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Health Characteristics and Performance of Broiler Chicks in Response to *Trigonella foenum graecum* and *Foeniculum vulgare*

Research Article

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ABSTRACT

The effects of *Trigonella foenum graecum* (TF) and *Foeniculum vulgare* (FV) seeds powder on antimicrobial activity and performance of broiler chickens were studied. Based on a completely randomized design, 240 broiler chicks (Ross 308) were assigned to 4 treatments and 4 replicates. The treatments were a basal diet (control, T 1), T 1 plus 0.5% TF (T 2), T 1 plus 0.5% FV (T 3) and TFFV (0.25% TF+0.25% FV) (T 4). The diets fed to birds during a 1-42 days period. Treatments containing medical plants showed better performance and lower total number of bacteria (TNB) and Coliform compared to the control ($P<0.05$). The presence of salmonella was negative in all tested samples. The weight and length of small intestine and carcass yield in birds fed medicinal plants were higher than those of control ($P<0.05$). Therefore, the results of this study showed that the use of medicinal plants can improve performance and health conditions in broiler chicks.

KEY WORDS antimicrobial properties, broiler, medical plants, performance.

INTRODUCTION

Restrictions on antibiotic growth promoters caused an increase tendency towards the development of alternative ingredients. The medical plants are possible alternatives which are perceived as natural and safe ingredients. The positive effects of medicinal plants were demonstrated on performance and bird's health condition (Al-Kassie, 2009; Bolukbasi and Erhan, 2007; Cross *et al*. 2007). Medicinal plants can promote efficient performance and reduction in chicken's gut microbial population (Elgayyar *et al*. 2001; Jang *et al*. 2007). The herbal additives were used as growth promoters or prohibit the growth of inward harmful bacteria through the digestion system (Eldeeb *et al*. 2007; Hernandez *et al*. 2004; Ruberto *et al*. 2000; Tekeli *et al*. 2006). Mostly, the effects of medicinal plants attributed to some ingredients (herbal essential oils, non starch polysaccharides, essences) (Chen *et al*. 2003; Mahmoud *et al*. 2006; Raeini-Sarjaz *et al*. 2006; Ruberto *et al*. 2000). Antibacterial effect is the main reason to use of the medicinal plants in poultry diets. *Foeniculum vulgare*, commonly known as "*Fennel*" is a small annual or biennial herb relevant to *Apiacea* family. Its blossoms are yellow with bunches in the end of the steams. *Fennel* used as antibloat, diuretic, laxative, blood thinning in traditional human medicine and growth promoter in animal diets (Ruberto *et al*. 2000). About 50 to 60 percentage of oil in *Foeniculum vulgare* is *Antol*. It has drastic antimicrobial effects on some bacterial strains e.g. *Staphylococcus aureus*, *Listeria monocytogenes*, *Salmonella enteritidis* and *Escherchia coli*

(Bolukbasi and Erhan, 2007). Its antimicrobial properties have been recognized (Elgayyar *et al*. 2001; Ruberto *et al*. 2000).

Trigonella foenum graecum commonly known as "*Fenugreek*" is a small annual or biennial herb related to *Fabacea* family, slim and branch like leafs with the triangle yellow pale blossoms. These medicinal plants are generally used as vermicide, germicide and as a traditional diuretic drug to blood pressure treatment and regulation of coronary heart diseases (Ruberto *et al*. 2000).

Some studies showed that derivative essences of these plants can promote the growth performance, and health condition development (Elgayyar *et al*. 2001; Ruberto *et al*. 2000). But little studies were examining the effects of *Trigonella foenum graecum* and *Foeniculum vulgare* on gut microbial, intestinal, and carcass traits condition. Therefore, this study was conducted to clear some of unknown roles of *Trigonella foenum graecum* and *Foeniculum vulgare* in broiler production.

MATERIALS AND METHODS

Birds and diets

Based on a completely randomized design, 240 unsexed broiler chicks (Ross 308) were assigned to 4 treatments, 4 replicates with 15 chickens in each. A control diet (treatment 1) was included to meet the requirements of chickens according to national research council (NRC, 1994). Other treatments were T 1 plus 0.5 % TF (T 2), T 1 plus 0.5 % FV (T 3) and TFFV (0.25% TF and 0.25% FV) (T 4). The diets were separated in starter (1-21 d of age) and grower (22-42 d of age) periods (Table 1).

Birds were kept under controlled environment. Feed and water were offered *ad libitum* and light was provided 24 h/day while the temperature was gradually reduced by increments of 3 ˚C from initially 32 ˚C in each week. Feed intake (FI), weight gains (WG), and feed conversion ratio (FCR) was measured.

Digesta collection and microbial assay

On day 42 of experiment, 2 birds from each replicate were killed via cervical dislocation. The ileum contents were collected. Contents were gently removed in sterile sampling tubes under anaerobic chamber and immediately transferred on ice to the laboratory. The contents of ileum were used for microbial study. The serial dilutions (10^{-4} to 10^{-7}) were made. Thereafter, the selective media of MacConkey agar were used for coliforms and number of G^- bacteria. Moreover, Plate Count Agar and XLD agar were used for total number of bacteria and salmonella, respectively. Microbial populations for all bacteria were counted after aerobic incubation at 37 ˚C for 24 hours.

Table 1 Composition of experimental diets in different periods of the experiment

Ingredients (%)	Starter (1-21 d)	Grower (22-42 d)
Corn grain	53.80	60.70
Soybean meal	38.70	32.20
Soybean oil	3	3
Calcium carbonates	1.63	2.03
Dicalcium phosphate	1.72	1.13
Vitamin and mineral premix[1]	0.50	0.50
NaCl	0.44	0.23
DL-methionine	0.14	0.06
L-lysine	0.07	0.05
Calculated analysis		
Metabolizable energy (kcal/kg)	3000	3055
Crude protein (%)	21.54	19.09
Calcium (%)	0.93	0.85
Available phosphorus (%)	0.45	0.33
Ca: P	2.07	2.57
Energy: protein	139.27	160.03

[1] Premix provided the following (per kg of complete diets): vitamin A: 8400 IU; vitamin D_3: 18000 IU; vitamin E: 300 mg; vitamin K: 24 mg; vitamin B_6: 18 mg; vitamin B_{12}: 36 mg; Niacin: 3600 mg; Pantothenic acid: 120 mg; Folic acid: 1.2 mg; Choline: 900 mg; Ca: 28.8 mg; P: 19.1 mg; Mn: 600 mg; Fe: 300 mg; Zn: 480 mg; Cu: 60 mg; Co: 1.5 mg and Iodine: 9 mg.

pH measurement

To assay intestinal content pH, 2 birds from each replicate were slaughter on 42 day of age. After contents collection, the 1 g samples were homogenized by distilled water (2 mL) and pH were measured by digital pH-meter (Methrom).

Carcass characteristics

On 42 day of age, final body weights were taken then 4 birds from each pen (each bird as a replicate) were randomly selected, tagged and birds were fasted (no limitation of water access) for 8 hours. Birds were weighed and slaughtered by serving both of the right and left carotid artery and jugular vein in a single cut and bled for 180 s. Carcass weights were measured after removal of feather, head, legs and abdominal content. The breast, thighs, intestinal weights were calculated as the percentage of fasted live body weight. Also, intestinal length was measured.

Statistical analysis

Based on the completely randomized design, the data were analyzed using GLM procedure of SAS (SAS, 2004). Significant differences among treatments were determined by using Duncan's multiple range tests. All statements of significance are based on a probability of less than 0.05.

RESULTS AND DISCUSSION

Performance

The effects of treatments on broiler performance are presented in Table 2.

Table 2 Broiler performance traits in response to medicinal plants treatments

Treatment	Feed intake (g/d)	Daily weight gain (g/d)	FCR
Control	112.88[b]	50.39[b]	2.24[a]
TF	103.19[c]	45.26[c]	2.28[b]
FV	116.19[a]	53.30[a]	2.18[c]
TFFV	116.02[a]	52.98[a]	2.19[c]
SEM	2.82	1.28	0.06

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
TF: *Trigonella foenum graecum*; FV: *Foeniculum vulgare*.
FFFV= TF + FV.
FCR: feed conversion ratio and SEM: standard error of means.

The FV and TFFV treatments caused significantly increases in FI and WG rather TF and control (P<0.05). Also, the FV and TFFV treatments induced a better FCR rather control and TF treatments (P<0.05).

Microbial activity

The results of gut microbial population are shown at Table 3. The highest total bacteria and coliforms counts were obtained by control rather all medicinal plants treatments (P<0.05). Salmonella isolation and detection showed that it is negative in all of treatments.

Table 3 Effects of various treatments on microflora population of broiler chickens (log_{10})

Treatment	Total number of bacteria	Number of *Coli forms*	Presence of *Salmonella*
Control	10.00[a]	9.00[a]	Negative
TF	8.33[c]	6.00[c]	Negative
FV	9.50[b]	7.17[b]	Negative
TFFV	8.83[c]	6.50[c]	Negative
SEM	0.23	0.18	-

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
TF: *Trigonella foenum graecum*; FV: *Foeniculum vulgare*.
FFFV= TF + FV.
FCR: feed conversion ratio and SEM: standard error of means.

Intestinal characteristics

The results of various treatments on intestinal trait are presented at Table 4. The results indicated that all of medicinal plant treatments lead to significant decrease in gut pH as compared to control (P<0.05). Also, intestinal weight were significantly higher than control in all medicinal plant treatments (P<0.05). All medicinal plant treatments induced significantly longer intestinal length rather control (P<0.05).

Carcass traits

The effects of different treatments on carcass characteristics are illustrated in Table 5.

The medicinal plants treatments caused a significantly increases in carcass yield rather control (P<0.05). Also, no significantly differences was observed in other carcass traits (P>0.05).

According to the results of current study it is proposed that TF and FV had different effects on traits (Tables 2 and 3). The FV treatment could promote performance traits such as FI, WG and FCR. It is found that medical plant (1 g/kg diets) improved the nutritive value of Japanese quail diets by increasing body weight, FCR along with economic efficiency (Genedy and Zeweil, 2003).

Table 4 Treatments effects on the intestinal characteristics of broiler chickens

Treatment	pH	Intestinal weight (g)	Intestinal length (cm)
Control	6.69[a]	71.70[b]	198.50[b]
TF	5.58[b]	82.80[a]	225.60[a]
FV	5.87[b]	80.50[a]	219.60[a]
TFFV	5.82[b]	85.30[a]	232.70[a]
SEM	0.15	2.19	5.41

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
TF: *Trigonella foenum graecum*; FV: *Foeniculum vulgare*.
FFFV= TF + FV.
FCR: feed conversion ratio and SEM: standard error of means.

These results are agreed with findings of current study. Many studies indicated that the positive effects of medicinal plants might be due to their stimulant, antimicrobial properties and presence of essential oils and other plant extracts (Chen *et al*. 2003; Eldeeb *et al*. 2007; Sarica *et al*. 2007; Willis *et al*. 2007; Zeweil *et al*. 2006). Based on the finding of another study, essential oils of ginger and fennel in did not affect FI and FCR; although, treatments groups achieved these essential oils have numerically higher performance values (Nasiroleslami and Torki, 2010).

The results showed that all medicinal plants could decrease the number of bacteria in samples gathered from gut. Thus these results confirm the antimicrobial nature of used medicinal plants in this study. Thus, it might deduced that effects of medicinal plants be additive. Because TFFV could promote the performance traits like FV, also could decrease the number of undesirable gut micro flora population like TF. Moreover, all diets with medicinal plant additives had a better result in health traits aspects just as gut pH, intestinal weight, and length. The antibacterial, antifungal and anticoccidial effects of essential or other components from plant extracts may be due to the lipophilic property and special chemical structure of them (Elgayyar *et al*. 2001; Guo *et al*. 2004; Willis *et al*. 2007). The result of the present study are in harmony with other studies (Guo *et al*. 2004; Sarica *et al*. 2007) who reported that the dietary herbal treatments resulted in lower *Escherchia coli* counts in small intestine compared to the control. Sarica *et al*. (2007) reported that use of garlic in diets lowered the counts of total aerobic bacteria and *Escherchia coli* in the small intestine in broiler chickens. Other health enhancing compounds are also being examined (Chen *et al*. 2003; Guo *et al*. 2004; Midilli and Tuncer, 2001).

Table 5 Carcass characteristics of broiler chicken in response to dietary treatments

Treatment	Live weight (g)	Carcass weight (g)	Carcass yield (%)	Leg percent (%)	Breast percent (%)	Empty intestinal percent (%)
Control	2237	1512	67.61[b]	19.56	20.60	2.82
TF	2224	1563	70.25[a]	20.77	22.08	2.85
FV	2276	1599	70.23[a]	20.82	22.15	2.83
TFFV	2307	1619	70.19[a]	20.77	22.31	2.88
SEM	51.50	35.91	1.58	0.47	0.51	0.32

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
TF: *Trigonella foenum graecum*; FV: *Foeniculum vulgare*.
FFFV= TF + FV.
FCR: feed conversion ratio and SEM: standard error of means.

Antibacterial action from the use of Shiitak (*Lentinus edodes*) mushrooms was reported (Yuan *et al*. 1993). Performed work (Guo *et al*. 2004) reported that the population of *Bifidobacteria* and *Lactobacilli* were significantly increased with the addition of Shiitak mushroom extract (*Lentinus edodes*). Improved performance can attributed to decrease unfavorable microflora and competitive with host to nutrients. Antioxidant activity of Trigonella foenum graecum using various *in vitro* and *in vivo* models has been reported (Subhashini *et al*. 2011).

CONCLUSION

The results have shown to food safety and prohibit antibiotics herbs, medical plants and their derivations have been used in poultry feed. The results showed that TF, FV and mixture of TF and FV can improve FCR and intestinal condition. Hence consideration must look to natural means to reduce classical feed additives such as antibiotics in poultry nutrition.

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