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EVALUATION OF DRIED PEPPERMINT LEAVES AS NATURAL GROWTH PROMOTERS ALTERNATIVE TO ANTIBIOTICS ON JAPANESE QUAIL

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ABSTRACT: A total number of 360 sexed, one day old Japanese quail were used to study the effect of using dried peppermint leaves (DPL)as natural growth promoters alternative to antibiotics at the levels of (0, 8mg avilamycin / kg diet, 1%DPL and 3 %DPL) under the two sexes (males and females). The obtained results abbreviated as follows: Treatments significantly affected most studied traits more than sex effect did. Females had higher LBW_{38d}, $BWG_{10-38,}$ PI $_{10-38,}$ dressing%, giblets weight and giblets% than males. Treatments significantly affected, serum biochemical indices (except both HDL and ALT), antioxidant parameters and immune responses and intestinal microflora count, favoring the quail fed diet supplemented with peppermint 3% which had the best growth performance. Quail fed diet appended with peppermint 3% showed desirably lower total cholesterol, and lower lipid profile parameters, random blood sugar, and liver enzyme activities, had the elevated antioxidant parameters, immune responses and the lowest thiobarbaturic acid. Peppermint (3% and 1%) supplementation desirably increased Lactobacillus count as compared with those fed diets appended with avilamycin and the control groups and decreased both E coli and Salmonella counts compared to group of control.

In conclusion, peppermint can be supplemented to growing quail diets up to 3% acting as a good alternative to antibiotic (avilamycin) for promoting quail growth.

Key words: Antibiotics-Growth Promoter-Peppermint-Japanese quail

INTRODUCTION

Recently, most antibiotics used for long periods in poultry production as a growth promoter (AGP) have been forbidden because it is risky due to not only cross-resistance but also to multiple resistances (Shazali et al. 2014). The ban on the use of growth promoters such as antibiotics in the European Union (Regulation 1831/2003/EC), the United States and nearly worldwide have prompted the search for alternative feed supplements in poultry production, not only the consumers but also either researchers or nutritionists. So, herbs proposed to sustain both good health and welfare of poultry, improve their performance and enhancing their gut health and productivity (Luna et al., 2018). Peppermint (M piperita) consider one of the natural herbs that referred to as "the world's oldest medicine as a human therapeutic use for many types of sickliness that extends back to the ancient Egypt which widely grown throughout every districts in the world. Nutritionally, peppermint is a low-calorie and offers vitamins A and C, iron, potassium, and fiber. The substances that give the mints their characteristic aromas and flavors are menthol (Edward 2015). Sokovic et al. (2009) reported that M piperita yields 0.1–1% of volatile oil composed primarily of menthone (20–31%), menthyl acetate (3–10%), menthol (29–48%) and menthofuran (6.8%). Also, M piperita included some pharmacologically active ingredients called bitter substances such as carotenes, betaine, flavonoids (12%), caffeic acid, tocopherols, polymerized polyphenols (19%), choline and tannins. There are antibacterial characteristics for oil extracted from peppermint and menthol against both of antibiotic-resistant bacteria and antibiotic-susceptible bacteria and that mean they have wide spectrum effects of essential oils compare to antibiotics (Kamatou et al., 2013). Clinically, Edward (2015) reported that peppermint menthol can help in defending against many types of harmful organisms, acts as a digestive aid, promotes respiratory health, increased oxygen concentration, decreased blood lactate levels, and supports a sanitary oral ambience by inhibiting the growth of bacteria and oral pathogens. Peppermint may support liver function by supporting the influx of bile that helps fats digestion, encourages normal cholesterol levels and may protect the liver against certain toxins. The fresh or dried leaves are popular to use in poultry diets because of its antioxidant, antibacterial, antiviral and anti-inflammatory properties (Khursheed et al. 2017 and Darabighane et al., 2017). Many studies about peppermint's ability to support bird performance are positive, it enhanced performance production (as average daily weight gain and feed conversion, Asadi et al., 2017)) and dressing % (Darabighane et al., 2017).

Peppermint powder resulted in significant differences in serum concentrations triglyceride, total cholesterol, increased high-density lipoprotein-cholesterol, low-density lipoprotein-cholesterol and very low-density lipoprotein-cholesterol and had an antioxidative potential to improve oxidative stability and immune response at 21days and 42 days of age (Arab Ameri et al. 2016). Ghazaghi et al. (2014) reported that increasing dietary Mentha spicata decreased Chol in the serum.

It is evident that peppermint can improve the performance by improving gut (Mehri et al. 2015a) through increasing the digestive function of the intestine via increasing absorptive surface area, brush border enzyme secretion and improving transport system of nutrients. Moreover, peppermint had a significant effect for the gut microflora, anti-body immune response (Mehri et al. 2015b). Also, Ghazaghi et al. (2014) reported that the 3% dietary Mentha spicata was the optimal level of supplementation for increasing Lactobacillus bacteria and decreasing E coli.

Although numerous literatures on beneficial effects of medicinal plants and their essential oils are available in vitro, the evidence of their mode of action is still limited in vivo. Therefore, the aim from this study evaluation the powder of dry peppermint leaves as a natural substitutional to antibiotic as a growth promoter for get better and increasing growth performance, improving serum biochemical indices, antioxidant statues, immune responses, intestinal microflora population and carcass characteristics of Japanese quail.

MATERIALS AND METHODS

Experimental birds design and diets

Three hundred and sixty, one day-old sexed quail were obtained from market and adapted for 10 days. Quails were randomly distributed at the levels of (0, 8mg avilamycin / kg diet, 1%DPL, and 3 %DPL) under the two sexes (males and females). Each group was replicated six times, 15 chicks /replicate. Chicks were housed in a five decks, three sections quail cages with stand and dropping pans with automatic watering. The control diet was formulated to meet the nutrient requirements of the quails during the experiment period from 0 to 38 days (NRC, 1994).

The antibiotic used in this study was Avilamycin which is an orthosomycin antibiotic complex manufactured for: Elanco Animal Health, A Division of Eli Lilly and Company, Indianapolis, IN 46285, USA, produced by the fermentation of Streptomyces viridochromo genes. It is primarily active against gram-positive bacteria and is intended for using as a veterinary medicine to control bacterial enteric infections and was earlier authorized as a feed additive for growth promotion in accordance with Council Directive 70/524/EEC.

The composition of the basal diet is presented in Table 1. Chicks were exposed to continuous lighting and chicks were fed and watered ad libitum. At 31 day of age, birds were vaccinated against Newcastle virus (Lasota) via spraying.

Determination of total polyphenols content

The total contents of polyphenol were determined by using the Folin–Ciocalteu technique according to Rebaya et al. (2015) with modifications. Nearly 500mL of dilute extract from each sample was mixed with 2 mL Folin–Ciocalteu reagent (diluted 10 times with distilled water. Adding 2.5 mL from sodium carbonate solution (7.5%) after 5 min and allow to the mixture to stand for about 90 min with intermittent shaking. The absorbance was measured at 760 nm for the solution was resulting. The contents of phenol were expressed in terms of milligrams of Gallic acid equivalent per gram of dry weight (mg GAE/g DW).

Determination of total flavonoids content

According to Rebaya et al. (2015), the total flavonoid contents were estimated using the aluminum chloride colorimetric method**.** By mixing 500 mLof diluted extract with 500mL of 2% AlCl3methanolic solution. The absorbance was measured at 430 nm after incubation at room temperature for 40 min. Flavonoid contents were calculated by using the calibration curve of rutin and expressed as milligrams of rutin equivalent per gram of dry weight (mg RE/g DW).

Estimation of condensed tannins

With slight modifications, total tannins were determined according to Rebaya et al. (2015). A volume of 12.5mL of extract was added to 750mL of vanillin and 375mL of HCl. The mixture was then shaken and incubated at room temperature for 15 min. At 500 nm the absorbance was measured and the tannin content was accurate as milligrams of catechin equivalent per gram of dry weight (mg CE/g DW).

Growth performance and carcass traits measured:

Live body weights of chicks (LBW) were individually weighed and feed consumptions per pen were weekly recorded (FI), the uneaten feed discarded, live body weight gain (BWG) as a difference between final and initial body weights, feed conversion ratio (FCR) and performance index (PI) were calculated based on North (1981) as follows: $PI = BW_{kg}/FCR$. At the end of the experiment (38 of age), six birds from eachgroup were reweighed and slaughtered by cutting the Jugular vein, defeathered and eviscerated. Carcass yield was calculated from eviscerated weight the dressing % was calculated, giblets weight was measured and their % was calculated while blood samples were collected for blood analysis.

Blood biochemical, anti-oxidant and immunity:

At slaughter, individual 48 blood samples (4 treatment x 6 samples/sex) were collected in dry clean centrifuge tubes and serum was separated through centrifugation at 3000 rpm for 15 minutes and assigned for subsequent determination. Quantitative determination was done for the following: total cholesterol (Chol), high density lipoproteins (HDL), low density lipoproteins (LDL), very low density lipoproteins (VLDL) triglycerides (Tri G), Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT). All blood biochemical parameters were calorimetrically determined using commercial diagnosing kits (produced by Spectrum Diagnostics Company, Egypt). The glutathione peroxidase (GPx, EC 1.11.1.9) determined calorimetrically according to Paglia and Valentine (1967) and thiobarbaturic acid- reactive substances' (TBARS) were performed according to Yagi (1998) using commercial diagnosing kits produced by Cayman Chemical Company (USA). The method used for the assay of chicken Immunoglobulins Isotypes IgG, IgM, and IgA in Sandwich ELISA described by Erhard et al. (1992) the absorbance measured on an ELISA plate reader set at 450 nm.

Microbial analysis

After slaughter, intestinal content was immediately collected in sterile glass containers, digesta was evacuated and mixed. At 4°C, the sealed containers were kept in the laboratory till enumeration of microbial population. Samples (1g of the mixed fresh mass) were taken into sterile test tubes, diluted 1:10 in sterile 0.1% peptone solution and homogenized for 3 min in a Stomacher homogenizer. Ten fold serial dilutions up to 10^{-7} of each sample were prepared in nine ml of 0.1% sterile peptone solution. Viable counts of Salmonella ssp, Escherichia coli (E. coli) and Lactobacilli ssp were performed. One milliliter of the serial dilution was incubated into sterile Petri dishes and sealed with an appropriate medium. Lactobacillus spp. colony count was determined using MRS agar (Biokar Diagnostic, France) after incubation in an anaerobic chamber at 37 °C for 72 h. Salmonella and E. coli colonies were counted on brilliant green agar plate and incubated at 37°C for 24 h). After cultivation in Petri dishes, the total colony count for Lactobacilli, Salmonella and E. coli was then calculated as the number of colonies by reciprocal of the dilution. The microbial counts were determined as colony forming units (cfu) per gram of sample.

Statistical analysis:

Using General Linear Models (GLM) procedure of SPSS (2013), studied traits were subjected to a two-way analysis of variance with treatment and sex as main effects as follows:

$Y_{ijk}=\mu+ T_i + S_j+ e_{ijk}$.

Where: Y_{ijk}: Observed value in the i^{th} treatment of the j^{th} sex of the kth individual, μ: Overall mean, T_i: Treatment effect (i: 1 to 4), S_j: Sex effect (j: 1 and 2) and e_{ijk}: Random error term. When significant F values were obtained main effects means were compared by Duncan's new multiple range tests (Duncan's, 1955).

RESULTS

The data reviled that birds fed diet supplemented with peppermint 3% had the heaviest LBW_{38d}, $BWG10_{-38}$, better FC $_{10-38}$ and higher PI $_{10-38}$ ($P\leq .001$) than other treatments studied whereas both the control and availamycin groups had inferior performance than peppermint groups. Significant sex effects were shown for LBW38d, $BWG10_{-38}$ and PI $_{10-38}$ favoring females (Table 2).

Treatments insignificantly influenced all slaughter parameters %. Conversely, females had significantly higher dressing% and giblets% than males (Table 3).

Treatment effect influenced all serum biochemical indices ($P\leq0.001$) studied, except both HDL and ALT ($P >0.05$). Quail fed diet supplemented with peppermint 3% showed desirably lower total Chol, and lower LDL, VLDL, RBS, Tri G and AST than the control and avilamycin supplemented groups. All serum biochemical indices insignificantly affected by sex, except total Chol and RBS. Females had higher total Chol ($P \leq0.05$) concentration but lower RBS ($P \leq0.001$) than males however the males showed opposed situation for these components (Table 4).

All Antioxidant parameters and immune responses studied were significantly affected by treatment effect. Quail fed the diet supplemented with peppermint 3% had the highest GPx , Ig_G, Ig_A and Ig_M but the lowest TBAR followed by those fed the diet supplemented with peppermint 1%, whereas both those fed the control and avilamycin groups showed opposite situations. On the contrary, antioxidant parameters and immune responses tested insignificantly affected by sex (Table 5).

Dietary treatments represented useful and harmful intestinal bacteria. Both Peppermint 3% and 1% supplementation desirably increased Lactobacillus count and decreased both E coli and Salmonella counts as compared with those fed diets supplemented with avilamycin and the control groups. The lowest number of E coli and Salmonella counts were shown for the group fed the diet supplemented with avilamycin whereas the control group had the highest harmful intestinal bacteria. Insignificant differences due to sex effect were obtained for useful and harmful intestinal bacteria studied (Table 6).

Discussion:

Recently, many efforts exerted to maximize the nutrient utilization of poultry feeds to guarantee profitable production. The results of this study indicated that feeding quails with peppermint led to significant improvements in all growth performance traits which were in accordance with the findings of Ocak et al. (2008) and Asadi et al. (2017). The positive effect of different levels of peppermint on improving growth performance was due to its role in strengthening the digestive system, improving feed efficiency and decreasing the gastrointestinal disorders. In addition, Sefidcon et al. (1996) demonstrated that peppermint reinforced the stomach and causing on slow motion for intestinal resulting from alpha humlone. The active compounds such as essential oil that existence in the peppermint were caused stimulate appetite and improve the digestion and mineral absorption and increase feed efficiency in broilers (Asadi et al. 2017).

The results of carcass traits in this study completely confirmed those of Khursheed et al. (2017) that supplementation of either raw or enzyme treated peppermint leaves to broiler did not reveal any significant difference in dressing % among various treatments.

The current findings of serum biochemical indices agreed with the results of Mehr et al. (2015b) and Arab Ameri et al. (2016) that the peppermint powder significantly made a difference for serum concentrations of Tri G, total Chol, increased HDL, LDL and VLDL and had an anti-oxidative potential to improve oxidative stability and immune response. The large amount of menthol, thymol menthone and carvone contained in peppermint had high reducing power that retard lipid oxidation in meat (Sokovic et al., 2009) and improve the lipid profile of blood in favor of decreasing Chol and Tri G in growing quails as reported by Mehr et al.(2015b) and Ghazaghi et al. (2014). Moreover, peppermint oil and menthol have antibacterial particular of against both of antibiotic-resistant bacteria and antibiotic-susceptible bacteria that occurring through disruption of the lipid fraction of the plasma membrane, resulting in altered permeability and infiltration of intracellular materials (Kamatou et al., 2013). Generally, the prospective benefits of medicinal plants on bird responses may be referred to their content from essential oils and phenolic compounds (Windisch et al., 2008) and a lot of pharmacological and biological effects of Mentha plants are regarded to the C-3 oxygenated monoterpenes of menthane class and C-2 oxygenated monoterpenes of carbon class of volatile components (Gardiner, 2000). It is evident that the activity of some of the compounds in the volatile oil of peppermint (menthol and thymol) decreases the enzymatic activity of hydroxymethyl glutaryl coenzyme A and hepatic reductase that regulates synthesis of cholesterol. It seems that one of the reasons for the decrease in total Chol is the presence of volatile phenolic compounds such as essential oils (menthol, menthone, mentyl acetate, menthofuran, limonene, polygen, cineole and azolen). On the other hand, the active components in peppermint by improving the activity of liver cells, give rise to the condensation of bile acids. The high condensation of bile acids in the small intestine improves digestion of fats and fat-soluble vitamins, because bile acids are essential for fat emulsion (Crossland, 1980). Peppermint may increase the flow of bile in the gallbladder due to its antioxidant and antibacterial properties (Mimica Dukic et al., 2003). The results of this study confirmed the important role of peppermint in controlling the liver function which is consistent with the results of Fallah et al. (2013) and Arab Ameri et al. (2016). Anti-oxidant enzymes are most effective when synergistically acting with one another or with other components of the anti-oxidant barrier of the organism when their activity remains balanced. Peppermint has antioxidant activity and is able to counteract free radicals and oxidative stress and strengthens the immune system (Fallah et al. 2013). Antioxidants have been shown to fight a wide variety of diseases therefore, peppermint, which possesses antioxidant activity, might also have protective and enhancing effects on chicks (Arab Ameri et al., 2016). Also, the present study agreed with the results of Mehri et al. (2015a,b) that peppermint supplementation to quail diets(1 up to 4%) decreased the number of the harmful E. coli bacteria and increased the number of beneficial Lactobacillus bacteria.

CONCLUSION

Adding either avilamycin or DPL to Japanese quail diet had clear effect on performance than sex effect. Growth performance traits, all serum biochemical indices studied (except both HDL and ALT), antioxidant parameters and immune responses and intestinal microflora count, favoring the quail fed diet supplemented with peppermint 3% and showed desirably lower total Chol, lower LDL, VLDL, RBS, Tri G and AST and had the highest GPx, IgG, IgA and IgM but the lowest TBAR followed by those fed the diet supplemented with peppermint 1%. Moreover, both peppermint groups desirably increased Lactobacillus count and decreased both E coli and Salmonella counts than the control group. Therefore, it can be concluded that peppermint can be successfully supplemented to growing quail diets up to 3% and act as a good potential alternative to antibiotic for promoting quail growth.

Table (1a): Feed ingredients and chemical composition of basal experimental diet .

Feed Ingredient	**Basal diet %**
Maize	56.00
Soybean meal (44 CP%)	32.00
Plant concentrate meal[1](45 CP)	10.30
Vegetable oil	0.50
DL-methionine	0.10
Salt(NaCl)	0.30
Vitamin and mineral premix[2]	0.30
Dicalcuom phosphate	0.50
Calculated/determined analysis	
Metabolizable energy (kcal/kg	2919
Crude protein	24.00
Crude fiber	3.5
Calcium	0.8
Available phosphorus	0.5

[1]-Plant concentrate contains (%): CP 50, CF 1.3, Ca4.72, Av P 3.1, lysine 6, methionine 2 and ME 2650 kcal/kg.

[2]-Premix provided per kg of diet: vitamin A, 12.000 IU; vitamin D3, 2.400 IU; vitamin E, 30 mg; vitamin K3, 4 mg; vitamin B1, 3 mg; vitamin B2, 7 mg; vitamin B6, 5 mg; vitamin B12, 15 µg; niacin, 25 mg,Fe, 80 mg; folic acid, 1 mg; pantothenic acid, 10 mg; biotin, 45 mg; choline, 125,000 mg; Cu, 5 mg; Mn, 80 mg; Zn, 60 mg; Se, 150 µg.

Table (1b): Proximate analysis and nutritive value of dried leaves of Peppermint.

Chemical composition	**Present study**	**Abdel-Wareth and Lohakare (2014)**	**Mehri et al. (2015) 207:104–111**
Dry matter (g/kg)	911.0	942	957
Organic matter (g/kg)	750	-	883
Gross energy (MJ/kg)		12.8	-
Crude protein (g/kg)	159	162	176
Crude fat (g/kg)	51.0	-	55.7
Crude fiber (g/kg)		-	58.0
Ash (g/kg)	161.9	149	-
Calcium (g/kg)		19.7	-
Phosphorus (g/kg)		3.10	2.50
Total phenolic contents (mg GAE/g DW)	26.14		
Flavonoid contents (mg RE/g DW)	12.70		
Tannin contents (mg CE/g DW)	3.50		

Table (2): Effects of treatment and sex on growth traits in Japanese quail (Main effects)

Item	**LBW_{10d}**	**LBW_{38d}**	**BWG_{10-38}**	**FI_{10-38}**	**FC_{10-38}**	**GR_{10-38}**	**PI_{10-38}**
Treatment effect:							
Control	40.68	201.09^{c}	160.41^{c}	584.22^{a}	3.67^{a}	1.33^{b}	5.56^{c}
Avilamycin	41.50	219.68^{b}	178.19^{b}	583.64^{a}	3.29^{b}	1.37^{a}	6.73^{b}
Peppermint1%	41.64	222.41^{b}	180.77^{b}	547.93^{b}	3.09^{c}	1.37^{a}	7.41^{a}
Peppermint3%	41.90	231.40^{a}	189.50^{a}	582.90^{a}	3.09^{c}	1.39^{a}	7.56^{a}
SE	0.50	1.60	1.47	4.02	0.60	0.01	0.15
P	$P \leq 0.40$	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$
Sex effect:							
Females	41.77	222.70	180.93	575.03	3.34	1.37	7.11
Males	41.09	214.59	173.50	574.32	3.23	1.36	6.52
SE	0.49	1.13	0.78	1.39	0.03	0.01	0.09
P	$P \leq 0.17$	$P \leq 0.001$	$P \leq 0.001$	$P \leq$	$P \leq$	$P \leq$	$P \leq 0.001$

SE: Standard error, BWG: Body weight gain= $LBW_{38d} - LBW_{10d}$, FI: Feed intake, PI :Performance index=$(LBW_{kg}/FCR)X\ 100$ FC: Feed conversion= FI_{10-38} / BWG_{10-38},
GR:Growth rate $(LBW_{10} - LBW_{38})/\ 0.5\ (LBW_{10} + LBW_{38})$.
$^{a-c}$:Means within the same column with different superscript.

Table (3): Carcass traits of growing quails at slaughter as affected by treatment and sex (Main effects).

Item	Edible parts, g	Dressing %	Dressed meat, g	Meat %	Giblets, g	Giblets%
Treatment effect:						
Control	155.89	75.45	79.65	38.54	12.74	6.20
Avilamycin	176.88	76.70	94.82	40.99	14.18	6.11
Peppermint1%	170.73	74.26	87.90	38.17	13.93	5.98
Peppermint3%	162.17	76.14	77.93	36.85	13.64	6.33
SE	7.02	1.70	5.18	2.16	1.04	0.40
P	NS	NS	NS	NS	NS	NS
Sex effect:						
Females	171.29	77.51	86.12	37.04	15.61	6.53
Males	161.55	73.76	84.03	40.23	11.63	5.90
SE	3.75	1.20	3.67	1.52	0.64	0.21
P	NS	$P \leq 0.05$	NS	NS	$P \leq 0.001$	$P \leq 0.05$

a...c: Means within the same column with different superscript . NS: Not significant. SE: Standard error

Table (4): Carcass chemical composition of growing quails affected by treatment and sex (Main effects).

Item	Moisture%	CP%	Oil%	Ash%	NFE%
Treatment effect:					
Control	66.60	20.60	9.41	2.00^{b}	1.38^{a}
Avilamycin	66.81	20.35	9.52	1.98^{b}	1.34^{ab}
Peppermint1%	66.33	20.83	9.57	1.98^{b}	1.30^{ab}
Peppermint3%	66.45	20.84	9.25	2.24^{a}	1.23^{b}
SE	0.24	0.14	0.16	0.8	0.4
P	NS	NS	NS	$P \leq 0.01$	$P \leq 0.05$
Sex effect:					
Females	66.53	20.67	9.48	2.08	1.31
Males	66.56	20.65	9.40	2.02	1.31
SE	0.17	0.10	0.08	0.04	0.02
P	NS	NS	NS	NS	NS

a...c: Means within the same column with different superscript . NS: Not significant. CP : Crude protein , NFE: Nitrogen free extract. SE: Standard error.

Table (5): Serum biochemical indices at slaughter as affected by treatment and sex (Main effects).

Item	Total Chol, mgdl	HDL mgdl	LDL mgdl	VLDL mgdl	RBS mgdl	Tri G mgdl	AST UL	ALT UL
Treatment effect:								
Control	189.64^{a}	104.12	67.5^{a}	18.01^{b}	235.68^{a}	124.79^{a}	99.12^{a}	17.33^{ab}
Avilamycin	188.32^{a}	99.96	64.15^{a}	24.22^{a}	233.53^{a}	120.99^{a}	98.90^{a}	21.83 ^{ab}
Peppermint1%	158.17^{b}	106.43	33.72^{b}	18.02^{b}	208.10^{b}	91.91^{b}	81.02^{b}	12.59 ^{b}
Peppermint3%	145.03^{c}	99.46	29.70^{b}	15.88^{b}	196.18^{c}	99.42^{b}	78.97^{b}	19.97 ^{ab}
SE	1.52	3.09	2.82	1.69	2.50	4.16	2.39	2.37
P	P ≤0.001	NS	P≤0.001	P ≤ 0.01	P ≤0.001	P ≤0.001	P ≤0.001	NS
Sex effect:								
Females	172.20	102.17	50.07	19.95	213.50	109.81	87.68	18.19
Males	168.37	102.80	47.46	18.10	223.24	108.74	91.32	17.67
SE	1.08	2.19	2.00	1.20	1.77	2.94	1.69	1.68
P	P ≤0.05	NS	NS	NS	P ≤0.001	NS	NS	NS

Chol: Cholesterol, HDL: High density lipoprotein , LDL:Low density lipoprotein, VLDL: Very low density lipoprotein, RBS :Random blood sugar ,Tri G: Triglycerides, AST: Aspartate aminotransferase , ALT: Alanine aminotransferase. $^{a...c:}$ Means within the same column with different superscript . NS: Not significant, SE: Standard error

Table (6): Antioxidant parameters and Immune response as affected by different dietary treatments and sex (Main effects).

Item	**Antioxidant parameters**		**Immune response**		
Treatment effect:					
	GPXnmolminmgprotien	TBARµgg	IgGmgdl	IgA mgdl	IgMmgdl
Control	6.43^{c}	1.86^{a}	936.15^{b}	175.53^{b}	93.62^{b}
Avilamycin	6.74^{c}	1.75^{a}	848.80^{c}	159.15^{c}	84.88^{c}
Peppermint1%	8.81^{b}	1.42^{b}	1064.82^{a}	199.65^{a}	106.48^{a}
Peppermint3%	9.93^{a}	0.98^{c}	1121.57^{a}	210.29^{a}	112.16^{a}
SE	0.15	0.04	19.04	3.75	1.90
P	P≤0.001	P ≤0.001	P ≤0.001	P ≤0.001	P ≤0.001
Sex effect:					
Females	7.88	1.50	988.59	187.30	99.89
Males	8.07	1.50	986.71	185.00	98.67
SE	0.11	0.03	13.46	2.52	1.34
P	NS	NS	NS	NS	NS

GPX: Glutathione peroxidase : TBAR: thiobarbaturic acid IgG, IgA ,IgM Immunoglobulins G,A,M

$^{a...d:}$ Means within the same column with different superscript .NS: Not significant, SE: Standard error

Table (7): Useful and harmful intestinal bacteria in growing quails as affected by different dietary treatments and sex (Main effects).

Item	Lactobacillus log 10 cfug	E coli log 10 cfug	Salmonela log 10 cfug
Treatment effect:			
Control	6.52^{a}	8.40^{a}	8.22^{a}
Avilamycin	4.72^{b}	5.19^{c}	5.03^{c}
Peppermint1%	7.12^{a}	7.65^{b}	7.41^{b}
Peppermint3%	7.26^{a}	7.52^{b}	7.37^{b}
SE	0.24	0.18	0.21
P	P ≤0.001	P ≤0.001	P ≤0.001
Sex effect:			
Females	6.43	7.17	7.05
Males	6.37	7.21	6.96
SE	0.17	0.13	0.15
P	NS	NS	NS

E coli: Escherichia coli cfug: logarithm of colony forming unit per gram of digesta

[a...d:] Means within the same column with different superscript .

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الملخص العربي

تقييم أوراق النعناع المجففة كمحفز طبيعي للنمو بديلا للمضادات الحيوية في السمان الياباني

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تم إجراء هذه الدراسة باستخدام 360 كتكوت سمان عمر يوم متساوية فى متوسط وزن الجسم وقسمت إلى أربع مجموعات كانت كالتالى المجموعة الأولى مجموعة الكنترول (بدون إضافات) بينما المجموعة الثانية كانت عبارة عن عليقة الكنترول مضافا إليها الأفلاميسين مضاد حيوي (عليقة الكنترول + جرعة علاجية من أفلاميسين بمعدل 8 مجم / كجم عليقة) وفى المجموعة الثالثة تم إضافة النعناع بنسبة 1% (عليقة الكنترول + 1 % مسحوق النعناع) وأخيرا المجموعة الرابعة حيث تم إضافة النعناع بنسبة 3% (عليقة الكنترول + 3 % مسحوق النعناع) وتم أستخدام هذه المعاملات التجريبية لاختبار إمكانية استخدام النعناع كمحفظ ومنشط نمو طبيعي كبديل المضادات الحيوية على السمان الياباني .

وقد كان ملخص النتائج التي تم الحصول عليها على النحو التالي: المعاملات أثرت بشكل كبير على معظم الصفات المدروسة أكثر من تأثير الجنس، كانت الإناث أعلى في LBW38d ، BWG10-38 ، PI 10-38 ، التصافي ٪ ، وزن الأحشاء المأكولة ونسبة الأحشاء المأكولة ٪ من الذكور. أثرت المعاملات بشكل ملحوظ على التحليلات البيوكيميائية في السيرم (باستثناء كل من HDLو ALT) ، ومقاييس مضادات الأكسدة والاستجابات المناعية ومحتوى أو عدد الميكروفلورا المعوية، كان هناك أفضلية للمعاملة الرابعة الذي يتم تكميله بالنعناع 3٪ (عليقة الكنترول + 3 % مسحوق النعناع) والتى أظهرت أفضل أداء نمو للسمان المغذى عليها مع خفض الكوليسترول الكلى ، وانخفاض مقاييس الشحوم ، وسكر الدم العشوائية ، وانزيمات أنشطة الكبد، كما أدى تغذية الطيور على 3 % نعناع إلى رفع وزيادة مقاييس ومقاييس مضادات الأكسدة والاستجابات المناعية، مع خفض أو تقليل حمض ثيوباربيتوريك . من المتوقع أن تناول النعناع بنسبة (3٪ و 1٪) يزيد من أعداد بكتيريا حامض اللاكتيك (Lactobacillus) بالمقارنة مع بالمجموعات التي يتم تغذيتهاعلى أفلاميسين(عليقة الكنترول + جرعة علاجية من أفلاميسين بمعدل 8 مجم / كجم عليقة) ومجموعة الكنترول ويقلل من تعداد كل من E coli و Salmonella مقارنه بمجموع الكنترول

وملخص الدراسة، يمكن إضافة النعناع فى علائق السمان الياباني بنسبة قد تصل إلى 3 ٪ حيث تعمل كبديل جيد للمضادات الحيوية (avilamycin) لتحفيز وتنشيط نمو السمان.