

BEHAVIOUR, WELFARE AND PERFORMANCE OF BROILER CHICKS FED DIETARY ESSENTIAL OILS AS GROWTH PROMOTER

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ABSTRACT

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One hundred fifty day-old Ross broiler chicks were used in this experiment. Chicks were weighed on arrival and randomly assigned to five dietary treatments (15 birds per pen) with two replicates for each treatment. The dietary treatments were consists of basal diet without additive (control), basal diet supplemented with 200 mg/kg essential oils of garlic (garlic group), basal diet supplemented with 200 mg/kg essential oils of ginger (ginger group), basal diet supplemented with 200 mg/kg essential oils of thyme (thyme group) and the (anti biotic group) which received basal diet supplemented with 10g/kg zinc bacitracin. Dietary treatment started from day one to day 46 of age. Behavioral observation was carried out twice daily, two days a week for 6 consecutive weeks. Body weight (BW) and Feed intake per pen were measured weekly, from which body weight gain (BWG) and feed conversion ratio (FCR) were measured. At the end of experiment, fear responses, differential leucocytic count, Hb, PCV and selected visceral organs were assayed. Also, dead birds and those showed lameness were recorded. Results revealed that birds in garlic and thyme exhibited higher feeding behavior. Control birds showed less resting, more walking and standing behaviors. BW, BWG and FCR were significantly influenced by dietary treatments. Garlic and thyme improved productive performance and could be used as alternative for an antibiotic growth promoter. Ginger group showed worst productive performance, however it not differed significantly from control group. Ginger at 200 mg/kg is not suitable feed additives as growth promoter. Garlic group showed highest bursal weight and lowest liver weight. Supplementation of diet with essential oils (garlic, ginger and thyme) and antibiotic resulted in improved welfare (reduce stress and decrease fear responses). Dietary treatments had neither effect on percentage of birds showed lameness nor died ones.

Key words: *Broilers; Behavior; Performance; Essential oil; Fear; Stress.*

INTRODUCTION

In the recent years, there has been a pronounced trend towards the intensification of methods of poultry keeping. The welfare problems of broiler chickens was a matter due to high densities of birds in broiler house and their selection for rapid growth, where feeding, drinking, walking, scratching, pecking and dustbathing were inhibited while time lying down, resting and sleeping increased (Vestergaard and Sanotra 1999).

Sub-therapeutic dosage of antibiotics has been used extensively as feed additives growth promoters in the poultry industry and other livestock feeds for several decades. A manipulation of gut function and microbial habitat of domestic animal has been recognized as an important tool for improving growth

performance and feed efficiency (Collington *et al.*, 1990) and control of zoonotic pathogens such as Salmonella, Campylobacter, Escherichia coli and Enterococci species in the gut (NOAH, 2001). Recently, the concerns about possible antibiotic residues and antibiotic resistance have aroused great caution in the usage of antibiotics in the animal industry (Donoghue, 2003), and led to the ban of these products by the European Union in January 2006. This decision has therefore stimulated a search for alternative feed-additives including probiotics, prebiotics, enzymes, and plant extracts in animal feeding (Demir *et al.*, 2003; Hernandez *et al.*, 2004; Sarica *et al.*, 2005). In this view, aromatic plants and oils extracted from these plants are becoming more important due to their antimicrobial effects (Dorman and Deans 2000), antioxidative potential (Hui 1996) and the stimulating effect on animal digestive system

(Brugalli 2003) and immune system (Mikulski *et al.*, 2008). It is in this respect that essential oils from garlic (*Allium sativum*), ginger (*Zingiber officinale*) and thyme (*Thymus vulgaris*) supplements were evaluated in the current study as natural alternatives to feed antibiotics in broiler diets.

Garlic (*Allium sativum*) was known as spice and herbal medicine for prevention and treatment of a variety of diseases (Adibmoradi *et al.*, 2006; Javandel *et al.*, 2008) as well as growth promoter (Ali and Zahran, 2010) and improves productive performance in broiler chickens (Demir *et al.*, 2003; Tollba and Hassan, 2003). Garlic has antimicrobial, antioxidant as well as antihypertensive properties (Sivam, 2001) and lower serum and liver cholesterol (Qureshi *et al.*, 1983). These functions were attributed to bioactive components present in garlic (Amagase *et al.*, 2001) including sulphur containing compound such as allin, diallylsulphur and allicin (Amagase and Milner, 1993).

Thyme (*Thymus vulgaris*) was a popular medicinal plant mostly grown in Mediterranean regions (Toghyani *et al.*, 2010). Thymol and caryophyllene were the major component isolated from essential oil of thyme, which have positive effect on growth performance in broilers (Allen *et al.*, 1998 and Denil *et al.*, 2004) and antibacterial, anticoccidial, antifungal and potent antioxidant properties (Aeschbach *et al.*, 1994; Vincent, 2002; Hagemüller *et al.*, 2006).

Ginger (*Zingiber officinale*) is an herb used as a spice for over 2000 years (Stoilova *et al.*, 2007) also utilized frequently in traditional oriental medicine for the treatment of a wide range of diseases (Badreldin *et al.*, 2008). Ginger has antioxidant, antimicrobial, and anti-inflammatory properties (Butt and Sultan 2011) and exert substantial anticarcinogenic and anti-mutagenic activities (Lee and Surh, 1998).

Fear is regarded as a powerful emotion that exerts a progressive inhibitory effect on behaviour patterns generated by all other motivational systems (Jones, 1987, 1996). The increased intensity of fear response can seriously affect the welfare and performance indicators in poultry, including growth, food conversion efficiency, egg production and product quality (Jones, 1996; Faure *et al.*, 2003). Fear can be assessed by duration of the tonic immobility reaction (TI) as a measure (Jones, 1986). Tonic immobility is a variable period of immobility induced by manual restraint. A long duration of TI is thought to be indicative of high levels of fearfulness, and a short duration is indicative of low levels of fearfulness (Jones, 1986). Many studies have noted that the

heterophil/ lymphocyte (H/L) ratio was affected by stressors and could be used as an indicator of stress in birds (Gross and Siegel 1983; Maxwell 1993; Maxwell and Robertson 1998). Zulkifli *et al.* (2003) reported that the heterophil/lymphocyte ratio (H:L) is a reliable indicator of avian stress. The H: L ratio increased with heat stress in broiler chicks (McFarlane and Curtis 1989), feed restriction (Maxwell *et al.*, 1991), high stocking density (Martrenchar *et al.*, 1997; Feddes *et al.*, 2002), chronic bacterial infections, stress and trauma (Lane 1987).

The objective of this study was to investigate the effects of essential oils of garlic, ginger and thyme as alternative to antibiotic (zinc bacitracin) on the behaviour, welfare (fear and stress), growth performance, some carcass characteristics and some blood parameters of broiler chicks.

MATERIALS and METHODS

1. Experimental birds

One hundred fifty day-old Ross broiler chicks were purchased from commercial hatchery. Chicks were weighed on arrival and randomly assigned to five dietary treatments. Each treatment was housed in wood shaving bedded floor pen (15 birds per pen) with two replicates for each treatment. The light regimen in the house was 23 h light: 1 h dark. Temperature was reduced from 32 °C during the first week of life to 25 °C at three weeks and was then kept constant. Food and water were provided *ad libitum*. Birds fed on commercial ration free from antibiotics obtained from International Company for Feed and Animal Production (IFAP). The composition and nutrient content of the basal diets is shown in table 1. The diet was subjected to chemical analysis to meet the nutrient requirements recommended by National Research Council (NRC 2004). The dietary treatments were consists of basal diet without additive (control), basal diet supplemented with 200 mg/kg essential oils (EO) of garlic (*Allium sativum*- garlic group), basal diet supplemented with 200 mg/kg EO of ginger (*Zingiber officinale*- ginger group), basal diet supplemented with 200 mg/kg EO of thyme (*Thymus vulgaris*- thyme group) and the antibiotic group received basal diet supplemented with 10g/kg zinc bacitracin. Dietary treatment started from day one to day 46 of age (end of the experiment). Essential oils of garlic, ginger and thyme were considered pure 100% and were commercially purchased (Haraz El-Attar, Egypt). A standard vaccination program was applied during the whole period for all treatments group.

2. Measurements

2.1. Behavioral observations

Chicks of each group were directly observed in two periods, each of four hrs, one period was in the morning (7.00-11.00) and the other period was in the afternoon (13.00-17.00). Each group was observed for 15 minutes in each observation period by a person who was sitting outside of the pen on a high chair, with a good view over the whole pen. Before starting to observe a pen of birds, the observer sat quietly for 5 min. to get the birds accustomed to his presence. Instantaneous scan sampling observations of chick's behavior were performed according to Lee and Craig (1990). For each scan the number of chicks engaged in nine mutually exclusive activities were recorded every 60 seconds (feeding, drinking, resting, walking, standing, foraging, preening, wing related behaviors as wing/leg stretching and/or wing flapping, and feather pecking). A detailed description of those parameters is presented in Table 2. The percentage of chicks engaged in each behavior was calculated during all scan samples in each pen. Behavioral observations were carried out twice daily, two days per week for six consecutive weeks.

2.2. Performance

Body weight (BW) and feed intake (FI) per pen were measured weekly. Ten birds from each pen were marked at the end of the first week and then were individually weighed weekly till the end of the experiment. Body weight gain (BWG) and feed conversion ratio (FCR) were calculated for each treatment. At forty six days of age, four birds per replicate were randomly chosen, slaughtered and their liver, gizzard, heart and lymphoid organs (spleen and bursa of fabricius) were collected, weighed and calculated as a percentage of live body weight. Mortality and lameness were recorded for each pen.

2.3. Hematological parameters.

At the 46th day of age, blood samples were collected from wing vein of five chicks from each pen (10 chicks per treatment). The blood was received into EDTA anticoagulant for the determination of hemoglobin content (Hb) and packed cell volume (PCV) using the methods described by Wintrobe (1976). Blood smears were prepared. After drying the smears were stained using May-Grunewald-Giemsa stain. One hundred leucocytes, including heterophils, esinophils, lymphocytes, and monocytes were counted at $\times 40$ (oil immersion lens) and H/L was calculated.

2.4. Tonic immobility (fear test).

Tonic immobility (TI) reaction was assessed on six birds per replicate. Assessment was conducted in a quite room separate from the rearing pens. Each bird

was restrained on its back in a U-shaped wooden cradle covered with several layers of clothing (Jones and Faure 1981) with the head hanging, with firm but gentle pressure on the sternum for 10 seconds. If the bird remained immobile for 10 seconds after the experimenter removed his hands, a stopwatch was started to record latencies until the bird right itself. If the bird righted itself in less than 10 seconds, it was considered that tonic immobility had not been induced, and the restraint procedure was repeated. If the bird did not show a righting response over a 5-min test period, a maximum score of 300 seconds was given for righting time (Mills and Faure, 1991). If TI was not induced after three attempts the duration of TI was considered 0 seconds. (Zulkifli *et al.*, 2000).

3. Statistical analysis

Data collected were subject to analysis of variance and where significant differences were observed means were further subjected to Duncan's multiple range, using SPSS for Windows: 10.1, SPSS inc. (1999). The results were considered as significant when P- values less than 0.05 and 0.01.

Percentage of birds showed lameness and those died were analyzed by Chi Square.

RESULTS and DISCUSSION

1. Behavioral patterns

The effects of dietary supplementation of medicinal plant essential oils and antibiotic on broilers behaviors are presented in Table 3. A significantly higher proportion of chicks in garlic group were engaged in feeding behavior 13.19 ± 1.95 compared to control group 7.61 ± 1.33 (mean \pm SE respectively, $p=0.001$) with anti biotic group being intermediary but not different from them (11.20 ± 1.58), which in turn was reflected in final body weight and other productive performance of chicks. This result was in accordance with Poulair *et al.* (2010) who found that, garlic powder improved average daily feed intake in broiler chickens. In the same trend, Javed *et al.* (2009) reported that feed intake was improved when broilers were supplemented with aqueous extract of medicinal plants containing garlic (10ml/L of drinking water). Contrary, Aji *et al.* (2011) mentioned that administration of 100mg of garlic not affect feed intake of broiler chickens. Also, Ashayerizadaeh *et al.* (2009); Onibi *et al.* (2009); Mohebbifar and Torki (2011) found no effect of garlic powder supplementation on feed intake of broiler chicks.

Feeding behavior was significantly higher in thyme group compared to control group 13.63 ± 1.56 , 7.61 ± 1.33 (mean \pm SE respectively, $p=0.001$) with antibiotic group being intermediary but not different from them (Table 3). This result is in accordance with Foroughi *et al.* (2011) who reported that the birds were fed diet contains 180 mg/kg essential oils of thyme had the highest value of feed intake. Also, Al-

Kassie and Jameel (2009) found that supplementation of diet with 100 and 200 mg/kg thyme oil improved feed intake. On the other hand, Najafi and Toriki (2010); Toghyani *et al.* (2010) and Rahimi *et al.* (2011) indicated that diet supplemented with thyme had no effect on feed intake in broilers.

Results of feeding behavior (Table 3) indicated that percentage of birds engaged in feeding behavior in antibiotic group 11.20 ± 1.58 was not significantly different from control, garlic and thyme groups 7.61 ± 1.33 , 13.19 ± 1.95 , 13.63 ± 1.56 respectively (mean \pm SE, $p > .05$). This result was in agreement with Rahimi *et al.* (2011) who found no significant difference in feed consumption between chicks fed basal diet (control), basal diet supplemented with 15 ppm virginiamycin, 0.1% aqueous extract of thyme or 0.1% aqueous extract of garlic. Similar results were reported by Songsang *et al.* (2008) and Toghyani *et al.* (2010).

Results presented in Table 3. indicated that chicks in ginger group exhibited significantly lower feeding behavior ($3.75 \pm .97$, mean \pm SE, $p = 0.001$) compared to chicks in other groups except control birds. Contrary to our result, Arshad *et al.* (2012) mentioned that ginger extract at 40 and 50 ml/liter of drinking water significantly increase feed intake in broiler chicks compared to control birds. Also, Dieumou *et al.* (2009) found no significant difference in feed intake between broiler chicks fed basal diet (control) and those fed basal diet supplemented with ginger and garlic essential oils.

In consistency among the results in different studies might be due to different usage of medicinal plants sources, forms (powder, leaves, aqueous extraction, and essential oil), dose, diet, management and environmental conditions.

Results from behavioral observations in the present study indicated that dietary supplementation of essential oils and anti biotic significantly affects the proportion of birds engaged in resting, standing and movement behaviors (Table 3). Birds in unsupplemented diet control group were showed significantly less resting behavior 54.40 ± 3.88 compared to birds in garlic, ginger, thyme and antibiotic groups 64.87 ± 3.03 , 66.10 ± 2.17 , 63.76 ± 2.97 , 66.30 ± 2.88 , respectively (mean \pm SE, $p = .035$). Percentage of birds engaged in walking behavior was significantly higher in control birds 7.42 ± 1.26 compared to birds in garlic, thyme and anti biotic groups $4.33 \pm .83$, $3.49 \pm .89$, $3.26 \pm .71$ respectively (mean \pm SE, $p = .004$). The percentage of birds engaged in standing behavior was significantly higher in control and ginger groups 12.07 ± 1.62 , 12.75 ± 1.63 , respectively (mean \pm SE, $p = .001$) compared to birds in garlic, thyme and antibiotic groups (5.65 ± 1.08 , 7.14 ± 1.15 , 7.87 ± 1.45 , respectively, mean \pm SE). Increased walking and standing behaviors in control and ginger

supplemented birds may be related to low feeding behavior that demonstrated in these groups. Hocking *et al.* (1997) reported that pacing was negatively related to rate of consumption. Moreover, Hocking (1993) observed that the proportion of time spent standing and walking was associated with a decrease in the proportion of time involved in eating, scratching and pecking activities.

Results summarized in Table (3) showed non significant differences of dietary treatment on the percentage of birds engaged in drinking, foraging, preening, wing stretching and/or wing flapping and feather pecking.

2. Productive performance:

In the present study, body weights (BW), body weight gain (BWG) and feed conversion ratio (FCR) were significantly influenced by the addition of essential oils and antibiotic to diets (Table 4). At the 46th day of age birds in garlic group had significantly higher BW 2181.67 ± 51.63 compared to birds in control and ginger groups 1926.00 ± 63.13 , 1789.17 ± 73.97 respectively (mean \pm SE, $p = .001$) but not significantly differed from birds in thyme and antibiotic groups. Garlic group had significantly increased BWG at 21-46 days of age 1549.67 ± 47.19 compared to control and ginger groups 1298.00 ± 65.13 , 1161.17 ± 74.21 respectively (mean \pm SE, $p = .011$). Also, Garlic group had significantly higher BWG in the whole period (0-46 days) 2140.19 ± 84.56 compared to control and ginger groups 1882.69 ± 57.73 , 1746.03 ± 62.41 respectively (mean \pm SE, $p = .008$). Results in Table 4 indicated that, garlic improves FCR at 21-46 days of age $2.44 \pm .05$ compared to control and ginger groups $2.82 \pm .08$, $2.94 \pm .10$ respectively (mean \pm SE, $p = .007$). Similar results were showed in the whole period (0-46 days) as FCR was significantly better in garlic group $2.28 \pm .03$ compared to control and ginger groups 2.61 ± 0.05 , 2.69 ± 0.06 respectively (mean \pm SE, $p = .001$). Garlic in this study improves final body weight, BWG and FCR. Similar results were reported by Tollba and Hassan (2003). Also, many authors indicated positive effect of garlic on productive performance including FCR and BWG (Mahmood *et al.*, 2009; Pourali *et al.*, 2010), BW and FCR (Javed *et al.*, 2009; Mansoub 2011), BWG (Aji *et al.*, 2011; Kumar *et al.*, 2010). The improvement in broiler performance could attribute to active ingredient in garlic. Lewis *et al.* (2003) reported that garlic contain allicin, which promotes the performance of intestinal flora, thereby improving digestion and enhancing the utilization of energy. Also, Ramakrishna *et al.* (2003) suggested that garlic supplementation enhance the activity of pancreatic enzymes and provides an environment for better absorption of nutrients. Contrary to results in the current study, Songsang *et al.* (2008); Onibi *et al.* (2009); Rahmatnejad *et al.* (2009); Issa and Abo-Omar (2012) found no effect of garlic on broilers

BWG and FCR. Similarly, Horton *et al.* (1991); Konjufca *et al.* (1997) and Dieumou *et al.* (2009) found no effect of garlic on broiler performance. Moreover, Ademola *et al.* (2009) concluded that during the finishing phase of growth of the chickens, 1.5% garlic and 2% ginger caused significant ($P<0.01$) decreases in final live body weight and BWG of the chickens.

Although antibiotic group showed significantly higher BWG at 0-21 days of age compared to garlic group 637.58 ± 87.14 , 590.52 ± 75.53 respectively (mean \pm SE, $p=0.001$) (Table 4). Garlic group showed higher BWG than antibiotic group at 21-46 days of age 1549.67 ± 47.19 , 1337.46 ± 98.21 , respectively (mean \pm SE, $p=0.011$). Also, Garlic group showed significantly improved FCR compared to the antibiotic group at 21-46 days of age (2.44 ± 0.05 , 2.76 ± 0.07 , respectively, mean \pm SE, $p=0.007$) and at 0-46 days of age (2.28 ± 0.03 , 2.48 ± 0.04 , respectively, mean \pm SE, $p=0.001$) but not differed from thyme group at the same periods. These results were disagree with Rahimi *et al.* (2011) who reported that chicks fed diet supplemented with 15 ppm virginiamycin had better BW, BWG and FCR than those fed diet supplemented with 0.1% aqueous extract of garlic.

Data summarized in Table 4. showed non significant difference in productive performance between thyme and anti biotic groups.

Birds in thyme and antibiotic groups had non significant higher final BW 2034.16 ± 41.48 , 2017.16 ± 43.27 respectively (mean \pm SE) compared to birds in control group 1926.00 ± 63.13 (mean \pm SE, $p>0.05$). The average BWG (g/bird) was significantly higher in the thyme and antibiotic groups at 0-21 days 621.73 ± 86.03 , 637.58 ± 87.14 , respectively (mean \pm SE, $p=0.001$) compared to control group 593.69 ± 39.02 (mean \pm SE). Thyme group had a non significant improved BWG compared to control and anti biotic group at 21-46 days, and in the whole period (0-46 days) compared to control group. Thyme group had significantly better FCR compared to control group at 0-46 days (2.39 ± 0.04 , 2.61 ± 0.05 respectively $p=0.001$), and non significant improved FCR compared to antibiotic group during the same period. Broilers received antibiotic had a non significant improved FCR compared to control group at 0-46 days (2.48 ± 0.04 , 2.61 ± 0.05 respectively, $p>0.05$). Our results concerned with thyme and anti biotic were in agreement with Ciftci *et al.* (2009) who reported that 200 ppm thyme oil and antibiotic increased the daily live BWG and improved the FCR when compared with control group. In the same trend, Toghiani *et al.* (2010) indicated that, broilers received antibiotic and 5g/kg thyme had significantly higher BW compared to control birds and supplementing the diet with antibiotic resulted in significant improvement of FCR. Also, Al-kassie (2009); Najafi and Torki (2010) stated that, chicks fed basal diet supplemented with

200 mg/kg thyme had significantly improved BWG and FCR compared to control birds. Antibiotics may control and limit the growth and colonization of a variety of pathogenic and nonpathogenic species of bacteria in chicks gut (Ferket, 2004). A more balanced biota population in gut could lead to a greater efficiency in digestibility and utilization of food, resulting in an enhanced growth and improved FCR (Bedford, 2000). In the current study, the improvement in broilers productive performance received 200 mg/kg EO of thyme could be attributed to active materials (thymol and caracerol) and its positive effect on nutrient digestibility (Langhout, 2000), their probable antioxidant and antibacterial effects in the intestine (Nascimento *et al.*, 2000). Contrary to our results, Papageorgious *et al.* (2003) reported that essential oils were not effective in improving animal performance, and thymol did not improve poultry performance (Lee *et al.*, 2004). Demier *et al.* (2005) indicated no differences in BWG and FCR of broilers fed diets supplemented with anti biotic growth promoter and five herbal feed additives from day 0 to 42 of age.

Birds supplemented with 200 mg/kg ginger essential oil had significantly lower BW at 46 days of age 1789.17 ± 73.97 , compared to birds in garlic, thyme and antibiotic groups 2181.67 ± 51.63 , 2034.16 ± 41.48 , 2017.16 ± 43.27 respectively (mean \pm SE, $P=0.001$), but not significantly differed from control birds.

Ginger group had the worst BWG 1746.03 ± 62.41 in the whole period 0-46 days compared to garlic, thyme and antibiotic groups 2140.19 ± 84.56 , 1991.89 ± 69.09 , 1975.04 ± 82.47 respectively (mean \pm SE, $P=0.008$), but not significantly differed from control group.

FCR (Table 4) was worst in ginger group compared to garlic, thyme and antibiotic groups through out the experiment especially in the whole period (0-46 days) $2.69 \pm .06$, $2.28 \pm .03$, $2.39 \pm .04$, $2.48 \pm .04$ (mean \pm SE, respectively for control, garlic, thyme and antibiotic groups, $P=0.001$). FCR was not significantly differed in ginger group compared to control one through out the experiment. Results in the current study were disagree with Arshad *et al.* (2012) who observed that broiler chicks received Ginger extract at 30, 40 and 50 ml/liter of drinking water gained significantly ($P<0.05$) higher body weight and had significantly improved the over all performance than control birds.

It is obviously from the previous data that ginger EO 200 mg/kg is not a suitable feed additives alternative for antibiotics as a growth promoter in broilers.

Dietary treatment had non significant effect on percentage of bird's mortality as well as lameness (table 4).

The wide range of performance results may be attributed to the dose, form, duration of processing of medicinal plants and experimental condition.

3. Effect of dietary treatments on some carcass traits

Effect of dietary supplementation with some essential oils and antibiotic on some edible organs (Gizzard, liver and heart) and lymphoid organs (spleen and bursa) at the end of the experiment are presented in Table 5. It was observed that percent of live weight of gizzard, heart and spleen not significantly differed by dietary treatment. Garlic group had significantly lower percent of liver weight 1.99 ± 0.09 compared to the control, ginger and antibiotic groups 2.53 ± 0.09 , 2.92 ± 0.23 , 2.91 ± 0.05 respectively, (mean \pm SE, $P=0.001$) but not differed than thyme group. Thyme group had significantly lower liver weight 2.19 ± 0.10 compared to ginger and antibiotic groups 2.92 ± 0.23 , 2.91 ± 0.05 respectively, (mean \pm SE, $P=0.001$). Garlic group had significantly higher weight of bursa 0.13 ± 0.01 compared to control, ginger, thyme and antibiotic groups 0.05 ± 0.01 , 0.07 ± 0.01 , 0.08 ± 0.01 , 0.06 ± 0.01 respectively, (mean \pm SE, $P=0.001$). Results in this experiment concerned with gizzard, heart and spleen were in accordance with many authors but results of liver and bursa were disagree with the same authors. Tolba and Hassan (2003); Issa and Abo-Omar (2012); Onibi *et al.* (2009) and Mahmood *et al.* (2009) found no effect of garlic supplementation on carcass traits including liver, heart, gizzard, and spleen. Also, Denli *et al.* (2004); Najafi and Torki (2010) and Toghyani *et al.* (2010) found no significant effect of thyme on carcass traits. Our result from bursa was in agreement with Rahimi *et al.* (2011) who reported that Relative weight of bursa fabricius in the garlic group showed a significantly more increase as compared with control, antibiotic and thyme groups. Also, our result from liver was in harmony with Dieumou *et al.* (2009) who found that relative liver weight of birds decreased ($P < 0.05$) in garlic oil treatment compared with those given ginger oil and control.

4. Effect of dietary treatments on differential leukocytic count, Hb and PCV.

Table 6. Shows the effects of dietary treatments on differential leukocytic count, Hb and PCV. The present study showed that groups fed 200mg/kg oil extract derived from garlic, ginger and thyme or supplemented with anti biotic had significantly lower heterophil 7.66 ± 1.20 , 11.50 ± 1.25 , 8.25 ± 0.85 , 10.25 ± 0.47 respectively, (mean \pm SE) compared to control group 16.00 ± 0.57 (mean \pm SE, $p=0.001$). H/L ratio was significantly higher in control birds 0.19 ± 0.02 compared to garlic, ginger, thyme and antibiotic groups 0.09 ± 0.01 , 0.14 ± 0.01 , 0.10 ± 0.01 , 0.12 ± 0.01 , respectively, (mean \pm SE, $p=0.001$). These results indicated that control group were more stressed and supplementation of diet with essential oils or

antibiotic reduced stress in broiler chicks. Maxwell (1993) mentioned that, stressed birds shown an increase in H: L ratios and this ratio may be a more reliable indicator of mild to moderate stress than plasma cortisone concentration. Stress in control birds was reflected on its productivity. These results were in accordance with Saxena and Madan (1997) who reported that, stress evokes harmful responses that interferes with the general health, productivity and resulted in immunosuppression. Results of this study were in agreement with Al-Kassie (2009) and Najafi and Torki (2010) they reported that, groups fed oil extract derived from thyme had significantly lower H/L ratio. Also, Ali (2010) found supplementation of the broiler chickens diet with *Thymus vulgaris* leaves powder from 0 to 8 weeks of age resulted in significant ($p < 0.01$) decrease in heterophil to lymphocyte ratio. On the other hand, Al-Beitawi *et al.* (2010) found that feed additives mixture from crushed *Pimpinella anisum*, *Nigella sativa* seeds and *Thymus vulgaris* significantly ($p < 0.05$) improve heterophils in male broiler chicks. Also, Toghyani (2010) found no significant effect of thyme powder or antibiotic supplementation on H/L ratio. Moreover, Mohebbifar and Torki (2011) found no affected of garlic supplementation diet on heterophils in Ross broilers chicken.

Results of the current experiment indicated that Hb concentration (gm %) not significantly affected by dietary supplementation (Table 6). Garlic and thyme groups had significantly more PCV% 32.00 ± 3.78 , 35.50 ± 0.86 respectively, (mean \pm SE) compared to control, ginger and antibiotic groups 25.25 ± 1.88 , 24.50 ± 1.70 , 25.00 ± 0.40 , respectively, (mean \pm SE, $p=0.002$). These results were in agreement with Al-Kassie (2009) and Ali (2010); they concluded that birds fed diet supplemented with thyme had significantly more Hb and HCT. On the other hand, Toghyani *et al.* (2010) found no effect of antibiotic and thyme supplementation on Hb and HCT. Moreover, Rahimi *et al.* (2011) found no significant difference in Hb and HCT between control chicks and chicks fed diet supplemented with antibiotic, thyme and garlic. Also, Ademola *et al.* (2009) reported that dietary garlic, ginger and their mixtures did not affect the PCV and Hb concentration of the chickens.

5. Effect of dietary treatments on fear responses (tonic immobility test- TI):

Dietary supplementation with 200 mg /kg essential oils (garlic, ginger and thyme) and antibiotic had significant effect on the duration of tonic immobility (Table 7). The unsupplemented control birds were more fearful and showed significantly longer duration in TI test 234.16 ± 26.86 compared to garlic, ginger, thyme and antibiotic groups 108.66 ± 27.53 , 78.50 ± 39.34 , 102.83 ± 34.48 , 124.33 ± 32.03 respectively, (mean \pm SE, $p=0.002$). This result was in accordance with Jones (1986) who reported that a long duration of TI is thought to be indicative of high levels of

fearfulness, and vice versa. Increased fear in control group resulted in poor productive performance in compare with other groups. Similarly, Jones (1996)

and Faure *et al.* (2003) reported that increased intensity of fear response can seriously affect the welfare and performance in poultry.

Table 1: Composition of basal ration.

	Ingredient
Crude protein %	22.06
Digestable energy Kcal/ kg of diet	3079
Calcium %	1.2
Phosphorus %	0.44
Lysine %	0.75
Methionine and cystine %	0.82

Table 2: Ethogram of behavior parameters recorded through observation of broiler chicken.

Ethogram	Definition
Feeding	Head extended towards available feed resources while beak in or above the feeder appears to be manipulating or ingesting feed.
Drinking	Beak in contact with water in or above the drinker and appears to be drinking water
Resting	Sitting, lying or sleeping- with no other behaviour.
Walking	Moving forward taking one or more steps.
Standing	The abdomen is not touching the litter and the bird is motionless with no other behaviour.
Foraging	Pecking and Scratching the floor with feet.
preening	Beak related behaviour that beak touches the plumage of the bird itself.
Wing-leg stretching and/or Wing flapping	Stretching of the wing and leg Extending both wings out from the body simultaneously and flapping of wings
Feather pecking	Pecks at feathers of other birds

Table 3: The influence of dietary treatments on the total number of chicks observed performing various behaviors (% Means \pm SE).

Group	Feeding	Drinking	Resting	Walking	Standing	Foraging	Preening	Wing st. and/or wing flapping	Pecking
Control	7.61 ^{bc} \pm 1.33	3.46 \pm 1.14	54.40 ^b \pm 3.88	7.42 ^a \pm 1.26	12.07 ^a \pm 1.62	3.45 \pm 1.60	9.10 \pm 2.44	2.11 \pm .58	.64 \pm .36
Garlic	13.19 ^a \pm 1.95	3.70 \pm 1.13	64.87 ^a \pm 3.03	4.33 ^{bc} \pm .83	5.65 ^b \pm 1.08	1.65 \pm .57	3.92 \pm .96	2.64 \pm .77	0.22 \pm .12
Ginger	3.75 ^c \pm .97	1.11 \pm .56	66.10 ^a \pm 2.17	6.79 ^{ab} \pm 1.08	12.75 ^a \pm 1.63	.93 \pm .39	6.95 \pm 1.05	.76 \pm .36	.99 \pm .51
Thyme	13.63 ^a \pm 1.56	3.30 \pm 1.07	63.76 ^a \pm 2.97	3.49 ^{bc} \pm .89	7.14 ^b \pm 1.15	1.97 \pm .52	4.14 \pm .83	2.59 \pm .68	0.19 \pm .09
Antibiotic	11.20 ^{ab} \pm 1.58	1.70 \pm .75	66.30 ^a \pm 2.88	3.26 ^c \pm .71	7.87 ^b \pm 1.45	1.32 \pm .52	6.35 \pm 1.10	1.96 \pm .61	0.20 \pm .11
p-value	.001	Ns	.035	.004	.001	ns	ns	ns	ns

^{a,b}Means with the same letters and column are not significantly different. ns: non significant.

Table 4: The Effect of dietary supplementation on productive performance of broiler chicks.

	Control	Garlic	Ginger	Thyme	Anti biotic	P-value
Body weight (g/bird)						
1 day	43.31± .86	41.48± .53	43.14± .71	42.27± .94	42.12± .98	ns
21 days	637.00±21.09	632.00± 17.06	628.00± 15.45	664.00± 13.69	679.70± 28.82	ns
46days	1926.00 ^{bc} ±63.13	2181.67 ^a ± 51.63	1789.17 ^c ±73.97	2034.16 ^{ab} ±41.48	2017.16 ^{ab} ± 3.27	.001
Body weight gain (g/bird)						
0-21 days	593.69 ^b ± 39.02	590.52 ^b ± 75.53	584.86 ^b ±66.52	621.73 ^a ±86.03	637.58 ^a ±87.14	.001
21-46 days	1298.00 ^{bc} ± 65.13	1549.67 ^a ±47.19	1161.17 ^c ±74.21	1370.16 ^{ab} ±59.56	1337.46 ^{bc} ±98.21	.011
0-46 days	1882.69 ^{bc} ±57.73	2140.19 ^a ± 84.56	1746.03 ^c ±62.41	1991.89 ^{ab} ±69.09	1975.04 ^{ab} ±82.47	.008
FCR (Feed intake/Gain)						
0-21 days	2.10 ^{ab} ± .08	1.86 ^b ± .07	2.18 ^a ± .08	1.98 ^{ab} ± .07	1.87 ^b ± .07	.049
21-46 days	2.82 ^{ab} ± .08	2.44 ^c ± .05	2.94 ^a ± .10	2.57 ^{bc} ± .06	2.76 ^{ab} ± .07	.007
0-46 days	2.61 ^{ab} ± 0.05	2.28 ^d ± .03	2.69 ^a ± .06	2.39 ^{cd} ± .04	2.48 ^{bc} ± .04	.001
Mortality %	6.66	0.00	0.00	0.00	0.00	ns
Lameness %	6.89	6.66	6.66	3.33	6.66	ns

^{a,b}Means with the same letters and column are not significantly different. ns: non significant.

Table 5: Effect of dietary treatments on some carcass traits at day 46.

	Control	Garlic	Ginger	Thyme	Antibiotic	P-value
Gizzard%	1.41±.22	1.63±.05	1.44± .02	1.48± .17	1.52± .01	ns
Heart%	.48± .01	.41± .03	.44± .03	.48± .05	.50± .07	ns
Liver%	2.53 ^{ab} ± .09	1.99 ^c ± .09	2.92 ^a ± .23	2.19 ^{bc} ± .10	2.91 ^a ± .05	.001
Lymphoid organs						
Spleen %	.15± .01	.13± .01	.11± .02	.14± .02	.14± .01	ns
Bursa %	.05 ^b ± .01	.13 ^a ± .01	.07 ^b ± .01	.08 ^b ± .01	.06 ^b ± .01	.001

^{a,b}Means with the same letters and column are not significantly different. ns: non significant.

Table 6: Effect of dietary treatments on differential leukocytic count, Hb and PCV.

	Control	Garlic	Ginger	Thyme	Anti biotic	P-value
Heterophil	16.00 ^a ± .57	7.66 ^c ± 1.20	11.50 ^b ± 1.25	8.25 ^c ± .85	10.25 ^{bc} ± .47	.001
Lymphocyte	81.66± 1.85	84.67± .88	83.75± 1.10	85.75± .94	84.50± .28	ns
Monocyte	3.00± 1.15	6.00± 2.08	2.75± .25	4.00± .57	3.00± .40	ns
Esinophil	1.34± .33	3.33± .88	2.00± .41	2.00± .40	2.25± .75	ns
H/L ratio	.19 ^a ± .02	.09 ^c ± .01	.14 ^b ± .01	.10 ^c ± .01	.12 ^{bc} ± .01	.001
Hb	.48± .06	.51± .01	.52± .03	.59± .02	.58± .05	ns
PCV	25.25 ^b ± 1.88	32.00 ^a ± 3.78	24.50 ^b ± 1.70	35.50 ^a ± .86	25.00 ^b ± .40	.002

^{a,b}Means with the same letters and column are not significantly different. ns: non significant.

Table 7: Effect of dietary treatments on fear responses (tonic immobility test-TI).

	TI duration (second)
Control	234.16 ^a ± 26.86
Garlic	108.66 ^b ± 27.53
Ginger	78.50 ^b ± 39.34
Thyme	102.83 ^b ± 34.48
Anti biotic	124.33 ^b ± 32.03
p-value	0.002

^{a,b}Means with the same letters and column are not significantly different.

CONCLUSION

In conclusion, use of herbal EO from garlic and thyme at dose of 200 mg/kg increased feeding behavior and improved productive performance (BW, WG and FCR) and could be used as natural alternatives to feed antibiotics in broiler diets. EO from ginger at the same dose is not a suitable feed additive alternative for antibiotic as a growth promoter. Supplementation of diet with EO (garlic, ginger and thyme) and antibiotic resulted in improved welfare (reduce stress and decrease fear responses).

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تأثير استخدام الزيوت الأساسية كمحفز للنمو في الغذاء علي السلوكيات و الأراحة و الأداء في بدارى التسمين

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أجريت هذه الدراسة على عدد 150 فرخ من فراخ التسمين عمر يوم حيث تم توزيعهم عشوائيا على خمس معاملات غذائية (خمس مجموعات - 15 طائر\ مجموعة) حيث تم تكرار كل معاملة مرتين. بدأت المعاملات الغذائية من عمر يوم حتى اليوم 46 من العمر وكانت كالتالى: تمت تغذية المجموعة الأولى بالعليقة الأساسية بدون أي إضافات (المجموعة الضابطة). مجموعة التئوم غذيت على العليقة الأساسية مضافا اليها 200 مللى جرام/ كيلو جرام من العلف من زيت الثوم. مجموعة الزنجبيل غذيت على العليقة الأساسية مضافا اليها 200 مللى جرام/ كيلو جرام من العلف من زيت الزنجبيل. مجموعة الزعتر غذيت على العليقة الأساسية مضافا اليها 200 مللى جرام/ كيلو جرام من العلف من زيت الزعتر. مجموعة المضاد الحيوى غذيت على العليقة الأساسية مضافا اليها 10 جرام/ كيلو جرام من العلف من المضاد الحيوى زنك باستراسين. تمت ملاحظة سلوكيات الطيور بمعدل مرتين يوميا- مرتان فى الأسبوع ولمدة ستة أسابيع. تم وزن الجسم و حساب استهلاك العليقة لكل مجموعة أسبوعيا ومنة تم قياس الوزن المكتسب ومعدل التحويل الغذائى. فى نهاية التجربة تم عمل اختبار الخوف وتمييز لكرات الدم البيضاء لكل المجموعات وقياس تركيز الهيموجلوبين وحجم الكريات المصفوفة وكذلك وزن بعض الاعضاء الداخلية. كما تم تسجيل عدد الطيور النافقة وتلك المصابة بالعرج فى كل معاملة. لقد لوحظ أن نسبة الطيور التى تتناول الغذاء كانت عالية معنويا فى المجموعات المضاف اليها الثوم والزعتر. سلوك الرقاد كانت نسبته منخفضة معنويا ومعدل الوقوف والمشي كان عاليا فى المجموعة الضابطة مقارنة بالمجموعات الأخرى. اظهرت النتائج وجود فروق معنوية فى وزن الجسم والوزن المكتسب ومعدل التحويل الغذائى. أدى اضافة زيت الثوم والزعتر إلى تحسن الأداء الإنتاجي للطيور مما يمكن من استخدامها كبديل للمضادات الحيوية كمحفز للنمو. وقد أظهرت مجموعة الزنجبيل أداء فى الإنتاجية لا يختلف معنويا عن المجموعة الضابطة. واثبتت النتائج ان اضافة زيت الزنجبيل 200 مللى جرام/ كيلو جرام من العلف ليس لها تأثير كمحفز للنمو مثل الإضافات الأخرى. لوحظ عدم وجود تأثير معنوي للمعاملات المختلفة على نسبة النفوق او العرج فى الطيور. تميزت مجموعة الثوم بأعلى وزن لكيس فابريشى وقل وزن للكبد. أدى اضافة مكملات النظام الغذائى من الزيوت الأساسية (الثوم والزنجبيل والزعتر) والمضادات الحيوية فى تحسين راحة ورفاهية الحيوان وتقليل الإجهاد والخوف.