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INFLUENCE OF PHYTOGENIC EXTRACTS AND ESSENTIAL OIL ON GROWTH PERFORMANCE AND BLOOD PARAMETERS IN BROILER CHICKENS

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ABSTRACT: This study was carried out to evaluate the effects of dietary saponin supplementation and essential oil (thymol and carvacrol) on growth performance and some biochemical parameters of broiler chickens. Two hundred and fourty one-day-old chicks (Ross 308), which was randomly divided into 8 treatment groups each with three replicates of 10 birds. The first treatment (T1) was fed a diet without saponin while, saponin 10 ppm (T2), 20 ppm (T3) and 40 ppm (T4), however birds in group 5 (T5) fed diet without saponin and in drink water with 50 ppm essential oil, saponin 10 % with 50 ppm EO (T6), 20 ppm with 50 EO (T7) and 40 ppm with 50 EO (T8). Results obtained revealed that chicks fed basal diet with saponin had significantly ($P < 0.05$) better body weight, weight gain and feed conversion ratio, while feed intake was reduced comparison with control treatment. Chicks that received a diet supplemented with saponin at 20 or 40 ppm with 50 ppm EO significantly ($P<0.05$) improved growth performance compared with the other treatments. Supplementation of essential oils and saponin at levels of 40 and 20 ppm, respectively significantly increased Serum protein fractions (total protein, albumin and globulin). Significant reductions in serum total cholesterol and triglyceride, high density lipoprotein cholesterol, low density lipoprotein cholesterol were detected in the group that fed diet with 20 and 40 ppm diet saponin plus EO 50 ppm compared with other diets. Consequently, these findings suggest that phytogenic feed additives, particularly essential oils combined with saponin, hold promise as effective agents for enhancing the growth performance of broiler chickens.

Keywords: Broilers, Essential oils, Saponin, Performance, Serum lipid profile.

INTRODUCTION

Phytogenic feed additives (PFA) are a new class of growth promoters, derived from herbs, spices or other plants. In recent years, phytogenics have attracted increasing interests as an alternative feeding strategy to replace antibiotic growth promoters. Several studies have demonstrated that the use of PFA stimulates digestive enzymes' secretion and activity and exhibits a higher production of bile acids (Platel and Srinivasan, 2000; Williams and Losa, 2001). Furthermore, essential oil feed additives increased the activities of trypsin and amylase in broilers (Jang et al., 2004; Lee et al., 2003). The dietary spices enhanced absorption of micronutrients from the small intestine due to its effect on cell membrane fluidity and permeability (Prakash and Srinivasan, 2010).

The use of natural alternative feed additives such plant extracts have been put forward by various researchers and have shown promising results in the pursuit of organic poultry production (Khan et al., 2012). The use of natural plant extracts as health and productivity enhancers in poultry production could provide cheaper, safer, sustainable and more consumer acceptable alternative to antibiotics. The saponins are naturally occurring surface-active glycosides found in different plant parts and the biological activities ascribed to them such as antimicrobial, anti-inflammatory, immunostimulant, hypocholesterolaemic, anticarcinogenic and antioxidant (Guclu and Mazza, 2007) have generated considerable interest among researchers for its use in poultry production. The saponins from different sources have been supplemented in chicken diet by various researchers (Cheeke, 2009; Gaurav, 2015; Chaudhary et al., 2018) who observed that saponins influence the nutrient digestion and their absorption in many ways. However, results have shown considerable variations and thus, the role of saponins in growth performance of chicken remains largely inconclusive. The saponins from Yucca schidigera, ginseng and tea plants have shown immunomodulatory effects in chicken (Zhai et al., 2011; Bhardwaj et al., 2014) with higher immunoglobulin levels and positive effects on immune organ maturation (Su et al., 2016).

The saponins from Yucca schidigera were found to have differential effects on gut microbes, whereby, the faecal E. coli growth in layer chicken is significantly inhibited with no effect on the Lactobacillus count (Wang and Kim, 2012). The improved gut architecture has been observed in layer chicken fed dietary Yucca schidigera extract (Gurbuz et al., 2011). The aim of the present study was to evaluate the effectiveness of dietary saponin supplementation at different levels and essential oils (thymol and carvacrol) on the growth performance and plasma biochemical parameters of broiler chickens.

MATERIALS AND METHODS

Ethical approval

The experimental design and procedures were in compliance with the ethical standards of our relevant institutional committee on animal experimentation approved by the Scientific Ethics Committee, Animal Production Department, Faculty of Agriculture, Benha University, Egypt.

Experimental animals and design:

Birds and Housing Management

A total number of 240 (one-day old) chicks from Ross 308 strain were weighed equally and randomly divided and distributed in eight dietary treatments groups having three replicate in each. Each dietary treatment group consists of 30 chicks distributed in three replicated pens, with 10 chicks in each. The birds in the control group (T1) were fed a diet without saponin while ‹saponin 10 ppm)T2 20 ‹(ppm (T3) and 40 ppm (T4 ‹(however birds in group) 5 T (5fed diet without saponin and drink water with 50 ppm essential oil ‹from hatching day to the end of experimental work ‹saponin 10 %with 50 ppm EO (T6), 20 ppm with 50 EO (T7) and 40 ppm with 50 EO (T8 .(Chicks were weighed individually at hatch and wing banded ‹placed in the rearing farm to perform the post-hatching experiment. Chicks were kept under similar hygienic and environmental conditions .All chicks were brooded and reared at 32-33 °C from hatch to 7 d of age, 28-30°C from 8 to 14 d, 24-26°C from 15 to 21 d, and 21-24°C from 22 day of age to the end of the experiment . The light program was 24h light at the first 5 days of age, then from 6 to 35 days of age (the end of the experiment) 23 h light and 1 h dark was applied .The relative humidity was within 50 and 65% .

Diets and feeding regime

Standard commercial broiler diets consisted of a crumbled starter (232 g/kg crude protein and 3,000 kcal metabolizable energy/kg diet from 1 to 14 d of age, pelleted grower (211 g/kg crude protein and 3,100 kcal metabolizable energy/kg diet from 15 to 28 d of age and pelleted finisher (195 g/kg crude protein and 3,219 kcal metabolizable energy/kg diet from 29 to 35 d of age. were used for each group. Feed and water were offered ad-libitum.

Growth performance

At the 1st, 3rd and 5th week of chicks age growth performance (body weight, body weight gain, feed intake and feed conversion ratio) was measured. The operations were done at the same time, in the same pen order and with the same personnel.

For calculation of the body weight gain per broiler chicken, the following formula was used:

Average weight gain per bird for each period F - S (corrected by weight gain of died or culled chickens). F= Average weight of the live birds in the group at the weighing day. S= Average weight of the live birds in the group at the previous weighing. The feed intake (corrected for dispersed feed) was calculated by using the following formula: Feed intake per period= Total feed consumed per group / number of surviving birds ×days of the period; The feed conversion ratio was estimated by using the following formula; Feed conversion per period = total feed consumed for the period in each replicate / total weight gain for the period (with weight gain of died or culled chickens).

At the end of the experiment, two birds per replicate (6 birds/ treatment) were selected at random for measuring the blood parameters. Biochemical blood parameters, including, serum total protein (TP, g/dL), albumin (ALB, g/dL), Globuline (Glob, g/dL); total cholesterol (CLO, mg/dL), triglycerides (TG, mg/dL), low density lipoprotein (LDL, mg/dl); high density lipoprotein (HDL, mg/dL).

Statistical analysis:

All data were analyzed by two-way analysis of variance using the GLM procedure in SAS (9.1., Cary, NC, 2004). Duncan's new multiple-range test was performed to identify differences (Steel and Torrie .(1980 ‹A P-value 0.05> was considered significant. According to the following linear model:

$X_{ij} = \mu + S_i + O_j + SO_{ij} + e_{ij}$

Whereas: X_{ij} = the observation of traits for ij^{th} birds; μ = Overall mean; Si = Effect of the i^{th} saponin levels. (i, 1-4); Oj = the effect of the k^{th} oil. (j, 1-2); SOij= Interaction between i^{th} saponin level and j^{th} levels of oil (4×2); and e_{ij}= the experimental error.

RESULTS AND DISCUSSION

Growth performance

The results presented in Table (1) indicated significant variations in body weight (BW) and average weight gain (AWG) among chicks fed different experimental diets, influenced by saponin, essential oils (EO) such as thymol and carvacrol, and the interaction between them. In comparison to the control group, which had the lowest average body weight at 5 weeks (2097.0 g), chicks who received meals supplemented with saponin at doses of 10, 20, or 40 ppm/kg had considerably higher average body weights at 5 weeks (2145.6 g, 2239.8 g, and 2481.6 g, respectively). According to Alghirani *et al*. (2021), the presence of steroid saponin in Yucca promotes nutrient absorption in the gastrointestinal tract. Therefore, this improvement in body weight may be linked to saponin beneficial effects on nutritional absorption. Furthermore, Wang and Kam (2012) provided evidence that steroid saponins can enhance intestinal nutrient absorption

Chicks that received diets supplemented with water containing EO (thymol and carvacrol) at a level of 50 ppm/kg showed the highest average body weight and weight gain at 5 weeks and 1-5 weeks of age compared to the control group. These results contradict the findings of Du (2016), who reported that EO supplementation did not significantly affect growth performance. However, they align with the results reported by Luna et al. (2018), who observed that the addition of thymol in broiler chickens increased final body weight.

The interaction between saponin and EO showed a highly significant effect on body weight at the end of the experimental period only. The interaction between saponin at a level of 40 ppm and EO had significantly higher average body weights at 5 weeks and weight gains during the periods from 3-5 weeks and 1-5 weeks of age compared to the other interactions and the control group, which had the lowest average body weight throughout the estimation periods.

Chicks that were supplemented with water containing thymol and carvacrol at a level of 50 ppm exhibited significantly higher average weight gains (1417.1 g and 2246.6 g, respectively) during the periods from 0-3 weeks and 0-5 weeks of age compared to the control group (1314.5 g and 2153.4 g, respectively). These findings align with the results reported by Hashemipour *et al*. (2013), who found that thymol and carvacrol in the diet of broiler chickens resulted in higher weight gains at higher concentrations. Hafez *et al*. (2016) also demonstrated an increase in overall weight gain in broiler chickens when using an encapsulated mixture of thymol, carvacrol, and limonene.

The interaction between saponin at a level of 40 ppm and EO, as well as saponin at a level of 20 ppm and EO, showed a highly significant effect on weight gain during the periods from 3-5 weeks and 0-5 weeks of age compared to the other interactions and the control group, which had lower average weight gains.

Feed intake and Feed conversation

Regarding average feed intake, chicks that received diets supplemented with saponin at levels of 10 ppm, 20 ppm, or 40 ppm had decreased average feed intake (2924.0 g, 3021.2 g, and 3008.2 g per bird, respectively) during the period from 0-5 weeks of age compared to the control group, which had a higher average feed intake (3045.7 g per bird). These results are consistent with those reported by Ayoub et al. (2019), who observed a significant difference in total feed intake and protein efficiency in broilers supplemented with yucca compared to the control group. Additionally, the supplementation of YSE in the drinking water of broiler chickens led to a reduction in feed intake.

Chicks that were supplemented with water containing thymol and carvacrol at a level of 50 ppm had a higher average feed intake (3000.7 g per bird) compared to the control group (2998.8 g per bird) during the period from 0-5 weeks. These findings are in agreement with those reported by Haselmeyer et al. (2015), who reported that the addition of thymol and carvacrol to the feed improved feed intake in broiler chickens. However, these results contradict those of Lee et al. (2003). All the interactions proved a highly significant effect on average feed intake throughout the estimation periods. Specifically, the interaction between 10 ppm saponin without EO significantly decreased average feed intake during the period from 0-5 weeks of age compared to the other interactions.

When compared to the control group, chicks fed diets containing 40, 20 or 10 ppm saponin / kg significantly improved the average FCR (1.63 vs. 1.23, 1.37, and 1.42 g feed/ g gain, respectively). The presence of natural saponin from Y. schidigera may cause the emulsification of oil lipids, facilitating their digestion, and enhancing the absorption of vitamins and minerals, which may explain the improvement in FCR in the yucca supplemented groups. These outcomes matched those that Alfaro et al. reported in (2007). According to Begum *et al*. (2015), Yucca schidigera extract with caprylic acid improved the FCR of broilers at 35 days.

The average FCR of chicks supplemented with thymol and carvacrol in water at a level of 50 ppm was substantially higher than that of the control group (1.48 g vs. 1.34 g feed/g gain). The obtained results are in line with those reported by Lee et al. (2003) who found that carvacrol, increased the feed conversion ratio in broiler chickens which may be related to increase feed utilisation. Haselmeyer *et al*. (2015) found that the addition of thymol and carvacrol to the meal boosted the FCR of grill chickens. At all estimation intervals, the effects of all applied interactions on the average FCR were extremely significant (P>00.1). The interaction between 40 ppm saponin and EO considerably improved FCR during the periods from (3-5 and 0-5 wks) of age.

Economical efficiency

Data presented in Table 3 demonstrated the economic efficiency (EE) and relative economical efficiency (REE).

The control group displayed lower REE (151%) as compared with chicks fed a diet supplemented with saponin at a dose of 40 ppm/kg diet (175%). The findings corroborate those of Patoary et al. (2020), who found that economic analysis revealed Yucca treated groups had considerably ($p < 0.05$) more profit than control groups. While somewhat higher in the other groups than in control group , this difference was statistically insignificant ($p<0.05$).

In comparison to the control group, chicks fed a food supplemented with water containing EO at a level of 50 ppm displayed a lower relative economic efficiency (155%). Relative Economic Efficiency (REE) was higher as a result of the interaction between saponin at 40 ppm x EO.

Blood biochemical parameters

protein fractions Serum

The impact of saponin ،essential oils (EO), and their interaction on serum total protein, albumin, globulin, and alb/glob ratio is presented in Table 4 .The group that fed the diet supplemented with 40 ppm of saponin exhibited the highest level of serum total protein (6.50 g/dl), albumin (3.87 g/dl), and globulin (2.70 g/dl (compared to the other groups and the control group. Moreover,, the birds fed the diet supplemented with 20 ppm of saponin/kg showed the highest level of serum alb/glob ratio (1.52 g/dl), followed by those fed the diet supplemented with 40 ppm of saponin ،compared to the other groups and the control group.

Furthermore, the birds received water supplemented with 50 ppm of essential oils recorded the highest level of serum total protein (6.24 g/dl), albumin (3.71 g/dl), globulin (2.56 g/dl), and alb/glob ratio (1.46) compared to the control group. The interaction between essential oils and saponin (specially the interaction between 40 ppm of saponin and essential oils) proved highly significant effect on serum total protein, albumin, globulin, and alb/glob ratio ($p<0.001$).

Serum lipid profile:

The results of serum lipid profile, including triglycerides, cholesterol, LDL-C, and HDL-C, are presented in table 5. The results revealed that broiler chickens fed the diet supplemented with saponin at a level of 40 ppm/kg had the lowest levels of serum triglycerides. Additionally, the saponin were found to significantly decrease blood cholesterol LDL levels while increasing HDL levels . This cholesterol-lowering effect of saponin may be attributed to their ability to inhibit pancreatic cholesterol esterase, bind to bile acids, and reduce cholesterol solubility in micelles, thereby potentially delaying cholesterol absorption in the gut. Previous studies have also reported that saponin selectively reduce harmful LDL-cholesterol levels in rats, gerbils, and poultry (Matsuura, 2001; Gaurav, 2015; Chaudhary, 2017). Furthermore, Han et al. (2000) suggested that the mechanism of action of saponin in reducing serum triglycerides may involve the inhibition of pancreatic lipase activity, leading to a delay in the intestinal absorption of dietary fat.

In comparison to the control group, chicks fed the diet containing EO at a level of 50 ppm had the lowest serum levels of triglycerides (65.12), total cholesterol (50.52), and LDL (16.10) and the highest levels of HDL (35.62 mg/dl). These findings corroborated to those of Rahimi *et al*. (2011), who stated that include thyme in chicken diets dramatically reduced blood triglyceride, total, and LDL cholesterol levels while raising HDL cholesterol levels. The interaction between 40 ppm saponin and EO showed lower serum triglycerides, total cholesterol, and LDL. While the interaction between 10 ppm saponin x EO showed significantly the higher averages of serum HDL as compared with the different interactions and the control group.

CONCLUSION

According to the above menthioned results, the combination of essential oils and saponin improves broiler body weight, weight gain, and feed conversion. This suggests that saponin and essential oils work together in a synergistic manner. Additionally, improvements in serum protein fractions were proved when essential oils or saponin were provided separately or in combination. Moreover, the addition of saponin to essential oils decreased the levels of triglycerides, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and total cholesterol in the serum. Therefore, the use of phytogenic feed additives, specifically essential oils with saponin, shows promise as effective agents enhancing the growth performance of broilers. From the economic standpoint, it could be recommended to include 40 ppm saponin with 50 ppm essential oils, 40 ppm saponin alone, or 20 ppm saponin with 50 ppm essential oils in broiler diets to achieve favorable outcomes.

Table (1): Least square means and standard error (±S.E) for live body weight and body weight gain as affected by the studied factors.

Items	Live body weight (g)			Body weight gain (g)		
	Hatch	3 Wks	5 Wks	0-3 Wks	3-5 Wks	0-5 Wks
Saponin (ppm)						
Control	43.8±0.34	860.4±11.5b	2097.0±27.0c	816.5±11.4^{b}	1214.0±39.1^{c}	2053.1±27.0^{c}
10	43.9±0.38	883.7±12.7ab	2145.6±31.7c	839.9±12.6^{ab}	1281.8±34.2^{bc}	2101.6±31.7^{c}
20	43.6±0.38	874.8±12.7ab	2239.8±29.2b	831.2±12.4^{ab}	1365.4±31.5^{b}	2196.3±29.2^{b}
40	43.9±0.38	898.5±12.7a	2481.6±29.2a	854.6±12.7^{a}	1586.6±31.5^{a}	2437.7±29.2^{a}
Essential oils (ppm)						
control	43.8±0.25	881.9±8.5	2197.2±20.4b	838.0±8.5	1314.5±22.0^{b}	2153.4±20.4^{b}
50	43.7±0.27	874.1±8.9	2290.4±21.0a	830.4±8.9	1417.1±22.7^{a}	2246.6±21.0^{a}
Saponin × Essential oils						
Control × without	43.5±0.77	858.0±22.1	2013.8±44.3c	814.8±22.0	1117.5±49.5^{d}	1969.8±44.3^{c}
10 × without EO	43.8±0.77	886.5±28.5	2021.8±59.7c	843.0±28.4	1393.0±66.6^{bc}	1978.2±59.6^{c}
20 × without EO	44.2±0.77	885.0±27.1	2250.3±56.3b	840.7±26.9	1131.6±62.8^{d}	2069.0±56.2^{b}
40 × without EO	44.0±0.77	892.5±27.1	2500.0±53.4a	848.5±26.9	1607.5±59.6^{a}	2456.0±53.3^{a}
Control × plus EO	43.6±0.77	865.3±27.1	2034.0±53.4c	832.6±26.9	1286.2±59.6c	2031.0±53.3c
10 × plus EO	44.1±0.77	858.3±27.1	2194.5±53.4b	813.8±26.9	1336.5±59.6^{c}	2150.3±53.3^{b}
20 × plus EO	42.9±0.77	882.0±27.1	2450.0±54.7a	839.0±26.9	1561.5±61.1^{ab}	2407.3±54.7^{a}
40 × plus EO	43.8±0.77	903.3±28.5	2520.0±57.9a	859.3±28.4	1601.7±64.6^{a}	2476.3±57.9^{a}

$^{a,b,c....}$Means with different superscript in the same column are significantly different at (P>0.05).

Table (2): Least square means and standard error (±S.E) for feed intake and feed conversion ratio as affected by the studied factors.

Items	Feed intake (g /bird)			Feed conversation ratio (g feed/g gain)		
	0-3 Wks	3-5 Wks	0-5 Wks	0-3 Wks	3-5 Wks	0-5 Wks
Saponin (ppm)						
Control	1267.0	1778.7^{a}	3045.7	1.55^{ab}	1.51^{a}	1.63^{a}
10	1235.7	1688.2^{b}	2924.0	1.47^{ab}	1.30^{b}	1.42^{b}
20	1246.2	1775.0^{a}	3021.2	1.49^{b}	1.32^{b}	1.37^{b}
40	1221.0	1787.2^{a}	3008.2	1.43^{b}	1.13c	1.23^{c}
MSE	25.87	25.12	39.98	0.035	0.031	0.046
Essential oils (ppm)						
control	1261.7	1737.1	2998.8	1.50	1.36	1.48^{a}
50	1223.2	1777.5	3000.7	1.47	1.27	1.34^{b}
MSE	17.78	18.82	29.25	0.026	0.034	0.041
Saponin × Essential oils						
Control × without	1352.0^{c}	1750.0^{e}	3102.0^{d}	1.66^{b}	1.56^{a}	2.11^{a}
10 × without EO	1269.0^{g}	1698.0^{f}	2967.0^{g}	1.50^{h}	1.22^{e}	1.50^{c}
20 × without EO	1366.0^{b}	1673.0^{h}	3039.0^{f}	1.62^{c}	1.47^{b}	1.47^{d}
40 × without EO	1315.0^{d}	1803.0^{c}	3118.0^{c}	1.55^{e}	1.12^{g}	1.27^{g}
Control × plus EO	1285.2^{g}	1712.2^{f}	3015.2^{f}	1.48^{h}	1.46^{b}	1.46^{c}
10 × plus EO	1395.0^{a}	1856.0^{a}	3251.0^{a}	1.71^{a}	1.39^{c}	1.51^{b}
20 × plus EO	1278.0^{f}	1851.0^{b}	3129.0^{b}	1.52^{f}	1.18^{f}	1.30^{f}
40 × plus EO	1294.0^{e}	1750.0^{d}	3090.0^{e}	1.51^{h}	1.12^{g}	1.25^{h}
MSE	15.2	17.35	31.21	0.032	0.034	0.028

[a,b,c….]Means with different superscript in the same column are significantly different at (P>0.05).

Table (3): Least – square means for economical efficiency of broilers of different experimental groups as affected by the studied factors

Items	Total feed intake (g/bird)	Total feed cost(L.E)	Feed additive cost	Other 30% Cost (L.E)	Total cost (L.E)	Total revenue(L.E)	(*)Net revenue(L.E)	(**)Economical efficiency (EE)	(***)Relative economical efficiency (REE)
Saponin (ppm)									
Control	3045.7	26.67	-	8.0	34.67	52.42	17.75	1.51	151
10	2924.0	25.60	0.21	7.7	33.51	53.64	20.13	1.60	160
20	3021.2	26.46	0.4	8.1	34.96	55.99	21.03	1.60	160
40	3008.2	26.35	0.8	8.2	35.30	62.04	26.74	1.76	175
Essential oils (ppm)									
0	2998.8	26.26	-	7.9	34.14	54.93	20.79	1.61	161
50	3000.7	26.28	2.2	8.5	36.98	57.26	23.09	1.55	155
Saponin × Essential oils									
Control × without	3102.0	27.16	-	8.1	35.26	50.34	15.08	1.43	143
10 × without EO	2967.0	25.98	0.21	7.8	33.78	50.54	16.76	1.50	150
20 × without EO	3039.0	26.60	0.40	8.0	34.60	56.25	21.65	1.63	163
40 × without EO	3118.0	27.30	0.80	8.2	35.50	62.50	27.00	1.76	176
Control × plus EO	2954.0	27.63	-	7.9	34.52	55.52	19.21	1.58	162
10 × plus EO	3251.0	28.46	2.41	8.5	36.96	54.86	17.90	1.48	148
20 × plus EO	3129.0	27.40	2,60	8.2	35.60	61.25	25.65	1.72	172
40 × plus EO	3090.0	26.65	3.00	8.0	34.65	63.00	28.35	1.81	181

*****Net revenue group (L.E) = total revenue kg/gain (L.E) - total feed cost/group (L.E); **EE= total revenue (L.E) / total cost (L.E), ***REE = EE X 100; Price of 1 kg meat = 25 L.E, price of 1 kg feed = 8.8 L.E; Price of 1 kg saponin = 250 L.E, Price of 1 liter thymol and carvacrol = 550 L.E

Table (4): Least square means and standard error (±S.E) for serum protein fractions (total protein , albumin, globulin and A /G ratio) as affected by the studied factors.

Items	**serum protein fractions (g/dl)**			
	TP	**Alb**	**Glob**	**A/G ratio**
Saponin (ppm)				
Control	5.45^{d}	3.17^{d}	2.26^{c}	1.42^{b}
10	5.77^{c}	3.34^{bc}	2.436^{b}	1.39^{b}
20	6.20^{b}	3.72^{b}	2.47^{b}	1.52^{a}
40	6.50^{a}	3.87a	2.70^{a}	1.44^{ab}
MSE	0.06	0.04	0.04	0.03
Essential oils (ppm)				
Control	5.79^{b}	3.34b	2.37b	1.43
50	6.24^{a}	3.71a	2.56a	1.46
MSE	0.04	0.03	0.02	0.02
Saponin × Essential oils				
Control × without	5.13^{g}	3.16^{f}	1.90^{c}	1.63^{a}
10 × without EO	5.36f^{g}	3.30^{ef}	2.06^{bc}	1.60^{ab}
20 × without EO	5.76d^{e}	3.56^{cde}	2.20^{b}	1.62^{ab}
40 × without EO	6.30^{bc}	3.80^{bc}	2.43^{a}	1.62^{ab}
Control × plus EO	5.75^{de}	3.41^{ef}	2.04^{bc}	1.62^{ab}
10 × plus EO	6.03^{cd}	3.63^{cd}	2.40^{a}	1.51^{b}
20 × plus EO	6.43^{ab}	3.63^{cd}	2.40^{a}	1.68^{a}
40 × plus EO	6.73^{a}	4.16^{a}	2.56^{a}	1.62^{ab}
MSE	0.12	0.08	0.05	0.04

$^{a,b,c….}$Means with different superscript in the same column are significantly different at (P>0.05).
TP, total protein; ALB, albumin; Glob, Globulin

Table (5): Least square means and standard error (±S.E) of serum lipid profile (Triglycerides, Total cholesterol, HDL and LDL (mg/dL) as affected by the studied factors.

Items	Serum lipid profile (mg/dl)			
	Triglycerides	**Total cholesterol**	**HDL**	**LDL**
Saponin (ppm)				
Control	80.60[a]	66.31[a]	33.57[b]	35.26[a]
10	73.75[b]	58.79[b]	36.05[a]	22.73[b]
20	66.45[c]	51.52[c]	36.86[a]	14.62[c]
40	60.65[d]	45.61[d]	35.90[a]	9.55[d]
MSE	0.44	0.53	0.65	0.87
Essential oils (ppm)				
control	75.61[a]	60.60[a]	35.57[b]	24.98[a]
50	65.12[b]	50.52[b]	35.62[a]	16.10[b]
MSE	0.31	0.37	0.46	0.61
Saponin × Essential oils				
Control × without	84.73[a]	69.20[a]	32.70[d]	36.50[a]
10 × without EO	77.9[b]	63.03[b]	35.16[bc]	27.86[b]
20 × without EO	71.20[d]	56.33[c]	38.90[a]	17.43[d]
40 × without EO	64.10[e]	48.26[e]	36.33[b]	11.93[e]
Control × plus EO	76.8[b]	65.2[b]	34.2[bc]	29.5[b]
10 × plus EO	66.76[e]	52.10[d]	39.33[a]	12.76[e]
20 × plus EO	59.36[f]	43.80[f]	34.50[bcd]	9.30[f]
40 × plus EO	54.73[g]	40.26[g]	33.86[cd]	6.40[g]
MSE	0.95	1.04	0.65	0.47

[a,b,c….] Means with different superscript in the same column are significantly different at (P>0.05).

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الملخص العربى

تأثير المستخلصات النباتية والزيوت العطرية على أداء النمو ومقاييس الدم في دجاج التسمين.

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أجريت هذه الدراسة لتقييم تأثير إضافة الصابونين والزيت العطري (الثيمول والكارفاكرول) على أداء النمو وبعض المقاييس البيوكيميائية في السيرم لدجاج اللحم. تم توزيع عدد مائتين وأربعون كتكوت عمر واحد يوم (روس 308) عشوائيا الي ثمانية معاملات ، كل معاملة بها ثلاثة مكررات. المعاملة الاولي مجموعة كنترول بدون إضافة سابونين. المعاملة الثانية تم إضافة السابونين 10 جزء في المليون. المعاملة الثالثة والرابعة سابونين 20 و 40 جزء في المليون علي التوالي . تم معاملة المعاملة الخامسة بإضافة الزيوت الاساسية 50 جزء في المليون. المعاملة السادسة 10 جزء في المليون + زيت اساسي 50 جزء في المليون. المعالمة السابعة والثامنة 20 و 40 جزء في المليون + زيت اساسي 50 جزء في المليون. أوضحت النتائج التي تم الحصول عليها أن الكتاكيت التي تم تغذيتها على عليقه بها سابونين كان لها أفضل وزن حي وزيادة وزنية ومعدل تحويل العلف ، بينما انخفض معدل استهلاك العلف مقارنة بالكنترول. الكتاكيت التي غذيت علي سابونين بمستوبات 20 أو 40 جزء في المليون مع 50 جزء في المليون من الزيت العطري أدت إلى تحسين ملحوظ في أداء النمو مقارنة بالمعاملات الأخرى. أدت إضافة الزيت العطري أو السابونين بمستويات 20 و 40 جزء في المليون إلى زيادة كبيرة في بروتين السيرم (البروتين الكلي والألبومين والجلوبيولين). لوحظ إنخفاضا كبيرة في مستويات الدهون الكلية ، والدهون الثلاثية ، الكوليستيرول الكلى بالسيرم و الدهون الثلاثية مرتفع و منخفض الكثافة في المجموعة التي غذيت على عليقة مضاف اليها 20 و 40 جزء في المليون / سابونين و زيت أساسي بمستوي 50 جزء في المليون مقارنة بالمعاملات الأخرى. وبالتالي ، يمكن اعتبار إضافات المستخلصات النباتية خاصة الزيوت العطرية مع السابونين ،تشير كعوامل واعدة في تعزيز أداء النمو لدجاج التسمين.

الكلمات الدالة: دجاج التسمين ، الزيوت العطرية ، السابونين ، الاداء ، الدهون في السيرم