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# Effects of dietary inclusion of ginger (Zingiber officinale) and garlic (Allium sativum) oil (GGO) mixtures on carcass characteristics and sensory evalaution of broiler chickens

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## Abstract

An experiment was carried out to examine the effect of dietary inclusion of ginger (Zingiber officinale) and garlic (Allium sativum) oil (GGO) mixtures on the carcass characteristics and sensory evaluation of broiler chickens. A total of 120 one-day-old (Arbo acre) were divided into five treatments with three replicates per treatment consisting of 8 birds each in a completely randomized design. Clean feed and water were provided ad libitum throughout the experiment which lasted for 8 weeks. Basal diet was formulated to meet the nutritional requirement of birds according to NRC (1994). Birds in treatment 1 (T1) were fed diet supplemented with 0 % GGO while T2, T3, T4 and T5 were fed GGO at 0.1 %, 0.2 %, 0.3 % and 0.4 % respectively. Results obtained were used to examine the phytochemical composition of (Zingiber officinale) and garlic (Allium sativum) oil as well as carcass and organ characteristics of birds. Phytochemical composition of Zingiber officinale revealed the presence of phenols (8.21 %), alkaloids (5.12 %), flavonoids (7.49 %), tannins (6.52 %), saponins (3.18 %), streiods (2.38 %), glycosides (0.18 %), oxalates (0.07 %) and phytate (0.02 %). Allium sativum contains 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 %). Dressing percentage, carcass and relative organ weights were significantly ($P<0.05$) among the treatments. There was no noticeable inflammation observed in the liver, kidney, spleen, liver and other internal organs. Sensory evaluation of the meat (tenderness, juiciness, flavor and aroma) were significantly ($P<0.05$) influenced by GGO except the meat colour which was not significantly ($P>0.05$) different among the treatments. It was concluded that GGO can be included up to 0.4 % in the diet of broilers without causing any deleterious effect on the health and performance of birds.

***Keywords: broilers, ginger, garlic, sensory evaluation, phytochemicals.***

## INTRODUCTION

Poultry has a short life cycle and is much more profile than larger livestock such as cattle. They are easily raised and adaptable to a wide range of climate condition (Erikssson, 2008). The protein in poultry meat corresponds with those of turkeys, beef, and pork in amino acid required by man and is easily digestible. Poultry meat has a wide acceptance with little or no limitation in terms of traditional and religious taboos as compared to port which is rejected by Muslims (Dixon, 2008). However, the industry in the developing countries is facing some challenges; these challenges include high feed to gain ratio and increase in the cost of feed because of high prices of feed ingredients and most recently multidrug resistance due to indiscriminate use of antibiotics (Abbas, 2013; Alagbe and Betty, 2019; Olafadehan et al., 2019).

With increasing consumer pressure for producers to minimize drug use (antibiotics), more research is been conducted to find alternatives to antibiotics. Among the potential alternatives includes; probiotics, prebiotics, organic acid and plant extracts (essential oils) (Bento et al., 2013; Zhang et al., 2005). Essential oils are volatile, aromatic oily liquids distilled from plant parts and have a characteristic aroma and unique composition. They are complex mixtures of chemical compounds such as terpenes, terpenoids, aldehydes, alcohols, phenols, methoxy-derivatives and a few others of which terpenes are the most common (Dorman and Deans, 2000; Kalemba and Kunicka, 2003; Alagbe, 2019). According to Botslogou et al. (2002); Alagbe (2018), EOs enhance the production of digestive secretions and nutrient absorption, improving gut health and enhancing meat quality due to the presence of phytochemicals in them.

Major aromatic oils that may have potential in poultry production and processing include nutmeg, lime, mandarine, orange, rosewood, oregano, mountain savory, fennel, turmeric, rosemary, sage, neem, cinnamon, thyme, ginger, eucalyptus, garlic, pimenta, lemongrass, and clove. These essential oils can be used as additives in feed or drinking water or as anti-bacterial for the processing of poultry products (Yesilbag et al., 2011; Li et al., 2012).

Ginger is the rhizome of the plant Zingiber officinale, consumed as a delicacy, medicine, or spice. Preliminary research indicates that nine compounds found in ginger may bind to serotonin receptors which may influence gastrointestinal function (Botsoglou et al., 2002). Research conducted in- vitro tests show that ginger extract might control the quantity of free radicals and the peroxidation of lipids (Al-Amin et al., 2006). The characteristic odor and flavor of ginger is caused by a mixture of zingerone, shagaols and gingerols, volatile oils that compose one to three percent of the weight of fresh ginger. Rivlin (2001) reported that in laboratory animals, gingerols increase the motility of the gastrointestinal tract and have analgesic, sedative, antipyretic and antibacterial properties.

Garlic (Allium sativum) has been used as a spice and a native medicine for many years. It has been indicated to possess antibacterial, antifungal, antiparasitic, antiviral, antioxidant, anti-cholesteremic, anticancerous and vasodilator characteristics (Khan et al., 2007; Hanieh et al., 2010). The key active ingredient in garlic is the plant chemical, allicin, which rapidly decompose to several volatile organosulphur compounds with bioactivities (Chang and

Cheong, 2008). Ginger and garlic supplements in broiler chicken diets have been recognized for their strong stimulating effect on the immune and digestive systems in birds (Gardzielewska et al., 2003).

This experiment was designed to examine the effects of dietary inclusions of garlic (Allium sativum) and ginger (Zingiber officinale) oil mixture on the carcass characteristics, sensory evaluation of broiler chickens.

## MATERIALS AND METHODS

Site of the experiment

This study was carried out at the Department of Animal Science, University of Abuja Teaching and Research Farm, Main Campus, along airport Road, Gwagwalada, Abuja, Nigeria. Gwagwalada is the headquarters of the Gwagwalada Area Council located between latitudes 8o571 and 8o551N and longitude 7o051 and 7o061E (Balogun, 2001).

Sourcing, authentication and extraction of oil (GGO)

Fresh samples of ginger and garlic rhizomes were purchased from a local market in Gwagwalada Abuja, Nigeria. The samples were sorted out of the bad ones, then washed and peel manually with a kitchen knife to remove the outer covering of the rhizomes. It was dried for 14 days, milled into powder using a laboratory blender (Panasonic: Model 07A-08C) and then stored in an air tight well label container for further analysis. The oil was extracted using soxhlet extraction procedure; 100g of the sample were placed in a reflux condenser which consists of a condenser and a round bottom flask. The solvent used is petroleum ether and adjusted to 65oC to reach a vaporization point before the filtrate was exposed to the atmosphere and the residual solvent was allowed to evaporate before extracting the oil. The extracted oil was mixed in ratio 1: 1 to obtain ginger and garlic oil mixture (GGO).

Pre-experimental operations

Pens were fumigated two weeks prior to the commencement of the study, surroundings were cleaned and foot bath was made available to ensure strict biosecurity. Feeding and water troughs were properly washed, all other electrical fittings were properly fixed.

Experimental Animals and their management

One hundred and fifty one day old (Arbo acre) broiler chicks with mixed sex were used for the experiment. The birds were purchased from a commercial hatchery in Ibadan, Oyo State, Nigeria. It was weighed on arrival on the farm to obtain their initial body weight and given anti-stress to reduce stress and prevent mortality. A deep litter housing system was used for the experiment and birds were divided to five treatments with 3 replicates of ten birds in a completely randomized design. Charcoal pots were used as source of heat and wood shavings serve as the litter material. All other management practices were strictly adhered to throughout the experiment which lasted for 8 weeks.

Ration formulation

Two basal diets were formulated at different stages of production to meet up with the requirements of birds according to NRC (1994) as presented in Table 1. Broiler starter's mash (1-21 days), Gowers mash (22-35 days) and finishers mash (36-56 days). Birds in Treatment 1 (T1) was fed dietary inclusion of ginger and garlic oil (GGO) at 0 %, while T2, T3, T4 and T5 were fed 0.1 %, 0.2 %, 0.3 % and 0.4 % respectively.

**MEASUREMENTS**

Carcass evaluation

At the end of the 8th week, 3 birds were randomly selected per treatment; they were feed fasted overnight and given fresh clean water, weighed, slaughtered and manually de-feathered. The carcass weight, dressed weight, weight of the visceral organs and cut parts of the birds were recorded. Relative organ weights of the carcass were expressed in percentage (%) of dress weight of the birds.

Sensory evaluation

The sensory evaluation of cooked samples of broiler chicken breast minced meat from three birds per treatment was carried out by ten panelists. Parameters evaluated by the panelists include colour, juiciness, flavour, tenderness and overall acceptability. Each meat sample was coded and presented one after the other to each member of the panel. Each member rinsed his or her mouth with warm water after assessing each meat sample to avoid carry over effect. The panelists awarded scores using a nine (9) point hedonic scale of:

i) Dislike extremely

ii) Dislike very much

(ii) Dislike moderately

(iv) Dislike slightly

(V) Intermediate

(vi) Like slightly

(vii) Like moderately

(viii) Like very much

(ix) Like extremely

Phytochemical analysis

Flavonoids, alkaloids, saponin, oxalates and steroids were determined using gravimetric and double gravimetric methods outlined by Harbone (1973). Phenol terpenoids and tannins were determined were estimated using methods described by Harbone (1973), Odebiyi and Sofowora (1978).

Statistical analysis

Data obtained were subjected to one -way analysis of variance (ANOVA) using SPSS (18.0) and significant means were separated using the software of the same package. Significant difference was declared if $P \leq 0.05$.

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 |

*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 %), streiods (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).

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. Phytics 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 3 : 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 4: 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) | $40.86^{b}$ | $45.86^{b}$ | $48.87^{b}$ | $52.76^{a}$ | 56.46a | 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 |

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 5: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 6: 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.

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