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PRODUCTIVE PERFORMANCE, PHYSIOLOGICAL AND IMMUNOLOGICAL RESPONSE OF BROILER CHICKS AS AFFECTED BY DIETARY AROMATIC PLANTS AND THEIR ESSENTIAL OILS

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ABSTRACT:A total number of 378 unsexed 7 d old cobb boiler chicks were randomly divided among nine dietary treatments, with six replicates per treatment, seven birds each, to investigate the effect of sweet basil (Ocimiumbasilicum L.), thyme (Thymus vulgaris L.) and their oils as natural fee7723*23d additives on broiler performance, blood parameters, immune response, and total bacterial count. Experimental chicks were fed the same basal diet and submitted to the following dietary treatments: the first group fed a commercial broiler basal diet without supplementation (control), while the 2nd and 3rd groups fed basal diet supplemented with 10 and 20 g/kg of sweet basil powder, the 4th and 5th groups fed basal diet supplemented with 0.5 and 1g/kg of sweet basil oil, the 6th and 7th groups fed basal diet supplemented with 5 and 10 g/kg of thyme powder and the 8th and 9th groups fed basal diet supplemented with 0.5 and 1g/kg of thyme oil. Growth performance, production index and economical efficiency were calculated. At the end of the experiment (39 d old), some carcass characteristics, blood constituents and bacterial count of the digestive system were measured. Results showed that broiler fed basal diet supplemented with sweet basil, thyme and their oils had significantly greater BW, BWG, economical efficiency, production index compared to control. All supplementations decreased serum AST, ALT, total lipids, triglycerides, cholesterol, LDL and increased T3, TAC, GSH, GPX, SOD, glucose, total protein, γ-globulin, globulin, IgM, IgG, LA, BA, LTT, phagocytic activity, phagocytic index, RBCS and Hb compared to control. All supplementations increased percentage of dressing and total edible parts compared with control. However, all supplementations decreased total bacterial count, Salmonella and E.Coli compared to control.

In conclusion, either sweet basil or thyme and their oils could be used safely as a natural growth promoters to improve growth and immune response of broiler chick.

Key words: Broiler - Aromatic plants - essential oil.

INTRODUCTION

Herbs could be used as alternatives to AGPs in poultry nutrition due to their antimicrobial properties. Many herbs and their bioactive constituents possess a broad antimicrobial activity (Dorman and Deans, 2000; Kamel, 2001; Cross et al., 2003 and Lewis et al., 2003). Phytobiotics were redefined by Windisch and Kroismayr (2006) as plant derived products added to the feed in order to improve performance of agricultural livestock.Several investigators reported that using Medicinal and Aromatic Plants (MAP) in broiler diets improved body weight, body weight gain, feed conversion efficiency and reduce the cost of feed (Azouz, 2001; Tucker, 2002; Alcicek et al., 2004; Osman et al., 2004 and Abdel-Azeem, 2006). As a result, new commercial additives of plant origin, considered as natural products acceptable by consumers, have been offered to poultry producers. Herbs, spices and various plant extracts have received rising attention as replacements of possible antibiotic growth promoters.

Plant extracts, such as essential or volatile oils, are usually utilized in animal feeding and are considered growth and immune enhancers due to their antioxidant, antimicrobial and digestion properties (Abdulkarimi et al., 2011; Assiri et al., 2016 and Fallah and Mirzaei, 2016).

Basil (Ocimumbasilicum L.), also known as sweet and garden basil is commonly cultivated throughout Mediterranean region (Abbas, 2010). Basil called Rehan in Arabic belonging to plant family Lamiaceae, which contains essential oils rich in phenolic compounds, polyphenols such as flavonoids and anthocyanins (Phippen and Simon, 2010). Basil seeds improved productive performance of broiler chicks and decreased serum cholesterol (Rabia, 2010).The leaves and flowering tops of sweet basil are used as a carminative, galactogogue, stomachic and antispasmodic in folk medicine (Sajjadi, 2006). However, recently the potential uses of basil essential oils, particularly as antimicrobial and antioxidant agents, have also been investigated. There is extensive diversity in the constituents of the basil oils, and several chemo types have been established from various phytochemical investigations (Sajjadi, 2006). However, methyl chavicol, linalool, methyl cinnamate, methyl eugenol, eugenol and geraniol are reported as major components of the oils of different chemotypes of O. basilicum (Sajjadi, 2006).

Many research strategies have been practiced particularly introducing feed supplements and feed additives in poultry feds (Christaki and Bonos, 2012). Nweze and Ekwe (2012) concluded that Ocimum leaf extracts can be used to improve growth performance, stabilize the blood components and reduce the gut and blood micro-organisms for finishing broilers. Utilization of basil leaf in livestock nutrition has not been widely and scientifically exploited. The use of basil leaf in growing pullets will increase the knowledge for the search for natural herd and reduce cost of production.

Thyme (Thymus vulgaris L.) is a medicinal herb in the Lamiaceae family, cultivated worldwide for culinary, cosmetic perennial and medical purposes. This species has special functions such as antispasmodic, expectorant antiseptic, antimicrobial and antioxidant (Hertrampf, 2001 and Abu-Darwish et al., 2009). Rahimi et al. (2011) reported that dietary thyme extract solution (0.1%) in water increased the performance and lactic acid counts whereas reduced the E.coli

numbers (P<0.05). In addition, high levels of thyme extract (up to 0.6%) in drinking water were investigated on performance and some carcass characteristics in broiler chickens.

This study aimed to investigate the effect of using phytobiotic including sweet basil, thyme and their oils as natural feed additives on performance, blood profile, bacterial account and the immune response of broiler chicks.

MATERIALS AND METHODS

The study was conducted at the Poultry Research unit, Damanhour University from October to November 2016. The main objective was to investigate the effects of sweet basil and thyme powder and their oils as feed additives in diets of broiler from day 7 to 39 of age.

Chicks and supplements

Three hundred and seventy-eight unsexed one-day-old Cobb-500 broiler chicks obtained from commercial hatchery were used. Experimental chicks were fed the same basal diet and submitted to the following dietary treatments: the first group fed a commercial broiler basal diet without supplementation (control), while the 2nd and 3rd groups fed basal diet supplemented with 10 and 20 g/kg of sweet basil powder, the 4th and 5th groups fed basal diet supplemented with 0.5 and 1g/kg of sweet basil oil , the 6th and 7th groups fed basal diet supplemented with 5 and 10 g/kg of thyme powder and the 8th and 9th groups fed basal diet supplemented with 0.5 and 1g/kg of thyme oil. Basil oil represented a constant ratio of basil powder about 4.4% of basil powder; while, thyme oil represented a constant ratio of thyme powder about 7.5 % of thyme powder. The basal diets were formulated according to NRC (1994) to contain 22.9% and 3042 kcal/kg, 21.4% crude protein and 3103 kcal/kg during the starter and grower periods, respectively.

Housing and husbandry

Chicks were housed in battery brooders in semi-opened room equipped with two exhaust fans to keep normal ventilation. Chicks were fed the experimental diets ad libtium and given free access to water. A light schedule similar to commercial condition was 23 h light until 7th day followed by 20 h light from 8th day to through the experimental period until 3 days before slaughter test (8-39 days of age). The average outdoor minimum and maximum temperature and relative humidity during the experimental period was 22C^{o} and 24 C^{o} and 55.7% and 58.7%, respectively. The brooding temperature (indoor) was 32, 30, 27 and 24-21 C^{o} during 1-7, 8-14, 15-20 and 21-39 days of age (declined gradually).

Data collection

Performance parameters including body weight at 7 and 39 days of age, voluntary feed intake, while feed conversion ratio (g feed/g gain) was easily calculated .European production efficiency index (EPEI) was measured throughout the experimental period (7-39 d of age), according to Hubbard broiler management guide. (1999).

At 39 d of age, 12 chicks were taken randomly from each treatment, slaughtered and the dressed weight was calculated. The carcass organs and parts were expressed as relative to live body weight.

At 39 d of age, about 3 ml blood, six chicks from each group were randomly taken at 08:00 – 09:00 am from the wing vein of chicks under vacuum in clean tubes with or without heparin before slaughtering, coagulated blood samples were centrifuged at 4000 rpm for 15 minutes and the clear serum was

separated and stored in a deep freezer at -20oC until biochemical analysis. Non-coagulated blood was tested shortly after collection for estimating blood picture. Red blood cells (RBCs) and white blood cells (WBCs) were counted according to Feldman et al. (2000). Hemoglobin concentration and packed cells volume percentages were measured according to Drew et al. (2004).

At 39 d of age, serum samples were obtained from twelve birds of each treatment. Glucose concentration (mg/dl) was measured according to Trinder (1969). Total protein (g/dl) (Henry et al., 1974), albumin (g/dl) (Doumas, 1971), globulin (g/dl) (Coles, 1974) and different types of globulin (α-globulin, β-globulin and γ-globulin) were determined according to Bossuyt et al. (2003). In addition, serum samples were assigned for determination of creatinine and urea (Bartles et al., 1972), triglycerides (Fossati and Prencipe, 1982), total cholesterol (Stein, 1986), HDL (Lopez-Virella, 1977), while LDL was determined according to (Friedewald et al., 1972). The activity of serum aspartate amino transferase, and alanine amino transferase, were estimated according to Reitman and Frankel (1957).

Total antioxidant capacity was determined according to Koracevic et al. (2001), Superoxide dismutase activity (Misra and Fridovich, 1972), Glutathione peroxidase activity (Paglia and Valentine, 1967) and Glutathione activity (Ellman, 1959). Phagocytic activity (PA) = Percentage of phagocytic cells containing yeast cells. Phagocytic index (PI) = Number of yeast cell phagocytized/ Number of phagocytic cells. Phagocytic activity and index was determined according to Kawahara et al. (1991).

Serum immunoglobulins (IgG, IgM and IgA) were determined using commercial ELISA kits (Kamiya Biomedical Company, USA) according to Bianchi et al. (1995). The contents of IL-2, IL-10 and IFN-γ were measured using chicken ELISA Kits (R&D Systems, Minneapolis, MN, U.S.A.). Measurements were conducted according to the manufacturer's instructions. Lymphocyte transformation test was determined following the method described by Balhaa et al. (1985). Serum bactericidal activity to Aeromonas hydrophila strain was determined according to Rainger and Rowley (1993). Serum lysozyme activity was measured with the turbid metric method described by Engstad et al. (1992) and the results are expressed as one unit of lysozyme activity that defined as a reduction in absorbance at 0.001/min. Lysozyme activity = (A0 - A) / A.

The effect of dietary treatments on the microbial activity of the digestive system include : total bacteria count which was determined according to the method of ICMSF (1980), as well as the detection of Salmonella and Escherichia coli strains following the ISO-6579: 2002 food microbiology procedure employing the horizontal method of food and animal feeding stuffs (ISO Standards catalogue 07.100.30; WHO 2010).

Chemical analysis of the experimental sweet basil, thyme and their oils:

The results of chemical analysis shown in (Table 1) indicated that the experimental sweet basil powder contains 10.58% moisture, 16.77% crude protein, 4.12% ash, 8.9% crude fiber, 52.7% carbohydrate and 4.4% oil. while fatty acid content of basil oil include 21.62% palmitic (C16:0), 6.31% linoleic (C18:2 w6), 9.38% linolenic (C18:3 w3), 22.41% stearic (C18:0), 5.42% palmitoleic

(C16:0) and 33.82% oleic (C18:1 w9)

Seemingly, thyme powder contains 7.5% moisture, 10.9% ash, 8.7% crude protein, 6.8% lipids, 18.3% crude fibers, 64.4% carbohydrates and 7.5% oil. Active components of essential thyme oil are1.12% A-pinene, 0.83% camphene, 0.40% β-pinene,1.63% myrcene, 0.9% α-terpinene, 34.5% p-cymene, 0.70% limonene, 31.77% thymol and 4.01% carvacrol.

Statistical analysis

Data were analyzed by the GLM procedure (Statistical Analysis System (SAS), 2002) using one-way ANOVA with the following model:

$Y_{ik} = \mu + T_i + e_{ik}$

Where Y is the dependent variable; μ the general mean; T the effect of experimental treatments; e the random error.

Before analysis, all percentages were subjected to logarithmic transformation ($\log_{10} x + 1$) to normalize data distribution. The difference among means was determined using Duncan's new multiple range test (Duncan, 1955) at $P < 0.05$.

RESULTS

Growth performance:

The production performance, economical efficiency and production index of broiler fed diet supplemented with different levels of sweet basil, thyme and their oils during days 7-39 of age are shown in Table 2. All supplementations had significantly ($p \leq 0.05$) greater BW, BWG, economical efficiency and production index as well as better FCR, than the control group.

Furthermore, broiler fed basal diet supplemented with different levels of basil powder, low level of thyme powder and different levels of thyme oil had significantly greater BW, BWG, economical efficiency, production index and better FCR, than other groups. While all supplements had no significant effect on FI compared to control group

Hematological profile:

The hematological blood contents are shown in Table 3. All supplementations increased RBC's, Hb, WBC's and Lymphocytes while had no significant effect on PCV, Heterophils, Monocytes, and Basophils compared to control group. Furthermore, broiler fed basal diet supplemented with different levels of basil powder, 5 g of thyme powder and with different levels of thyme oil had significantly higher RBC's than other group. However, no significant effects were detected on Hb, WBC's and Lymphocytes among all supplementations.

Blood constituents:

The biochemical blood constituents are shown in Tables 4 and 5. All supplements had no significant effect on urea, creatinine, HDL, albumin and T4, while decreased AST, ALT, total lipids, triglycerides, cholesterol and LDL compared to control group. In addition, all supplementations increased glucose, total protein, TAC, GPX, GSH. SOD and T3 compared to control group. Furthermore, broiler fed basal diet supplemented with different levels of basil powder, 5 g of thyme powder and different levels of thyme oil had significantly higher values of glucose, TAC, GPX, GSH, T3 than other groups. However, no significant effects were detected on AST, ALT, Total protein and SOD activity among all the tested supplements.

Immunization parameters:

The Immune indices are shown in Tables 6 and 7. Feeding diet with different levels of sweet basil, thyme and their oils significantly increased globulin, γ-

globulin, LTT, BA, LA , BA , PI, IgM, IgG, INFγ, IL.2 and IL10 compared to control group. While, all supplementations had no significant effect on α–globulin, β–globulin and IgA compared to control group. However, no significant differences were detected on globulin, γ- globulin, LTT, BA, LA, BA, PI, INFγ, IL.2 and IL10 between all supplementations. Moreover, broiler fed basal diet supplemented with different levels of basil powder, 5 g of thyme powder and different levels of thyme oil had significantly higher IgM values than other groups.

Carcass characteristics:

The carcass characteristics are shown in Tables 8. Supplementation of different levels of sweet basil, thyme and their oils increased significantly percentage of dressing and total edible parts and decreased abdominal fat and bursa compared with control. While, no significant differences between groups were observed in percentage of thymus and spleen. However, no significant effects were detected on bursa between all supplementations. Moreover, broiler fed basal diet supplemented with different levels of basil powder, 5g of thyme powder and different levels of thyme oil had significantly higher percentage of dressing and total edible parts and lower abdominal fat than other groups.

Bacterial counts:

Total bacterial counts of the experimental treatments are shown in Table 9. All supplementations of sweet basil, thyme and their oils decreased total bacterial counts, Salmonella, E.Coli and Proteus compared to control group. However, no significant effects were detected on TBC between all supplementations. Moreover, broiler fed basal diet supplemented with different levels of basil powder, 5 g of thyme powder and different levels of thyme oil had significantly lower Salmonella, E.Coli and Proteus than other groups.

DISCUSSION

Phytogenic compounds are an alternative to antibiotic growth promoters. The mode of action of phytogenics is to achieve better performance. The present study indicates that the addition of either sweet basil, thyme and their oils to diets improves the growth, FCR, economical efficiency, production index of broiler compared to the un-supplemented control one. These results are in line with those of Gunal et al. (2006); Hosseini et al. (2013) and Azadegan Mehr et al. (2014). Abbas (2010); Osman et al. (2010); Riyazi et al., (2015) and Onwurah et al. (2011) reported that addition of basil leaf and seed to the diet had a beneficial effect on body weight gain and feed conversion ratio. With regard to thyme and thyme oil, Attia (2016) reported that thyme oil (TO) fed groups had comparable FCR and EPEI and showed more desirable FCR and EPEI than the control group. El-Ghousein and Al-Betawi (2009); Najafi and Torki (2010) and Masek et al. (2014) reported that thymol had an enhancing effect on the growth performance of broilers. In addition, Feizi et al. (2013) showed that TO improved growth performance and reduced the mortality of broilers. On the other hand, Hosseini et al. (2013) and Fallah and Mirzaei (2016) concluded that thyme powder at 1, 1.5 and 5 g/kg diet did not affect the growth performance of broilers, and the hot water extracted thyme administered at 5g/l did not affect the growth performance of broilers . (Pourmahmoud et al., 2013 and Hady et al., 2016) These contradictions could be attributed to the thyme product, e.g. powder, extract or oil, the

composition of the basal diet, and the environmental, hygienic conditions and age. In general, growth promoters had less favourable effects when birds were raised in optimal environmental conditions (Bovera et al., 2012; Pourmahmoud et al., 2013; Masek et al., 2014 and Attia et al., 2016). There are three possible methods for the action of thymol: the first is a reduction of harmful microbiota; the second is a boosting of the antioxidant system due to polyphenol constituents (Abdulkarimi et al., 2011); the third may be due to increasing feed utilization and enhancing immunity (Ghazalah and Ali, 2008). Thus, the improved feed utilization of the thyme oil (Attia et al., 2016) may be due to the decrease in the pathogen micro flora and thus improved gut ecology and/or increased digestibility of the nutrients, decrease in the AST suggesting an improvement in general health status and a boosting in liver functions due to thyme oil, which was found to be a good source of PUFA (42.34%) and antioxidants (69.5%). Moreover, Attia, 2016 reported that Thyme oil at 1g/kg diet may be used as an alternative growth promoter with positive effects on economic performance (FCR and EPEI) and the immune responses (IBD) during 1–28 days of age of broiler chickens raised under hot climates, and showed a prebiotic-like effect.

It is worthy to mention that no mortality was occurred under the experimental conditions. This study performed under ideal conditions, so bacterial growth in the intestine may have been limited. As a result of this, the growth promotion may have been affected. In this connection, Riyazi et al. (2015) reported that basil essential oil was found to be effective against E.coli. Numerous in vitro studies reported that major components of basil essential oils including methyl chavicol, linalool, alpha-pinene, methyleugenol, eugenol, displayed antimicrobial activity against intestinal microbes such as C. perfringensS. typhimurium and E.coli (Prabuseenivasan et al., 2006; Sienkiewicz et al., 2013 and Hanif et al., 2011).Serum biochemistry is a labile biochemical system which can reflect the condition of the body and the changes happening to it under the influence of internal and external factors. It is possible that both the short feeding period and the relatively low doses may have been implicated in the failure of basil essential oil to reduce plasma triglycerides and cholesterol level. Furthermore, it is well known that the absence or presence of cholesterolemic effects of dietary components in an animal depend on various factors such as breed, gender and age, and also on the composition of the feed (Toghyani et al., 2010). These findings concur with the data of Demir et al. (2005), who indicated that the supplementation of dietary thyme powder (1g/kg) for 42 days numerically increased plasma cholesterol and triglycerides levels compared to the control. Osman et al. (2010) reported that feeding dietary basil leaf powder for 42 days did not significantly influence the plasma cholesterol and triglycerides level in broilers. However, Abbas (2010) reported that feeding dietary basil seed (3 g/k) significantly reduced the plasma cholesterol level in broilers.

The results obtained agree with those reported by Hernandez et al. (2004) who found no differences in gizzard, liver and pancreas weights of broiler chickens fed with wheat–soybean-meal-based diets supplemented with plant extracts from the Labiatae family compared to the avilamycin group. Also, our findings on

carcass traits are in agreement with those of Osman et al., (2010), who did not report any significant influence of dry basil leaf supplement on the relative weights of the gizzard, liver, heart and carcass at slaughter age in broilers. In another previous experiment, Abbas (2010) reported that organ weights and carcass characteristics were not affected by supplementing diet with 3 g/kg basil seed. Also, Azadegan Mehr et al. (2014) found no significant differences in carcass traits among a medicinal plant group, a probiotic group, and a control group.

Antimicrobial properties of basil essential oil ingredients such as methyl chavicol and pinene have been shown in various papers (Hanifet al., 2011). Given that most of the components of basil essential oil used in this study are comprised of methyl chavicol and α-pinene, therefore, we can attribute the reduction in abdominal fat to the antibacterial effect of basil essential oil. Studies have shown that reducing the population of harmful bacteria prevents the breakdown of feed amino acids and proteins in the gut, and with better absorption, amino acids used in the synthesis of proteins, and with their accumulation in the breast and thigh and improve their weights (Lee et al., 2003).

Further evidence for improved health status due to thyme oil can be seen from the significant increase in antibody titres to IBD, particularly of the group on the thyme oil diet. In addition, a higher globulin level is suggestive for a better disease resistance and immune response of birds as indicated by Bovera et al. (2016). The enhancements in the general health status of the broilers fed different thyme oil supplementations could be attributed, as previously mentioned, to the increase in digestion and absorption of feeds and to the antimicrobial, antioxidants effects and fatty acid profile (Bozkurt et al., 2012; Hosseini et al., 2013; Masek et al., 2014 and Hady et al., 2016).

In the literature, thymol, carvacrol and linalool are the major components in the thyme oil, which are found to have antioxidant, antimicrobial and digestion-enhancing effects (Bozkurt et al., 2012; Sethiya, 2016). Thyme extract, and particularly the phenolic and terpenic compounds of TO, protect against DNA damage (Sengul et al., 2008), suggesting that these compounds may act as free radical scavengers (Akbarian et al., 2014), so improve general health.

Therefore, performance promoting effects of essential oil, extract, powder or principal components of thyme have been demonstrated (Al-Mashhadani et al., 2011; Lee et al., 2003 and Bolukbasi and Erhan, 2007). Besides, ground thyme has been shown to inhibit the growth of S.typhimurium (Aktug and Karapinar, 1986) and the growth of the E.coli (Marino et al., 1999).

In conclusion, either sweet basil or thyme and their oils could be used safely as a natural growth promoters to improve growth, immune response and general health of broiler chicks.The reduction of E.coli may be explained by the ability of essential oils to disrupt the bacterial cell membrane. The antimicrobial action of essential oils is mediated by lipophilic property to perforate the bacterial membrane, which releases membrane components from the cells to the external environment (Helander et al., 1998). Moreover, it has been shown that essential oils stimulate the release of mucus into the small intestine which reduces the adhesion of pathogens to the epithelium (Jamroz et al., 2006). In general, basil essential oil decreased total bacteria counts of ileum of broilers. Riyaziet al. (2015) suggest that increased level of basil essential oil lowers E.coli colonies and increases the number of Lactobacillus colonies; a process that may improve intestinal micro flora and indirectly enhance the performance immune system through elimination of pathogens.

Table (1): Structure of sweet basil and thyme powders and their oils.

Structure of sweet basil powder	
Items	%
Moisture	10.58
Ash	4.12
Crude protein	16.77
Lipids	2.5
Crude fiber	8.9
Carbohydrate	52.7
Oil	4.4
Sweet basil fatty acids Fatty acid % of total F.As	
Myristic (C14:0)	1.03
Palmitic (C16:0)	21.62
Stearic (C18:0)	22.41
Palmiteleic (C16:0)	5.42
Oleic (C18:1 w9)	33.82
Linoleic (C18:2 w6)	6.31
Linolenic (C18:3 w3)	9.38
Ecosapentaenoic (EPA) (C20:5 w3)	--
Decosahexaenoic (DHA) (C22:6 w30	--
W6/W3	0.673
Structure of thyme powder	
Items	%
Moisture	7.5
Ash	10.9
Crude protein	8.7
Lipids	6.8
Crude fibers	18.3
Carbohydrates	64.4
Oil	7.5
Thyme volatile oil (%)	
A-pinene	1.12
Camphene	0.83
β-pinene	0.40
Myrcene	1.63
α-terpinene	0.9
p-cymene	34.5
Limonene	0.70
Thymol	31.77
Carvacrol	4.01

Table (2): Production performance, economical efficiency and production efficiency index of broiler fed diet supplemented with different levels of sweet basil, thyme powder and their oils.

Treatments	BW 7 d (g)	BW 39 d (g)	BWG 7-39 (g)	FI 7-39 (g)	FCR 7-39 (feed/gain)	Economical efficiency	Production Index (%)
Control	161	1700^{c}	1540^{c}	3460	2.18^{a}	0.404^{c}	199^{c}
10 g of basil powder/ kg feed	160	2220^{a}	2060^{a}	3415	1.65^{c}	0.857^{a}	255^{a}
20 g of basil powder/ kg feed	165	2120^{a}	1955^{a}	3290	1.63^{c}	0.868^{a}	255^{a}
0.5 g of basil oil /kg feed	160	2132^{b}	1853^{b}	3280	1.77^{b}	0.622^{b}	230^{b}
1.0 g of basil oil /kg feed	163	2160^{a}	1997^{b}	3300	1.85^{b}	0.797^{b}	234^{b}
5 g of thyme powder /kg feed	164	2220^{a}	2060^{a}	3450	1.67^{c}	0.889^{a}	265^{a}
10 g of thyme powder /kg feed	161	2070^{b}	1909^{b}	3560	1.86^{b}	0.767^{b}	237^{b}
0.5 g of thyme oil /kg feed	163	2210^{a}	2047^{a}	3400	1.65^{c}	0.871^{a}	286^{a}
1.0 g of thyme oil /kg feed	160	2272^{a}	2112^{a}	3500	1.65^{c}	0.869^{a}	266^{a}
P value	1.0000	0.0001	0.0001	0.0771	0.0001	0.028	0.009
SEM	0.647	24.8	128	118	0.070	4.56	6.09

SEM=Standard error of mean's; BW=body weight; BWG=body weight gain; FI=Feed intake; FCR=feed conversion ratio

^{a,b,c} Means in the same column followed by different letters are significantly different ($p \leq 0.05$).

Table (3): Blood hematological of broiler chickens fed diet supplemented with different levels of sweet basil, thyme powder and their oils.

Treatments	RBC's (10^6/cmm^3)	Hb (g/dl)	PCV %	WBC's (10^3/mm^3)	Lymphocytes (%)	Heterophils (%)	Monocytes (%)	Eosinophils (%)
Control	2.82^c	9.19^b	27.2	168^c	52.7^b	31.7	7.98	5.57
10 g of basil powder/ kg feed	3.42^a	12.0^a	32.2	199^a	59.7^a	31.7	7.45	5.56
20 g of basil powder/ kg feed	3.58^a	12.5^a	34.3	198^a	60.2^a	29.7	6.34	4.88
0.5 g of basil oil /kg feed	3.02^b	13.0^a	35.4	178^b	58.7^a	31.7	7.23	5.58
1.0 g of basil oil /kg feed	3.05^b	14.9^a	37.6	174^b	59.2^a	32.5	5.51	3.75
5 g of thyme powder /kg feed	3.74^a	11.5^a	32.8	196^a	60.0^a	30.6	5.67	3.67
10 g of thyme powder /kg feed	3.07^b	13.8^a	35.2	178^b	60.5^a	30.5	5.25	3.75
0.5 g of thyme oil /kg feed	3.77^a	12.5^a	36.5	196^a	64.2^a	37.0	5.00	3.75
1.0 g of thyme oil /kg feed	3.55^a	13.8^a	35,7	192^a	60.2^a	30.2	5.50	4.00
P value	0.008	0.087	0.098	0.020	0.006	0.098	0.980	0.898
SEM	0.435	2.49	6.14	0.543	0.603	0.327	0.159	0.297

^{a,b,c} Means in the same column followed by different letters are significantly different at ($p \leq 0.05$). SEM=Standard error of mean's.

^{a,b} Values within a row with different superscripts differ significantly at $P<0.05$.

SEM, Standard error of mean's; RBC's=red blood cell; PCV=packed cell volume; WBC's=white blood cell

Table (4): Blood biochemical of broiler chickens fed diet supplemented with different levels of sweet basil, thyme powder and their oils.

Treatments	**Urea (mg/dl)**	**Creatinine (mg/dl)**	**AST (U/L)**	**ALT (U/L)**	**Glucose (mg/dl)**	**Total lipids**	**Triglycerides (mg/dl)**	**Cholesterol (mg/dl)**	**HDL (mg/dl)**	**LDL (mg/dl)**
Control	12.3	0.505	41.9[a]	18.9[a]	198[c]	480[a]	88.3[a]	85.8[a]	33.6	34.9[a]
10 g of basil powder/ kg feed	11.5	0.552	29.9[b]	13.9[b]	222[a]	277[c]	70.3[b]	65.8[c]	33.6	18.2[b]
20 g of basil powder/ kg feed	11.8	0.520	28.9[b]	11.3[b]	226[a]	276[c]	71.7[b]	65.4[c]	38.6	13[b]
0.5 g of basil oil /kg feed	12.5	0.420	29.9[b]	13.9[b]	212[b]	380[b]	70.3[b]	73.8[b]	33.6	26.2[b]
1.0 g of basil oil /kg feed	11.9	0.365	30.1[b]	10.7[b]	211[b]	324[b]	72.9[b]	70.1[b]	31.3	24.6[b]
5 g of thyme powder /kg feed	11.0	0.787	26.4[b]	11.8[b]	224[a]	264[c]	71.8[b]	60.2[c]	36.3	9.5[c]
10 g of thyme powder /kg feed	14.3	0.522	30.5[b]	13.1[b]	211[b]	370[b]	75.0[b]	70.5[b]	37.3	18.5[b]
0.5 g of thyme oil /kg feed	12.0	0.435	29.1[b]	12.7[b]	227[a]	254[c]	71.0[b]	63.7[c]	35.7	14.5[b]
1.0 g of thyme oil /kg feed	13.5	0.405	29.0[b]	12.1[b]	235[a]	290[c]	70.8[b]	61.9[c]	35.1	12.8[b]
P value	0.079	0.670	0.045	0.008	0.008	0.031	0.017	0.008	0.098	0.007
SEM	0.987	0.009	4.98	2.09	3.98	4.98	3.98	3.95	2.09	3.98

[a,b,c] Means in the same column followed by different letters are significantly different at ($p \leq 0.05$). SEM=Standard error of mean's.

SEM, Standard error of mean's; AST=aspartate amino transferase; ALT=alanine amino transferase; HDL=high-density lipoprotein; LDL=low-density lipoprotein;

Table (5): Blood biochemical parameters of broiler chickens fed diet supplemented with different levels of sweet basil, thyme powder and their oils.

Treatments	Total protein (g/dl)	Albumin (g/dl)	TAC (mMol//dl)	GPX (U/dl)	GSH (ug/dl)	SOD (U/dl)	T3 (ng / ml)	T4 (ng / ml)
Control	2.78[b]	1.37	400[c]	1.71[c]	238[c]	199[b]	0.645[c]	7.62
10 g of basil powder/ kg feed	3.09[a]	1.35	422[a]	5.99[a]	388[a]	229[a]	0.998[a]	7.62
20 g of basil powder/ kg feed	3.03[a]	1.34	422[a]	5.97[a]	399[a]	255[a]	1.07[a]	6.85
0.5 g of basil oil /kg feed	3.09[a]	1.59	416[b]	4.71[b]	301[b]	244[a]	0.945[a]	7.62
1.0 g of basil oil /kg feed	3.00[a]	1.48	412[b]	4.58[b]	306[b]	243[a]	0.939[a]	5.11
5 g of thyme powder /kg feed	3.05[a]	1.20	425[a]	6.70[a]	410[a]	244[a]	0.999[a]	5.99
10 g of thyme powder /kg feed	3.16[a]	1.63	411[b]	4.91[b]	310[b]	214[a]	0.772[b]	6.66
0.5 g of thyme oil /kg feed	3.59[a]	1.85	424[a]	6.48[a]	333[a]	230[a]	0.995[a]	5.83
1.0 g of thyme oil /kg feed	3.15[a]	1.36	422[a]	6.80[a]	326[a]	243[a]	1.02[a]	5.86
P value	0.006	0.099	0.034	0.003	0.008	0.034	0.045	0.087
SEM	0.234	0.067	4.09	0.984	4.09	3.98	0.009	0.987

[a,b,c] Means in the same column followed by different letters are significantly different at ($p \leq 0.05$). SEM=Standard error of mean's.

SEM, Standard error of mean's; T3= triiodothyronine; T4=thyroxine; TAC=total antioxidant capacity; GPX =glutathione peroxidase; GSH= glutathione; SOD=superoxide dismutase

Table (6): Immune indices of broiler chickens fed diet supplemented with different levels of sweet basil, thyme powder and their oils.

Treatments	Globulin (g/dl)	α–globulin (mg/dl)	β –globulin (mg/dl)	γ –Globulin (mg/dl)	LTT (%)	BA (%)	LA (IU%)	PA (%)	PI (%)
Control	1.41[b]	0.545	0.754	0.295[b]	18.7[b]	32.7[b]	0.102[b]	12.2[b]	0.925[b]
10 g of basil powder/ kg feed	1.74[a]	0.556	0.753	0.895[a]	26.7[a]	38.1[a]	0.152[a]	21.2[a]	1.55[a]
20 g of basil powder/ kg feed	1.69[a]	0.651	0.544	0.864[a]	27.5[a]	39.2[a]	0.168[a]	22.5[a]	1.62[a]
0.5 g of basil oil /kg feed	1.50[a]	0.555	0.755	0.795[a]	27.7[a]	37.7[a]	0.162[a]	21.2[a]	1.65[a]
1.0 g of basil oil /kg feed	1.52[a]	0.550	0.575	0.795[a]	26.7[a]	38.2[a]	0.167[a]	23.5[a]	1.49[a]
5 g of thyme powder /kg feed	1.96[a]	0.959	0.805	0.965[a]	26.8[a]	37.6[a]	0.166[a]	21.3[a]	1.53[a]
10 g of thyme powder /kg feed	1.53[a]	0.625	0.575	0.534[a]	26.7[a]	38.2[a]	0.175[a]	22.2[a]	1.66[a]
0.5 g of thyme oil /kg feed	1.74[a]	0.675	0.525	0.747[a]	27.5[a]	38.7[a]	0.167[a]	22.5[a]	1.65[a]
1.0 g of thyme oil /kg feed	1.79[a]	0.675	0.645	0.722[a]	25.5[a]	37.9[a]	0.186[a]	22.8[a]	1.55[a]
P value	0.032	0.085	0.066	0.005	0.005	0.007	0.002	0.003	0.001
SEM	0.112	0.009	0.021	0.113	0.087	0.546	0.323	0.089	0.198

[a,b,c] Means in the same column followed by different letters are significantly different at ($p \leq 0.05$). SEM, Standard error of mean's.

[,b] Values within a row with different superscripts differ significantly at $P<0.05$.

SEM, Standard error of mean's; LA= lysozyme activity; BA=bactriocide activity ; LTT=lymphocyte transformation test; PI=phagocytic index; PA =phagocytic activity

Table (7): Immune indices of broiler chickens fed diet supplemented with different levels of sweet basil, thyme powder and their oils

Treatments	IgA (mg/100 ml)	IgM (mg/100 ml)	IgG (mg/100 ml)	INFγ (pg/mL)	IL.2 (pg/mL)	IL.10 (pg/mL)
Control	9.77	8.61^{c}	32.4^{b}	3.02^{b}	4.45^{b}	15.2^{b}
10 g of basil powder/ kg feed	9.77	18.6^{a}	45.8^{a}	4.62^{a}	6.45^{a}	19.2^{a}
20 g of basil powder/ kg feed	11.3	19.3^{a}	46.2^{a}	4.66^{a}	7.55^{a}	19.5^{a}
0.5 g of basil oil /kg feed	9.77	10.6^{b}	41.8^{b}	4.02^{a}	6.45^{a}	18.9^{a}
1.0 g of basil oil /kg feed	10.1	13.6^{b}	51.0^{a}	4.48^{a}	7.42^{a}	17.7^{a}
5 g of thyme powder /kg feed	9.43	20.1^{a}	49.3^{a}	4.58^{a}	7.46^{a}	18.0^{a}
10 g of thyme powder /kg feed	7.68	10.2^{b}	41.5^{b}	4.32^{b}	7.55^{a}	19.5^{a}
0.5 g of thyme oil /kg feed	11.1	19.5^{a}	50.8^{a}	4.57^{a}	7.46^{a}	18.7^{a}
1.0 g of thyme oil /kg feed	13.5	19.5^{a}	49.4^{a}	4.62^{a}	7.57^{a}	18.5^{a}
P value	0.087	0.043	0.001	0.008	0.037	0.043
SEM	0.655	1.00	3.76	0.065	0.876	0.277

^{a,b,c} Means in the same column followed by different letters are significantly different at ($p \leq 0.05$). SEM=Standard error of mean's.
^{,b} Values within a row with different superscripts differ significantly at $P<0.05$.
SEM, Standard error of mean's;

Table (8): Carcass characteristics and relative weight of immune organs to live body weight of broiler chickens fed diet supplemented with different levels of sweet basil, thyme powder and their oils

Treatments	Dressing, %	Total edible parts, %	Abdominal fat, %	Spleen, %	Bursa, %	Thymus,%
Control	60.7^{c}	68.4^{c}	1.37^{a}	0.157	0.347^{a}	0.517
10 g of basil powder/ kg feed	71.1^{a}	78.0^{a}	0.625^{c}	0.129	0.153^{b}	0.669
20 g of basil powder/ kg feed	77.2^{a}	77.9^{a}	0.520^{c}	0.147	0.144^{b}	0.475
0.5 g of basil oil /kg feed	67.0^{b}	74.8^{b}	0.706^{b}	0.109	0.132^{b}	0.444
1.0 g of basil oil /kg feed	65.0^{b}	73.6^{b}	0.824^{b}	0.117	0.159^{b}	0.516
5 g of thyme powder /kg feed	75.7^{a}	77.9^{a}	0.675^{c}	0.184	0.157^{b}	0.410
10 g of thyme powder /kg feed	69.0^{b}	72.5^{b}	0.715^{b}	0.198	0.152^{b}	0.469
0.5 g of thyme oil /kg feed	75.7^{a}	77.4^{a}	0.503^{c}	0.102	0.164^{b}	0.380
1.0 g of thyme oil /kg feed	75.4^{a}	79.3^{a}	0.531^{c}	0.115	0.130^{b}	0.372
P value	0.009	0.004	0.065	0.099	0.088	0.077
SEM	0.602	0.111	0.008	0.087	0.006	0.021

^{a,b,c} Means in the same column followed by different letters are significantly different at ($p \leq 0.05$). SEM=Standard error of mean's.

Table (9): Bacterial count (cfu) of broiler fed diet supplemented with different levels of sweet basil, thyme powder and their oils

Treatments	TBC x10^3	Salmonella x 10^2	E.Coli x 10^3	Proteus. x 10^2
Control	2.82^a	0.925^a	1.13^a	0.878^a
10 g of basil powder/ kg feed	2.09^b	0.732^c	0.712^c	0.607^c
20 g of basil powder/ kg feed	2.11^b	0.722^c	0.835^c	0.562^c
0.5 g of basil oil /kg feed	2.12^b	0.877^b	0.913^b	0.779^b
1.0 g of basil oil /kg feed	2.15^b	0.800^b	0.919^b	0.733^b
5 g of thyme powder /kg feed	2.16^b	0.795^c	0.836^c	0.537^c
10 g of thyme powder /kg feed	2.15^b	0.806^b	0.899^b	0.735^b
0.5 g of thyme oil /kg feed	2.17^b	0.792^c	0.867^c	0.565^c
1.0 g of thyme oil /kg feed	2.19^b	0.758^c	0.758^c	0.455^c
P value	0.009	0.0001	0.004	0.007
SEM	0.086	0.044	0.056	0.023

^{a,b,c} Means in the same column followed by different letters are significantly different at ($p \leq 0.05$). SEM=Standard error of mean's.

^{,b} Values within a row with different superscripts differ significantly at $P<0.05$.

SEM, Standard error of mean's; TBC= Total bacterial count

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الملخص العربى

الأداء الانتاجي والاستجابة الفسيولوجية والمناعية لدجاج التسمين وتأثره باضافة النباتات العطرية وزيوتها الاساسية في الغذاء

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أجريت هذه الدراسة في وحدة بحوث الدواجن بمزرعة البستان، قسم الانتاج الحيواني والداجني، كلية الزراعة جامعة دمنهور. هدفت هذه الدراسة إلى تقييم تأثير إضافة الريحان والزعتر والزيت الخاص بكل منهما على أداء النمو، والكفاءة الاقتصادية، والصفات البيوكيماوية والهيماتولوجية للدم والاستجابة المناعية عند عمر 39 يوما لدجاج التسمين. استخدم في هذه التجربة عدد 378 من الجنسان عمر 7 أيام والتي وزعت علي تسعة معاملات بكل منها عدد 42 كتكوت موزعة علي سته مكررات بكل مكرر سبعة طيور. استخدمت المجموعة الأولي للمقارنة (كنترول) بينما غذيت المعاملات رقم 2، 3 علي علائق تحتوي علي مسحوق اوراق الريحان بمستويات 10، 20جم/كجم علف بينما غذيت المعاملات رقم 4، 5 علي علائق تحتوي علي نفس مستويات زيت الريحان الموجود في المستويات السابقة من مسحوق الريحان بمعدل 0,5 و1 جم/كجم علف. بينما غذيت المعاملات رقم 6، 7 علي علائق تحتوي علي مسحوق الزعتر بمستويات 5، 10جم/كجم علف بينما غذيت المعاملات رقم 8، 9 علي علائق تحتوي علي نفس مستويات زيت الزعتر الموجود في المستويات السابقة من مسحوق الزعتر بمعدل 0,5 و1 جم/كجم علف.

أظهرت النتائج حدوث زيادة معنوية في وزن الجسم الحي ومعدل الزيادة في وزن الجسم وحدوث انخفاض في استهلاك العلف وكذلك حدوث تحسن في الكفاءة الغذائية والكفاءة الاقتصادية ووزن الذبيحة في المجموعات التي غذيت علي الريحان والزعتر والزيت الخاص بكلاهما مقارنة بمجموعة الكنترول. وكان فضل المعاملات تلك التي غذيت علي مسحوق الريحان وكذلك معاملات التي غذيت علي المستوي المنخفض من مسحوق الزعتر وكذلك المعاملات التي غذيت علي مستويات زيت الزعتر مقارنة بباقي المعاملات.

أظهرت النتائج أيضا حدوث زيادة معنوية في مستوي بروتينات والجلوبيولينات المناعية في المجموعات المضاف لها الاضافات المختلفة بمستوياتها المختلفة مقارنة بمجموعة الكنترول. بينما كان هناك انخفاض معنوي في مستوى الدهون الكلية في الدم والكوليسترول وكذلك انخفاض مستوي LDL في المجموعات المغذاة علي النباتات الطبية والزيت الخاص بها مقارنة بمجموعة الكنترول. سجلت زيادة في مستوي جلوكوز الدم وكذلك زيادة في تركيزات هرمونات الغدة الدرقية وأيضا تحسن في مستوي انزيمات الاكسدة المختلفة في سيرم الدم في المجموعات المغذاة علي النباتات الطبية والزيت الخاص بها مقارنة بمجموعة الكنترول. حسنت الإضافات المستخدمة من وظائف الكبد والكلى مقارنة بالكنترول. من ناحية أخرى أدت هذه الإضافات إلي زيادة معنوية في عدد كرات الدم البيضاء، كرات الدم البيضاء الليمفاوية، زيادة بروتين السيرم الكلي جلوبيولين السيرم والألفا والجاما جلوبيولين بالمقارنة مع مجموعة الكنترول. أدت جميع الإضافات إلى زيادة مستوى انزيم (SOD) والجلوتاثيون(GSH) والجلوتاثيون بيروكسيديز والقدرة المضادة للأكسدة والنشاط البلعمى ودليل النشاط البلعمى ومعامل تحويل الخلايا الليمفاوية ونشاط مقاومة البكتريا والنشاط الليسوسومى بالمقارنة مع مجموعه الكنترول.

أدت جميع الإضافات إلى زيادة الجلوبيولينات المناعية (IgG - IgM - IgA) بالمقارنة مع مجموعه الكنترول.

أدت جميع الإضافات إلى حدوث انخفاض في أعداد الكائنات الحية الممرضة في الأمعاء في المجموعات المغذاه علي النباتات الطبية والزيت الخاص بها مقارنة بالكنترول، وكان أفضل المعاملات المغذاه علي مسحوق الريحان بالمستويات المدروسة وكذلك المستوي المنخفض من الزعتر وكذلك المستويات المدروسة من زيت الزعتر.

مما سبق يتضح أن إضافة النباتات الطبية المدروسة سواء الريحان أو الزعتر أو الزيت الخاص بكل منهما إلي علائق دجاج التسمين بأي من المستويات المدروسة أدت إلي تحسن في الأداء الانتاجي والاقتصادي والفسيولوجي لدجاج التسمين تحت ظروف إجراء هذه الدراسة.