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Effects of using coriander (*Coriandrum sativum L.*), savory (*Satureja hortensis L.*) and dill (*Anethum graveolens L.*) herb powder in diet on performance and some blood parameters of broilers

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Abstract

This experiment was carried out to determine the effect of herbal plant powders such as coriander, savory, dill and mix powder of these three plants compared with virginiamycin in their feeds as a growth stimulant on certain blood parameters in broilers. Four hundred and eighty one-day chickens of lineage Ross 308 were divided in a completely randomized design among cages with 6 treatments including coriander, savory and dill powders as well as a mix powder of these plants in 1% dose, virginiamycin 150 (gr/ton) and basic feed in 4 replicate with 20 chickens for each replicate. Weight gain and feed intake were recorded weekly, and blood was taken on days 21 and 42 to determine percentage of white blood cell and assess blood biochemical parameters. At the end of both periods of 21 and 42 days, the highest and lowest body weight belonged to chickens fed with a feed of antibiotic and coriander respectively. Virginiamycin increased feed intake, but this differences, except for coriander treatment, was not significant in other treatments ($p>0.05$). Through the growth period (1-42 days) the lowest and the highest feed conversion ratio belonged to antibiotic and coriander treatments respectively ($p<0.05$), however during this time, feed conversion index in savory treatment showed not significantly different form that of antibiotic ($p>0.05$). In conclusion Addition of medicinal herbal powders caused a significant decrease ($p<0.05$) in blood eosinophil. Also among herbal powders used, dill significantly reduced cholesterol, triglyceride and LDL levels in serum ($p<0.05$).

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Introduction

Although antibiotics added to the meal played an essential role as a growth stimulant for raising poultry and livestock (Lee *et al.,* 2004). Recently using antibiotics in poultry industry due to creating microbial resistance as well as harmful effects on human health has become problematic for both policy makers and consumers (Alcicek *et al.,* 2003). Of the most important compounds introduced as replacements for growth stimulant antibiotics, we can refer to medicinal herbs and their essence (Hertrampf, 2001). Research result indicate that using medicinal herbs and their derivatives generally known as phytogenic supplements has led to an improvement in the output of poultry production as well as their gastrointestinal performance comparable to antibiotics (Grashorn, 2010; Windisch *et al.,* 2007). On the other hand, natural and safe advantages as well as being accessible and economic are among major incentives for using herbal compounds in poultry (Cross *et al.,* 2007; Ghazalah and Ali, 2008; Grashorn, 2010; Windisch *et al.,* 2007). Beneficial effects of herbal extracts or active substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune response and antibacterial, antiviral, antioxidant and antihelminthic actions. Isoprene derivatives, flavonoids, glucosinolates and other plant metabolites may affect the physiological and chemical function of the digestive tract. The stabilizing effect on intestinal microflora may be associated with intermediate nutrient metabolism (Jamroz *et al.,* 2003).

Coriander (*Coriandrum sativum L.*) is a herb from umbelliferae family whose fruit and leaves contain essence used in food and medicinal industries (Rojhan, 2000; Dhanapakiam *et al.,* 2008; Eidi *et al.,* 2009). Savory (*Satureja hortensis L.*) is a herb from lamiasceae family. Its main component is carvacrol used as an antibacterial, antifungal, coxidia, antioxidant and preservative material in food industries (Bagheri *et al.,* 2010; Rojhan, 2000; Moshefi *et al.,* 2006). Dill (*Anethum graveolens L.*) is a herb from umbelliferae family. It is a one-year herb with various uses in medicinal and food industries. Dill has two major components D-carvone and D-limonene as well as antioxidant effects (Rojhan, 2000; Yazdanpanah, 2001). Alcicek *et al.* (2003) reported that the supplementation of the essential oil to the broiler diet or drinking water increased body weight and feed conversion ratio. Jamroz *et al.* (2002) started more weight gain in broilers fed plant extracts, in comparison with control group. Denli *et al.* (2004) and Cross *et al.* (2007) reported the beneficial effects of thyme (carvacrol) in poultry production. Lavinia *et al.* (2009) stated that supplementation of essential oils from medicinal plants caused improving immune-defense in poultry. Hertrampf (2001) and Alcicek *et al.* (2003) demonstrated that medicinal herbs improved animal performance. In spite of above explanations, there is no research about the effects of using coriander, savory and dill herb powder in diet on performance and some blood parameters of broilers.

The objectives of this investigation were to evaluate the effects of herbal medicinal powders such as coriander, savory, dill and their mix on the performance and certain blood parameters in broilers.

Material and methods

Experimental animals and dietary treatments

In this experiment, 480 one-day chickens of Ross lineage 308 were used in a completely randomized design. During the experiment, the test groups were studied in 6 treatments composed of 4 replicate each including 20 chickens. During raising period the feeds of the start time (1-21) and in the growth period (21-42) were determined based on Table 1. Feed treatment tested in this study included: first treatment with a base feed without any additives (control), second treatment with a base feed with virginiamycin antibiotic 150 gr/ton, third, fourth and the fifth treatment included a base feed with medicinal herbs such as coriander, savory and dill respectively, and the sixth treatment with a base feed along with 1 percent mix of coriander, savory and dill

(coriander 0.33%, savory 0.33% and dill 0.33%).

Performance parameters

During raising period, functional properties (feed rate, live bird weight and feed conversion ratio) were collected and computed per week.

Blood parameters

At the age of 21 days and at the end of raising period (42 days), two chickens from each test unit were chosen randomly and blood was taken from their wings to examine certain blood parameters. The blood obtained in two test tubes, one containing EDTA to determine percentage of blood white cells (monocyte, lymphocyte, heterophil and eosinophil) on day 21, the other for taking serum to measure biochemical factors (glucose, cholesterol, HDL, LDL and triglyceride) on day 42 was sent to laboratory to be analyzed based on test methods and references.

Statistical analysis

To analyze data of measured properties, and to compare mean test groups, SPSS and Duncan test were used respectively.

Results

Performance

Results for medicinal herbs coriander, savory, dill and virginiamycin in the start feed (1-21 days) and in the growth feed (21-42 days) for chickens on weight gain, feed intake and feed conversion ratio in Table 2. At the beginning of the experiment mean body weight of chickens was similar and there was no significant difference among groups ($P>0.05$). At the end of both periods of 21 and 42 days the highest and the lowest body weights belonged to chickens fed by antibiotics and dill respectively. On day 21, the lowest mean weight belonged to dill treatment which compared with other treatment except for control treatment, savory and essence mix, this difference was significant ($P<0.05$).

Table 1. Composition of experimental diets (% diet).

Ingredient	Starter (1-21 days)	Grower (21-42 days)
Corn	59.77	64.45
Soybean meal	34.12	29.34
Sunflower oil	1.93	2.91
DCP	1.64	1.13
Methionine	0.2	0.1
Oyster	1.37	1.33
Salt	0.47	0.34
Vitamin premix*	0.25	0.25
Mineral premix**	0.25	0.25
Calculated composition***		
ME (kcal/kg diet)	2850	2950
CP	20.89	19.50
Ca	0.99	0.85
P (available)	0.48	0.44
Na	0.21	0.16
Lys	1.08	0.97
Met+Cys	0.84	0.73

*Vitamin premix per kg of diet: vitamin a, 11000 IU; cholecalciferol, 2300 ICU; vitamin E, 32 mg; vitamin K3, 2 mg; vitamin B12, 0.02 mg; thiamin, 4 mg; riboflavin, 4 mg; folic acid, 1 mg; biotin 0.03 mg; pyridoxine, 4 mg; choline chloride, 840 mg; ethoxiquin, 125 mg.

** Mineral premix per kg of diet: Mn, 100 mg; Se, 0.2 mg; I, 1 mg; Cu, 10 mg; Fe, 50 mg.

*** Amounts have been calculated based on NRC (1994).

Weight gain

Given the results shown in Table 2, it can be said that the highest weight gain in the start period (1-21 days) belonged to virginiamycin test group, and the lowest

daily weight gain belonged to coriander group. In the same period the highest weight gain following antibiotic belonged to dill group (P<0.05). At the age range of 22-42 days the maximum and the minimum weight gain belonged to antibiotic and coriander groups respectively. At the same age range, weight gain for antibiotic treatment had a significant difference (P<0.05) compared with other treatment except for savory. In the whole raising period too, the maximum and the minimum weight gain belonged to antibiotic and coriander treatments respectively. In the whole period of weight gain, there was no significant difference among test groups (P>0.05), but the highest weight gain went to savory.

Table 2. Effect of medicinal herbs and antibiotic on performance in broilers.

Trait	Treatments						SEM
	Coriander	Savory	Dill	Mix	Antibiotic	Control	
Body weight, (g)							
Days 21	633.10^{c}	643.30^{c}	682.30^{b}	669.20$^{b\,c}$	725.60^{a}	658.70^{bc}	13.46
Days 42	2248.50^{c}	2402.40^{b}	2400.00^{b}	2402.67^{b}	2574.40^{a}	2383.20^{b}	42.28
Feed intake, (g)							
Days 1-21	937.40^{b}	914.10^{b}	946.60^{ab}	940.89^{b}	982.52^{a}	924.36^{b}	9.60
Days 21-42	3156.10	3293.20	3313.22	3280.75	3347.34	3292.14	26.65
Days 1-42	4104.72^{b}	4219.89^{ab}	4270.48^{a}	4243.65^{ab}	4355.23^{a}	4296.08^{a}	34.47
Weight gain, (g)							
Days 1-21	589.20^{c}	601.40^{bc}	673.50^{b}	624.87^{b}	681.40^{a}	614.13^{bc}	15.59
Days 21-42	1604.40^{c}	1745.69^{ab}	1707.30$^{b\,c}$	1703.70$^{b\,c}$	1837.60^{a}	1713.20^{bc}	30.72
Days 1-42	2204.20^{c}	3258.20^{b}	2355.70^{b}	2357.24^{b}	2529.49^{a}	2338.24^{b}	42.21
Feed conversion ratio, (g/g)							
Days 1-21	1.60^{a}	1.52^{ab}	1.44^{bc}	1.51^{ab}	1.40^{c}	1.50^{ab}	0.028
Days 21-42	1.96^{a}	1.88^{ab}	1.94^{a}	1.92^{a}	1.82^{ab}	1.92^{a}	0.020
Days 1-42	1.86^{a}	1.79^{bc}	1.81^{ab}	1.80^{b}	1.72^{c}	1.83^{ab}	0.019

a-c: Means in each row with different superscript are significant different (P<0.05).

Feed intake

Results in Table 2 indicate that mean feed intake of treatments is at the age range of 1-21, 21-42 and 1-42 days. Mean feed intake at the age of 22-42 days was not significant (P>0.05). Thus, the highest feed intake until 21 days, belonged to virginiamycin which was significant compared to other treatments except for dill (P<0.05). At this age range (1-21) the lowest feed intake belonged to savory treatment which was only significant compared to virginiamycin (P<0.05). At the end of the raising period too, virginiamycin had the highest feed intake which was only more significant than coriander treatment. At the age of 42 days, the lowest feed intake belonged to coriander which except for savory and essence mix, was not more significant than other treatments (P<0.05).

Feed conversion ratio (FCR)

Results in Table 2 show that in this test, adding antibiotics and herbal essences in all treatments had a significant effect on feed intake ratio at the all ages (P<0.05). Thus, antibiotic treatment at the end of day 21 showed a lower feed conversion ratio than other treatments which was only more significant than the control and coriander (P<0.05). At this age (21 days), the highest feed conversion ratio went to coriander which was only more significant than dill and virginiamycin treatments (P<0.05). At the end of raising period too, the lowest conversion ratio belonged to antibiotics which except for savory was more significant than other treatments (P<0.05). At day 42 too, the highest feed conversion ratio belonged to coriander treatment which was more significant than antibiotics, savory and essences mix (P<0.05).

White blood cell (WBC)

Given the results obtained in this test shown in Table 3, we can analyze that white blood cells percentage

including lymphocyte, heterophil and monocyte was not affected by treatments (P>0.05). However, eosinophil among test treatments showed a significant difference (P<0.05), so that the highest percentage of eosinophil belonged to antibiotics which did not show more significant difference than base feed and dill (P>0.05), and the lowest eosinophil percentage belonged to herbal mix. In addition, there wasn't any significant difference in heterophil to lymphocyte ratio (P>0.05).

Table 3. Effect of medicinal herbs and antibiotic on white blood cell in broilers.

Trait	Treatments						SEM
	Coriander	Savory	Dill	Mix	Antibiotic	Control	
White blood cell percentage at the age of 21 days (%)							
Monocyte	1.30	1.60	0.70	2.30	0.90	2.70	0.320
Lymphocyte	71.60	71.10	71.00	71.50	69.30	68.30	0.550
Heterophil	21.40	21.00	19.90	21.30	18.70	19.00	0.485
Eosinophil	10.10^{bc}	$10.40^{b\,c}$	$12.60^{\,ab}$	9.40^{c}	13.50^{a}	12.70^{a}	0.668
H/L*	0.298	0.295	0.280	0.297	0.269	0.278	0.004

* Heterophil to lymphocyte ratio.

a-c: Means in each row with different superscript are significant different (P<0.05).

Blood biochemical parameters

Given the results of this test shown in Table 4, the lowest rate of triglyceride pertained to dill treatment while it showed no significant difference to savory, coriander and medicine herbal mix. Reduced triglyceride rate in tested herbs was more significant than antibiotics and base feed (P<0.05). Cholesterol in herbal medicines' treatments serum compared to antibiotics showed a significant difference (P<0.05). The lowest serum cholesterol rate was observed in dill treatment which was significantly different from other treatments except herbal medicine mix. The highest cholesterol and LDL pertained to virginiamycin antibiotic and base feed. Dill treatment had lower LDL than other treatments except medicine herbal mix. Dill treatment showed the highest HDL than other treatments except for savory and medicine herbal mix (P<0.05).

Table 4. Effect of medicinal herbs and antibiotic on blood biochemical parameters in broilers.

Trait	Treatments						SEM
	Coriander	Savory	Dill	Mix	Antibiotic	Control	
Blood biochemical parameters at the age of 42 days (mg/dl)							
Triglyceride	36.40^{b}	33.12^{b}	31.87^{b}	32.25^{b}	57.82^{a}	45.36^{a}	4.21
Glucose	224.50	222.80	227.30	236.80	254.20	255.60	6.26
Cholesterol	$88.46b^{c}$	87.77^{bc}	74.14^{d}	$80.15c^{d}$	112.60^{a}	96.89^{a}	5.52
HDL	$48.52b^{c}$	51.02^{ab}	54.38^{a}	49.94^{ab}	46.72^{c}	46.69^{c}	1.19
LDL	$34.05b^{c}$	29.14^{c}	18.72^{d}	25.89^{cd}	48.15^{a}	33.12^{ab}	4.02

a-d: Means in each row with different superscript are significant different (P<0.05).

Discussion and conclusion

This research indicate that at the end of test period, treatments receiving savory, dill and medicine herbal mix had a positive effect on chickens weight gain. Also, adding virginiamycin to feed ration during raising period led to a significant increase (P<0.05) of body weight compared to other treatments. The first reports regarding functional benefits of virginiamycin in broilers were presented by Yates and Schaible (1961), Combs and Bossard (1963), Belay and Teeter (1994), Miles *et al.* (2006), Ferket *et al.* (2004) and Bafundo *et al.* (2003). In Jamroz and Kamel (2002) test in the period of (21-42 days), weight gain in savory group didn't show a significant as well as feed

conversion was observed in chickens fed with commercial essences including capsicin, cinnamaldehyde and carvacrol a constituent of thyme and savory. In a study by Miah *et al.* (2004), Nakaue *et al.* (1980) and Yejuman *et al.* (1998) higher growth rate was observed that agrees with the result of test.

Given the result of this study, examining the feed intake at the end of the period shows that medicine herbal powders, especially dill, have been effective in increasing feed intake. And though dill medicinal herb has not yet been studied for poultry's feeding, reports by Alcicek *et al.* (2004) and Denli *et al.* (2004) on other essences have shown similar results. Therefore, Cabuk *et al.* (2006) has reported that linalool has an appetizing property in the ration that triggers digesting process in animals. Toghyani *et al.* (2010) showed that using 0.5% and 1% thyme can have a significant effect on feed intake. In a research by Hertrampf (2001) it has been reported that essences extracted from spices herbs can be used to improve growth. These results support the performed test results.

Results from feed conversion ratio in the first there weeks showed that except for coriander medicinal herb, other medicinal herbs have a positive effect on the poultry's feed conversion ratio. Thus, at the end of test period and among medicinal herbs, savory showed the best feed conversion ratio. In the first three weeks of broiler life, whose enzyme systems are not fully evolved, herbal essences, especially dill, can play an important role in improving growth and conversion ratio. Results obtained from this test are in accordance with results obtained by Platel and Srinivasan (2004) indicating that using spices herbs improves digesting function by affecting salivary glands and stomach secretion, pancreas, bile and intestine mucus, and a research by Pedroso *et al.* (2003) reporting that using antibiotics in the ration improves feed conversion ratio by 3.4% and 2.5% respectively. Toghyani *et al.* (2010), Nobakht *et al.* (2010), Fayaz and Bijanzad (2010) and Tschirch (2000) reported a positive effect of medicinal herbs on feed conversion ratio that agrees with the results of this experiment.

Since so far no studies have been carried out on the effect of medicinal herbs such as coriander, savory and dill on the percentage of white blood cells in broilers, examination of blood factors is important because they indicate the health and proper feed of chickens. In this study, white blood cells rate, including lymphocyte, heterophil and monocyte, was not affected by treatments. However, eosinophil among test treatments showed a significant difference, so that the highest rate for eosinophil pertained to antibiotics which had no significant difference to the base feed and dill. The lowest eosinophil rate pertained to medicinal herbal mix. In a study by Pourreza (2000), injection of thyme essence to rabbits significantly increased cell and humoral immunity. Deschepper *et al.* (2003) reported that lymphocytes play a role in immunity mediated by cells. Monsan and Paul (1995) suggested that oligosaccharides present in plants act as soluble fibers leading to decreased displacement of digestive materials and reduced infection factors. Lavinia *et al.* (2009) and Jamroz *et al.* (2003) too, reported improved immune system as a result of using medicinal herbs. These results are in contradiction to the results of this test.

Significant reduction in cholesterol, triglyceride and LDL rate as well as a significant increase in dill and other medicine herbal treatments compared to antibiotic and base feed treatments indicate that these medicinal herbs especially dill are effective in regulating blood lipids. These results are comparable to the research carried out on the regulating effect of dill on blood lipids discussed below. Results of a study by Yazdanparast and Alavi (2001) show that the blue essence of dill leaves before and after extracting furocoumarin can reduce triglyceride and cholesterol in male rats. In the results obtained by Bahramikia and Yazdanparast (2009), it was also shown that dill's leaf essence can reduce total triglyceride, cholesterol and lipoprotein in rats whose blood cholesterol had increased using a feed ration rich in fat. In a study by Elson and Qureshi (1995), it was suggested that probably organic acids (propionate) reduces blood cholesterol through increasing cholesterol enzyme

7alpha-hydroxylase and trigging bile acids. Various results (Ismaili *et al.,* 2003; Hajhashemi, 1998; Ghahramani and Khand, 1998; Yazdanpanah, 2001; Visioli, 1994) indicate that medicinal herbs change the plasma level in blood lipids, while using dill essence reduces the serum lipids level. These results agree with the results obtained by the current research.

Therefore, given limited use of antibiotics in chickens farms, using herbal medicines can prepare a ground for making food supplements containing herbal medicines to increase growth and control diseases prevalent in poultry industry. Based on the results obtained by this research, using 1% herbal medicines especially dill in broiler feed can lead to improved function and regulated blood lipids. This can have positive effect on their health and reduce diseases in poultry, so using medicinal herbs in poultry feed rather than chemical ingredients is recommended.

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