of the study were submitted to a one-way analysis of variance (ANOVA) using SPSS (18.0), and the means that were statistically significant were separated using software from the same package. If the p-value was less than 0.05, a statistically significant difference was proclaimed.

Table 1. Chemical composition of experimental diets

Materials	Starter (1-21 days)	Grower (22-35 days)	Finisher (36-56 days)
Maize	50.00	55.00	60.00
Wheat offal	8.00	8.00	8.05
Soya meal	28.55	22.00	21.00
Groundnut cake	10.00	11.55	6.05
Fish meal	2.00	2.00	2.00
Bone meal	0.35	0.40	0.40
Limestone	0.20	0.20	0.20
Lysine	0.15	0.15	0.15
Methionine	0.20	0.20	0.20
Premix	0.25	0.25	0.25
Salt	0.30	0.30	0.30
TOTAL	100.0	100.0	100.0
Calculated analysis			
Crude protein	23.08	20.11	19.33
Ether extract	5.03	4.87	4.28
Crude fibre	3.06	3.95	3.42
Calcium	0.98	1.00	1.10
Phosphorus	0.47	0.40	0.51
Lysine	1.17	1.29	1.60
Meth +Cyst	0.87	0.82	0.51
ME (Kcal/kg)	2936	3000.8	3100.2

*Premix supplied per kg diet: - vit A, 13,000 I.U; vit E, 5mg; vit D3, 3000I.U, vit K, 3mg; vit B2, 5.5mg; Niacin, 25mg; vit B12, 16mg; choline chloride, 120mg; Mn, 5.2mg; Zn, 25mg; Cu, 2.6g; folic acid, 2mg; Fe, 5g; pantothenic acid, 10mg; biotin, 30.5g; antioxidant, 56mg.

Result and Discussion

Phytochemical composition of ginger oil

Phytochemical composition of ginger oil is present in Table 2. Phytochemical components revealed the presence of phenols (8.21 %), alkaloids (5.12 %), flavonoids (7.49 %), Tannins (6.52 %), saponins (3.18 %), steroids (2.38 %), glycosides (0.18 %), oxalates (0.07 %) and phytate (0.02 %). Phenol had the highest concentration followed by flavonoids then tannins, alkaloids, saponins, steroids, glycosides, oxalates and tannins respectively. The chemical compounds in essential oils can be affected by plant parts, method of extraction, species, climatic conditions, anti-nutrients (Omonijo *et al.*, 2018). Higher concentrations of saponins, tannins and flavonoids in ginger oil confers it the ability to function as an antioxidant, anti-microbial and anti-inflammatory activities (Oluwafemi *et al.*, 2020; Shittu and Alagbe, 2020; Okwu, 2004).

Phytochemical composition of ginger oil

Table 2. Phytochemical composition of ginger oil

Constituents	Composition (%)
Alkaloids	5.12
Saponins	3.18
Flavonoids	7.49
Tannins	6.52
Oxalates	0.07
Phytate	0.02
Glycosides	0.18
Steroids	2.38
Phenols	8.21

Phytochemical composition of garlic oil

Phytochemical composition of garlic oil is present in Table 3. Phytochemical components revealed that flavonoids (10.67 %), phenols (9.19 %), alkaloids (7.02 %), tannins (4.72 %), steroids (3.65 %), saponins (2.40 %), glycosides (0.33 %), oxalates (0.26 %), phytate (0.05 %). Adisa *et al.* (2010) reported that tannins known to possess antibacterial and antiviral activity. Phytates and/or phytates compete with essential dietary minerals such as calcium, zinc, iron and magnesium to make them biologically unavailable for absorption (Alagbe, 2019; Faizi *et al.*, 2003). Phenols are strong antioxidants which prevent oxidative damage to biomolecules such as DNA, lipids and protein that play a role in chronic disease, (Ojewuyi *et al.*, 2014). Phenols are strong antioxidant which prevent the entry of diseases (Singh *et al.*, 2021; Oluwafemi *et al.*, 2021).

Table 2. Phytochemical composition of garlic oil

Parameters	Composition (%)
Alkaloids	7.02
Saponins	2.40
Flavonoids	10.67
Tannins	4.72
Oxalates	0.26
Phytate	0.05
Glycosides	0.33
Steroids	3.65
Phenols	9.19

Carcass and weights of broiler chicks fed diet supplemented with garlic and ginger oil

Carcass weight of broiler chicks fed diet supplemented with garlic and ginger oil is presented in Table 4. The live weight, dress weight and dressing percentage range between 1942.6 – 2600.4 g, 1492.6 – 2245.4 g and 78.98 – 86.35 % respectively. Weights of head (40.86 - 56.46 g), breast (499.4 - 880.1g), thigh (501.3 - 688.3 g), wing (156.2 - 266.3 g), back (394.3 - 521.5 g), neck (85.60 - 115.2 g), legs (65.00 - 95.38 g), heart (9.85 - 12.06 g), spleen (1.63 - 2.85 g), liver (38.63 - 52.00 g), kidneys (0.12 – 0.24 g), gizzard (53.33 – 63.96 g) and intestine (150.3 - 206.1g). All the parameters were significantly ($P<0.05$) influenced among the treatments.

Table 3. Carcass and organ weights of broiler chicks fed diet supplemented with ginger and garlic oil (GGO)

Parameters	T1	T2	T3	T4	T5	SEM
LW (g)	1942.6 ^b	2060.3 ^a	2402.4 ^a	2520.1 ^a	2600.4 ^a	10.89
Dress wgt (g)	1492.6 ^b	1708.3 ^b	2047.4 ^a	2165.1 ^a	2245.4 ^a	9.06
DP (%)	78.98 ^b	82.77 ^a	85.22 ^a	85.91 ^a	86.35 ^a	2.85
Head (g)	40.86 ^b	45.86 ^b	48.87 ^b	52.76 ^a	56.46 ^a	12.60
Breast (g)	499.4 ^c	731.4 ^b	735.8 ^b	760.3 ^b	880.1 ^a	24.60
Thigh (g)	501.3 ^b	555.5 ^b	596.3 ^b	607.4 ^a	688.3 ^a	33.40
Wing (g)	156.2 ^b	188.0 ^b	201.7 ^a	215.8 ^a	266.3 ^a	10.98
Back (g)	394.3 ^c	458.1 ^b	480.1 ^b	514.4 ^a	521.5 ^a	9.66
Neck (g)	85.60 ^c	95.96 ^b	96.15 ^b	100.8 ^a	115.2 ^a	8.03
Legs (g)	65.00 ^b	88.86 ^a	92.38 ^a	95.20 ^a	95.38 ^a	5.60
Heart (g)	9.85 ^b	10.56 ^a	11.51 ^a	11.81 ^a	12.06 ^a	1.44
Spleen (g)	1.63 ^b	1.70 ^b	1.93 ^b	2.10 ^a	2.85 ^a	0.60
Liver (g)	38.63 ^c	39.43 ^c	45.13 ^b	47.75 ^b	52.00 ^a	1.74
Kidneys (g)	0.12 ^b	0.15 ^b	0.14 ^b	0.12 ^b	0.24 ^a	0.01
Gizzard (g)	58.88 ^b	60.90 ^a	60.93 ^a	62.26 ^a	63.96 ^a	5.16
Intestine (cm)	150.3 ^b	155.8 ^b	165.8 ^b	184.3 ^b	206.1 ^a	12.63

Means in the same row with different superscripts differ significantly ($P<0.05$) SEM: standard error of mean; LW: live weight; DP: dress weight

Relative organ weight and primal cut parts of broiler chicks fed different inclusions of GGO

Relative organ weight and primal cut parts of broiler chicks fed diet supplemented with ginger and garlic oil is Table 5. The head, breast, thigh, wing, back, neck, legs, heart, spleen, liver, kidneys and gizzard ranges between 2.44 - 2.74 %, 33.19 - 42.81 %, 28.05 - 33.59 %, 9.97 - 11.86 %, 23.23 – 26.42 %, 4.66 – 5.73 %, 4.25 – 5.20 %, 0.54 – 0.66 %, 0.09 – 0.13 %, 2.20 – 2.59 %, 0.003 - 0.008 % and 2.85 – 3.94 %. Significant differences ($P<0.05$) were observed among the birds in each of the treatments.

Carcass and relative organ weights of birds revealed that there were significant differences ($P<0.05$) among the treatments. Carcass weights were highest in T2, T3, T4 and T5 and lowest in T1. The dressing percentage values were in close agreement with the findings of Kirkpinzar *et al.* (2014) who examined the effect of garlic and oregano oil on the carcass characteristics of broiler chickens. Similar result was observed by Tihonen *et al.* (2010), who recorded a higher dressing percentage in birds fed 0.3 % garlic oil. Significant differences ($P<0.05$) observed among the various organs indicated that garlic and ginger oil are non-toxic since there was no noticeable inflammation on the internal organs of the animals. According to Alagbe (2017), presence of anti-nutritional factors is associated with enlargements of internal organs like liver, kidney, pancreas and spleen. Similarly, Bamgbose *et al.* (2004) reported that dress weight and

internal organs weight characteristics are veritable indicators of the level of reduction or otherwise of anti-nutritional factors. Phytochemicals in the test material has proven to increase the absorption of nutrients which translates to a better final weight gain among birds.

Table 4. Relative organ weights and primal cut parts of broiler chicks fed diet with different inclusion of GGO

Parameters (%)	T1	T2	T3	T4	T5	SEM
Head	2.74 ^a	2.68 ^a	2.38 ^b	2.44 ^b	2.57 ^a	0.11
Breast	33.46 ^b	42.81 ^a	35.93 ^b	35.12 ^b	31.19 ^b	2.65
Thigh	33.59 ^a	32.52 ^a	29.12 ^b	28.05 ^b	30.54 ^a	0.42
Wing	10.46 ^a	11.01 ^a	9.85 ^b	9.97 ^b	11.86 ^a	0.51
Back	26.42 ^a	26.82 ^a	23.45 ^b	23.76 ^b	23.23 ^b	2.66
Neck	5.73 ^a	5.62 ^a	4.69 ^b	4.66 ^b	5.13 ^a	0.54
Legs	4.36 ^b	5.20 ^a	4.59 ^b	4.39 ^b	4.25 ^b	0.02
Heart	0.66 ^a	0.62 ^a	0.56 ^b	0.55 ^b	0.54 ^b	0.01
Spleen	0.11 ^b	0.09 ^a	0.09 ^a	0.09 ^a	0.13 ^b	0.01
Liver	2.59 ^a	2.31 ^a	2.20 ^b	2.21 ^b	2.32 ^a	0.12
Kidneys	0.003 ^b	0.008 ^a	0.007 ^a	0.006 ^a	0.004 ^b	0.001
Gizzard	3.94 ^a	3.56 ^a	2.98 ^b	2.88 ^b	2.85 ^b	0.13

Means in the same row with different superscripts differ significantly ($P<0.05$); SEM: standard error of mean

Sensory evaluation of meat from broiler chicks fed diet supplemented with ginger and garlic oil mixture

Sensory evaluation of broilers fed diets containing ginger and garlic oil mixtures is presented in Table 6. The Parameter examined includes, tenderness, juiciness, flavour, colour, and aroma. Tenderness values ranges from 4.32 – 9.04, juiciness (6.60 – 8.90), flavour (5.72 - 8.37), colour (7.36 – 7.80) and aroma (6.42 – 8.93). Significant differences ($P<0.05$) were observed among tenderness, juiciness, flavour and aroma. Colour values were not significant influenced ($P>0.05$) among the treatments.

Sensory evaluation of broiler chicken fed diet supplemented with garlic and ginger oil mixture (GGO) revealed that the meat tenderness, flavour, juiciness and aroma were significantly affected ($P<0.05$). This is a clear indication that GGO contains phytochemicals which are capable of enhancing the quality of meat. The result obtained was in agreement with the findings of Barreto *et al.* (2008); Pisarski *et al.* (2007); Musa *et al.* (2020) when different mixture was fed to broiler chicks but contrary to the reports of Symeon *et al.* (2009); Burt (2000) who fed broilers diet supplemented with 250 mg/kg oregano essential oil. The non-significant differences ($P>0.05$) recorded in the colour of the meat clearly shows that GGO has no carotene content. According to Young *et al.* (2003), dietary supplementation of oregano and neem oil in broiler chickens at 3 % is capable of affecting the colour in the muscle.

Table 5. Sensory evaluation of meat from broiler chicks fed diet supplemented with ginger and garlic oil mixture

Parameters	T1	T2	T3	T4	T5	SEM
Tenderness	4.32 ^c	7.01 ^b	8.33 ^a	8.56 ^a	9.04 ^a	0.66
Juiciness	6.60 ^c	7.73 ^b	8.02 ^a	8.50 ^a	8.96 ^a	0.52
Flavour	5.72 ^c	7.86 ^b	7.92 ^b	8.10 ^a	8.37 ^a	0.21
Colour	7.36	7.43	7.50	7.73	7.80	0.14
Aroma	6.42 ^b	8.10 ^a	8.62 ^a	8.80 ^a	8.93 ^a	0.10

Means in the same row with different superscripts differ significantly ($P < 0.05$); SEM: standard error of mean.

Conclusion

Essential oils are rich in secondary metabolites which are potential sources of drugs and essential oils of therapeutic importance. Essential oils are cheap, safe, effective and easily available. Dietary inclusion of GGO in broilers is capable of performing several pharmacological activities which includes: antioxidant, antimicrobial, anti-inflammatory, hepato-protective, hypolipidemic, cytotoxic etc. it can be used to further help to bridge the gap between food safety and production and can be included in the diets of broilers up to 0.4 % without causing any deleterious effect on the health and performance of birds.

References

- Al-Amin Z.M, Thomson M, Al-Qattan K.K, Peltonen Shalaby R, Ali M.(2006). Anti-diabetic and hypolipidemic properties of ginger (*Zingiber officinale*) in streptozotocin induced diabetic rats. *Br. J. Nutr.* 96:660–666.
- Adevale, A.O., Alagbe, J.O., Adeoye, Adekemi. O. (2021). Dietary Supplementation of *Rauvolfia Vomitoria* Root Extract as A Phytogenic Feed Additive in Growing Rabbit Diets: Haematology and serum biochemical indices. *International Journal of Orange Technologies*, 3(3): 1-12.
- Alagbe, J.O (2019). Proximate, mineral and phytochemical analysis of *Piliostigma thonningii* stems bark and roots. *International Journal of Biological, Physical and Chemical Studies*, 1(1): 1-7.
- Alagbe, J.O (2021). Dietary Supplementation of *Rauvolfia Vomitoria* Root Extract as A Phytogenic Feed Additive in Growing Rabbit Diets: Growth Performance and Caecal Microbial Population. *Concept in Dairy and Veterinary Sciences*. 4(2):2021.
- Alagbe, J.O. (2019). Performance and haemato-biochemical parameters of weaner rabbits fed diets supplemented with dried water melon (rind) meal. *Journal of Dairy and Veterinary Sciences*. 8(4):001-007.
- Alagbe, J.O. (2017) effect of Miadasan as a dietary supplement on performance, carcass characteristic and blood profile of broiler chicken. *Scholarly Journal of Agricultural Science*. 7(2):27-33.
- Abass, S.E. (2013). Chemical profile, antioxidant, antifungal and antiaflatoxigenic activity of parsley and ginger volatile and non-volatile extracts. *Journal of Biologically Active Products from Nature*. 1(1):81–96.
- Alagbe, J.O and Adegbite Motunrade Betty (2019). Haematological and serum biochemical indices of starter broiler chicks fed aqueous extract of *Balanites aegyptiaca* and *Alchornea cordifolia* bark mixture. *International Journal of Biological, Physical and Chemical Studies*. 1(1): 8-15
- Alagbe, J.O. (2019). Performance and haemato-biochemical parameters of weaner rabbits fed diets supplemented with dried water melon (rind) meal. *Journal of Dairy and Veterinary Sciences*. 8(4):001-007.
- Botsoglou, N.A., Florou-Paneri, E., Christaki, E., Fletouris, D. J and Spais B.A. (2002) Effect of dietary oregano essential oil on performance of chickens and on iron-induced lipid oxidation of breast, thigh and abdominal fat tissues. *Brit. Poultry Sci.* 43: 223-230.

- Burt S (2004). Essential oils: their antibacterial properties and potential applications in foods - a review. *International journal of food microbiology*, 94: 223-253.
- Balogun, O. (2001). *The Federal Capital Territory of Nigeria: A Geography of Its Development*. University of Ibadan Press Limited.
- Chang, L.K. & Cheong, D.C. (2008). *The impact of herbal medicines on dermatologic surgery*. *Dermatology Surgery*, 27(8): 759–763.
- Faizi, S., Khan, R.A., Azher, S and Khan, S.A. (2003a). New antimicrobial alkaloids from the roots of *Polyalthia longifolia*. *Planta Med.* 69:350-355.
- Gardzielewska, J., Pudyszak, K, Majewska, T., Jakubowska M. & Promianowski J. (2003) Effect of plant-supplemented feeding on fresh and frozen storage quality of broiler chicken meat. *Animal husbandry series of electronic J. Polish Agric-Univ.* 6 (2) [http:// www. ejpau- media.pl/series/volumes/issues/animal/art-12. html](http://www.ejpau-media.pl/series/volumes/issues/animal/art-12.html).
- Harborne, J. D. (1973). *Phytochemical methods: A guide to modern techniques of plant analysis*. Chapman and Hall, London. 279.
- Hanieh, H., Narabara, K., Piao, M., Gerile, C., Abe, A. and Kondo, Y. (2010) Modulatory effects of two levels of dietary Alliums on immune responses. *Animal Science Journal* 81: 673-680.
- Rivlin, R.S. (2001) Historical perspective on the use of garlic *J. Nutri.* 131 (35): 957-954.
- Shittu, M.D and Alagbe, J.O (2020). Phyto-nutritional profiles of broom weed (*Sida acuta*) leaf extract. *International Journal of Integrated Education* 3(11): 119-124.
- Tihonen, A.; Celik, L.; Kutlu, H.R.; Gorgulu, M. (2007). Effect of dietary supplemental plant extracts on performance, carcass characteristics, digestive system development, intestinal microflora and some blood parameters of broiler chicks. In *Proceedings of the 12th European Poultry Conference, Verona, Italy, 10–14 September 2006*; pp. 10–14.
- Musa, B., Alagbe, J.O., Adegbite Motunrade Betty, Omokore, E.A. (2020). Growth performance, caeca microbial population and immune response of broiler chicks fed aqueous extract of *Balanites aegyptiaca* and *Alchornea cordifolia* stem bark mixture. *United Journal for Research and Technology*, 2(2):13-21.
- Li, S.Y., Ru, Y.J., Liu, M., Xu, B and Shi, X.G. (2012). The effect of essential oil on performance, immunity and gut microbial population of weaner pigs. *Livestock Science* 145: 119-123.
- Khan, S. H., Sardar, R. & Anjum, M. A. (2007) Effects of dietary garlic on performance and serum and egg yolk cholesterol concentration in laying hens. *Asian-Australian Journal of Animal Sciences* 21: 22-27.
- Kalemba, J.E. and Kienicka, T.O.(2003). Dietary n- 3 polyunsaturated fatty acids and amelioration of cardiovascular disease: Possible mechanism. *Am. J. Clin. Nutr.* 52: 1-28.
- National Research Council (1994). *Nutrient requirement of poultry 9th Rev Edn*, Washington D.C. National Academy Press.
- Oluwafemi, R.A., Uankhoba, I.P and Alagbe, J.O. (2021). Effects of turmeric oil as a dietary supplements on the growth performance and carcass characteristics of broiler chicken. *International Journal of Orange Technologies*, 3(4): 1-9.

- Oluwafemi, R.A., Uankhoba, I.P and Alagbe, J.O. (2021). Effects of turmeric oil as a dietary supplement on the haematology and serum biochemical indices of broiler chickens. *Bioinformatics and Proteomics Open Access Journal* 5(1): 000138.
- Oluwafemi, R.A., Grace Funmi Reuben and Alagbe, J.O. (2020). Effect of feeding *Polyalthia longifolia* leaf meal as partial replacement of wheat offal. *European Journal of Biotechnology and Bioscience*. 8(4): 8-12.
- Olafadehan, O.A., Okunade, S.A., Njidda, A.A., Kholif, A.E., Kolo, S.G and Alagbe, J.O. (2019). Concentrate replacement with *Daniellia oliveri* foliage in goat diets. *Tropical Animal Health Production*. 52(1): 227 – 233.
- Ojewuyi, O.B, Ajiboye, T. O, Adebanjo, E. O, Balogun, A, Mohammed, A.O. (2014). Proximate composition, phytochemical and mineral contents of young and mature *Polyalthia longifolia* Sonn.leaves. *Fountain Journal of Natural and Applied Sciences*: 2014; 3(1): 10 – 19.
- Odebiyi, A. and Sofowora, A. E. (1978). Phytochemical Screening of Nigerian Medicinal Plant. Part III, *Lloydia*, 41, 234- 246.
- Omonijo, F.A., Ni, L., Gong, J., Wang, Q and Yang, C. (2012). Effect of essential oil supplementation as alternatives to antibiotics in swine production. *Animal Nutrition* 4:126-136.
- Okwu, D.E. (2004). Phytochemical and vitamin content of indigenous spices of South Eastern Nigeria *Journal of Sustainable Agriculture and Environment* 6:30-37.
- Singh, A.S., Alagbe, J.O., Sharma, S., Oluwafemi, R.A and Agubosi, O.C.P. (2021). Effect of dietary supplementation of melon (*Citrullus linatus*) seed oil on the growth performance and antioxidant status of growing rabbits. *Journal of Multidimensional Research and Reviews*, 2(1): 78-95.
- Yesilbag, D., Eren, M., Agel, H and Balci, F. (2011). Effect of rosemary oil and vitamin E on the performance, meat quality and serum sod activity. *British Poultry Science* 52: 472-482.
- Young-Liang J, Jun-Ming Z, Lin-Hui Z, Bao-Shan S, Meng-Jing B, Fen-fen L (2003). Analgesic and anti-inflammatory effects of ginger oil. *Chinese Herbal Medicines*. 3(2):150–55