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Effects of Peppermint (*Mentha piperita*) and Aloe vera (*Aloe barbadensis*) on Ileum Microflora Population and Growth Performance of Broiler Chickens in Comparison with Antibiotic Growth Promoter

Research Article

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ABSTRACT

This research was conducted to compare the effects of two medicinal plants (peppermint and aloe vera) and antibiotic growth promoter on ileum microflora population and growth performance of broiler chickens. In this experiment, 375 one-day old male broiler chickens (Ross 308) were used on a completely randomized design with 5 dietary treatments which were replicated 5 times with 15 birds per replicate. The experimental treatments were: 1) the control diet (basal diet with no additive); 2) basal diet + 10 g/kg dry peppermint leaves (DPL); 3) basal diet + 10 g/kg aloe vera gel (AVG); 4) basal diet + 5 g/kg DPL + 5 g/kg AVG and 5) basal diet + 10 ppm virginiamycin. Growth performance parameters were evaluated during the starter, grower and finisher periods and the populations of *Lactobacillus* and *Escherichia coli* bacteria was determined on the 42nd day of age. The maximum number of *Lactobacillus* bacteria was observed in the ileum of broilers fed diets containing DPL + AVG ($P<0.05$). The birds receiving the medicinal plant supplements had lower *Escherichia coli* population in comparison with control birds ($P<0.05$). The antibiotic fed broilers had higher feed intake, body weight gain, and dressing percentage than the control treatment and those fed medicinal herbs. The broilers fed medicinal herbs had higher feed intake, body weight gain and dressing percentage than the control ($P<0.05$). The birds fed mixture of DPL + AVG has better growth performance and dressing percentage. This study suggests that using a mixture of peppermint and aloe vera as a feed supplement of broiler chickens could be a potential alternative for antibiotic growth promoter.

KEY WORDS aloe vera, broiler chicken, growth performance, microflora, peppermint.

INTRODUCTION

The antibiotic growth promoters are a group of feed additives which inhibit intestinal pathogens and improve the growth performance of poultry. However, in recent years the excessive use of antibiotic growth promoters has been a major concern due to increased antibiotic resistance in human and inclination of users to eat healthy foods (Castanon, 2007). At the moment, extensive efforts on finding alternatives to antibiotic growth promoters are under way. Probiotics, prebiotics, organic acids or medicinal plants have been suggested as alternatives for antibiotic growth promoters (Dibner and Richards, 2005). Among the feed additives used for poultry and food animals, medicinal plants have drawn higher attention; however, this attention is not solely limited to recent years. A review of the past events suggests that even ancient communities used medicinal plants to treat diseases of poultry and other animal. On the other hand, because medicinal plants are readily available than other feed additives, they are more highlighted. At the moment, studies concerning the influence of medicinal plants in broiler chickens suggests that these substances could be a viable substitute for antibiotic growth promoters (Diaz-Sanchez *et al.* 2015).

In this regard, Demir *et al.* (2003) reported that chickens fed thyme and garlic, had better growth performance than those receiving antibiotic growth promoters. It seems that because of their antibiotic properties, some medicinal plants could improve growth performance and health status of birds. On the other hand, these plants might exert multiple effects due to containing numerous effective compounds (Yang *et al.* 2009). In broader sense, medicinal plants have been proposed as alternatives to antibiotic growth promoters.

In the present research, two medicinal plants (i.e. peppermint and aloe vera) were used. Previous studies have suggested that these two plants have antibiotic properties. Peppermint (*Mentha piperita*) is planted in Europe, North America, Canada and other regions. It is highly significant in nutritional and pharmaceutical industries (McKay and Blumberg, 2006). Peppermint has been reported to possess certain anti-oxidant, anti-tumor, anti-allergic, anti-viral and anti-bacterial properties (McKay and Blumberg, 2006). Aloe vera (*Aloe barbadensis*) is one of the oldest medicinal plants known ever. It grows in both tropical and subtropical regions. Previous reports have shown that aloe vera presumably contains anti-bacterial, anti-viral, anti-fungal, anti-inflammatory and immunomodulatory properties (Christaki and Florou-Paneri, 2010). However, there are few studies concerning the effect of peppermint and aloe vera on performance of broiler chickens. Recently, Mehri *et al.* (2015) added peppermint powder (*Mentha piperita*) to feeds of Japanese quail.

In earlier studies, Ghazaghi *et al.* (2014) added *Mentha spicata* powder to the feed of the Japanese quail as well. In both studies, the number of *Lactobacillus* bacteria in the intestine increased significantly, whereas the number of *E. coli* bacteria decreased. However, the growth performance of Japanese quails did not change in comparison with the control treatment. Studies have also shown that feeding aloe vera could change broiler's intestinal microflora population such that the populations of *Lactobacillus* and *Bifidobacteria* bacteria increase while the population of *E. coli* bacteria decrease (Darabighane *et al.* 2012; Lin *et al.* 2005). Jafarzadeh *et al.* (2015) reported that in Japanese quails, aloe vera gel powder increased the number of *Lactobacillus* bacteria and reduced the number of *E. coli* bacteria; however, the aloe vera gel powder did not significantly improve growth performance of Japanese quails.

Other researchers reported the positive influence of peppermint and aloe vera on growth performance of chickens, however, they used peppermint essential oils in the feed (Emami *et al.* 2012), ethanolic extract of peppermint in drinking water (Nanekarani *et al.* 2012) or added aloe vera gel powder (Alemi *et al.* 2012) or aloe vera gel to the feed (Darabighane *et al.* 2011) of broiler chickens. The differences in the influence of medicinal plants on growth performance broiler chickens might be due to the type of Peppermint processing product (powder, extract or essential oil), products of aloe vera processing (powder or gel) and their incorporation into the feed or drinking water of broiler chickens. Considering the fact that diet is one of the most significant factors influencing the population of intestinal microflora and because microflora in the digestive system might significantly affect the health and growth performance of birds (Yang *et al.* 2009; Pan and Yu, 2014) The use of feed additives (e.g. medicinal plants) has the potential to change the microflora population of digestive system and realize maximum growth rate of birds. Therefore, the objective of present study was to compare the effect of dietary peppermint powder, aloe vera gel or a mixture of these two medicinal plants and antibiotic growth promoter on intestinal microflora population and growth performance of broiler chickens.

MATERIALS AND METHODS

Experimental treatments, diets and management

In the present study, 375 one-day old male broiler chickens (Ross 308) were used on a completely randomized design with 5 treatments, 5 replicates, each consisting of 15 broilers. The experimental treatments included the control diet (basal diet with no additive), a treatment that received basal diet + 10 g/kg DPL, basal diet + 10 g/kg AVG, basal diet + 5 g/kg DPL + 5 g/kg AVG and basal diet + 10 ppm virginiamycin. The broiler rations were formulated based on nutrient requirements of the Ross 308, using UFFDA software for starter (0-10 days), grower (11-24 days) and finisher (25-42 days) phases. Table 1 shows the ingredient and chemical composition of the starter, grower and finisher experimental diets.

The vaccination schedule was based on veterinarian's recommendation. The broiler chickens were fed *ad libitum* and they received a lighting regimen of 23 h light: 1 h darkness. The initial temperature was 32 °C which gradually reduced according to breeding standards. Control parameters, such as temperature, humidity, light and ventilation, were the same for all treatments.

Table 1 Ingredients and chemical composition of the experimental basal diets

Ingredients	Starter (1-10 d)	Grower (11-24 d)	Finisher (25-42 d)
Corn (g/kg)	560.8	596.8	654.1
Soybean meal (g/kg)	325.2	312.4	259.3
Corn gluten meal (g/kg)	35.9	0	0
Soybean oil (g/kg)	27.2	46.7	43.9
Dicalcium phosphate (g/kg)	21.9	19.4	18
Calcium carbonate (g/kg)	13.3	10.8	10.6
Sodium bicarbonate (g/kg)	1.4	0.8	2.3
Salt (g/kg)	2.2	2.7	1.9
Vitamin premix[1] (g/kg)	2.5	2.5	2.5
Mineral premix[2] (g/kg)	2.5	2.5	2.5
L-lysine HCl (g/kg)	3.3	1.9	1.8
DL-methionine (g/kg)	3	2.9	2.5
L-threonine (g/kg)	0.8	0.6	0.6
Calculated composition			
Metabolizable energy (kcal/kg)	2850	3000	3100
Crude protein (%)	25.15	22.10	19.60
Ca (%)	0.16	0.98	0.94
Available phosphorous (%)	0.49	0.47	0.43
Methionine + cysteine (%)	1.08	0.9	0.8
Lysine (%)	1.40	1.21	1.07

[1] Vitamin premix provided per kilogram of diet: vitamin A: 10000 IU; vitamin D_3: 5000 IU; vitamin E: 50 IU; vitamin K_3: 3 mg; Thiamine: 3 mg; Riboflavin: 9 mg; Nicotinic acid: 50 mg; Pantothenic acid (D-calcium pantothenate): 15 mg; vitamin B_6: 4 mg; D-biotin: 0.1 mg; Folic acid: 2 mg; vitamin B_{12}: 0.02 mg and Choline (choline chloride): 1000 mg.
[2] Mineral premix provided per kilogram of diet: iron ($FeSO_4 \cdot 7H_2O$): 55 mg; Iodine ($Ca(IO_3)_2$): 1.3 mg; Manganese ($MnSO_4 \cdot H_2O$): 120 mg; Zinc (ZnO): 100 mg; Copper ($CuSO_4 \cdot 5H_2O$): 16 mg and Selenium (Na_2SeO_3): 0.3 mg.

Preparation of medicinal plants
An essential amount of aloe vera leaves was supplied from a local farm and after washing the leaves with distilled water, they were cut by scalpel blade to extract the inner gel. The gel was turned into a homogeneous liquid by mixing device (Mwale *et al.* 2006).

The liquid was then mixed with the experimental feed. peppermint was supplied from a peppermint farm and after washing with distilled water, the peppermint leaves were air-dried in a dark room with ambient temperature (for 5 days at 28 ˚C and 40% of relative humidity) (Ghazaghi *et al.* 2014).

After drying, the leaves were powdered by a milling device and added to the broiler feed.

Measurement of growth performance parameters
The growth performance of broiler chickens comprising body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) for starter, grower and finisher periods and for the entire experimentation period were measured. During these periods, the number and weights of mortalities in broiler chickens were recorded to adjust the growth parameters (Darabighane *et al.* 2011).

In order to measure the dressing percentage, 2 birds were randomly selected out of each replicate during the 42nd day and sacrificed.

Measurement of ileum microflora
In 42nd day, two birds from each replicate were randomly selected and sacrificed by cervical dislocation. In order to determine the numbers of *Lactobacillus* and *E. coli* bacteria, one gram of ileal content of broiler chickens was sampled. The numbers of *Lactobacillus* and *E. coli* bacteria were measured according to the method of Salim *et al.* (2013).

Statistical analysis
The experimental results were analyzed using ANOVA and the SAS (2002). The comparison of means was done through Duncan's multiple range test at the level of 0.05.

RESULTS AND DISCUSSION

Ileum microflora
The numbers of *Lactobacillus* and *E. coli* bacteria colonies are shown in Table 2.

Table 2 Effect of ppeppermint, aloe vera and antibiotic on ileum microflora counts ($\log_{10}$ CFU/g) of broiler chicks

Type of bacteria	Dietary treatments					SEM
	CON	DPL	AVG	DPL + AVG	VM	
Lactobacillus	5.30^{bc}	5.70^{b}	5.52^{b}	6.35^{a}	4.92^{c}	0.23
E. coli	6.45^{a}	5.32^{b}	5.27^{b}	5.60^{b}	5.35^{b}	0.21

CON: control; DPL: dry peppermint leaves; AVG: aloe vera gel; DPL+AVG: mixture of DPL + AVG and VM: virginiamycin.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

The results showed that the *Lactobacilli* population was increased in birds fed a combination of peppermint-aloe vera (DPL+AVG). The *Lactobacilli* population was not differing between broilers receiving AVG and DPL than the control treatment. The lowest *Lactobacilli* population was observed in the antibiotic fed birds which was not significantly different from the control treatment. The control treatment had the highest *E. coli* bacteria population (P<0.05). There was no significant difference in *E. coli* bacteria population between birds fed antibiotic and those receiving the medicinal plants (i.e. DPL, AVG and DPL+AVG). However, the least number of *E. coli* was associated with the birds fed diets containing AVG.

Growth performance

The results of FI during the starter, grower and finisher periods as well as for the entire experimentation period are shown in Table 3. In the starter period, the antibiotic receiving birds had higher FI (P<0.05) than other treatments. Among those treatments which had received medicinal plants (i.e. DPL, AVG and DPL+AVG) the treatment receiving the mixture of DPL + AVG recorded higher FI. During the grower period, the highest and lowest FI were recorded in antibiotic receiving birds and the control birds, respectively (P<0.05). However, no significant difference was observed in FI of birds fed medicinal plants. In the finisher period, as well as the entire experiment period, the highest and lowest FI were observed in antibiotic fed and control birds, respectively (P<0.05). Among experimental treatments receiving medicinal plants, the FI of AVG treatment was insignificantly different from the other two treatments (DPL and DPL+AVG).

The results for BWG during starter, grower and finisher as well as whole the experiment period are shown in Table 4. In the starter period, higher BWG was recorded in antibiotic receiving birds (P<0.05), which was significantly superior to other treatments with exception of the birds which received a mixture of DPL + AVG. In the starter period, the control treatment had the lowest BWG (P<0.05). During the grower period, antibiotic receiving birds had higher BWG in comparison with other treatments (P<0.05). The broilers fed medicinal plants (i.e. DPL, AVG and DPL+AVG) showed a higher BWG than the control treatment (P<0.05). In the finisher period, no significant difference was observed in BWG of the experimental treatments (P>0.05). The control treatment had lower BWG in comparison with other treatments (P<0.05).

During the total experiment period, the highest BWG was observed in antibiotic fed birds (P<0.05), but the difference was not significant from the AVG receiving birds. No significant differences were observed in BWG of birds fed the DPL + AVG or AVG. The least BWG for the entire rearing period was observed in the control treatment (P<0.05).

The results of FCR of starter and grower, finisher as well as the entire experimentation period are shown in Table 5. In the starter period, the lowest FCR was observed in birds receiving medicinal plants compared to the antibiotic fed or control treatment (P<0.05). During the grower period, differences in FCR between the control treatment and the treatments fed medicinal plants were not significant. However, birds in the antibiotic treatment had higher FCR (P<0.05). No significant difference was observed for FCR of experimental treatment during the finisher phase. In the entire experimental period, the highest FCR was observed in antibiotic-fed birds (P<0.05). Although lower FCR was calculated for AVG fed birds, but the differences in the bird fed the DPL + AVG and the control birds were not significant (P>0.05).

The dressing percentage of experimental birds at 42 day of age are shown in Table 6. Higher dressing percentage was recorded in antibiotic receiving birds than from the birds fed DPL and those in the control treatment (P<0.05). The birds which received medicinal plants (DPL, AVG and DPL+AVG) were not different in dressing percentage, but were significantly higher than the control treatment (P<0.05).

As a part of digestive ecosystem, microflora of digestive system exerts significant influence on health and growth performance of birds. Therefore, creating a healthy intestinal environment and increase of useful bacteria through antibiotic alternatives could significantly improve growth performance and increase immune competence (Huyghebaert *et al.* 2011).

The results of present study suggest that consuming peppermint, aloe vera and a mixture of peppermint-aloe vera could increase the number of *Lactobacillus* bacteria and decrease *E. coli* bacteria. In other words, increase in the number of *Lactobacillus* bacteria leads to reduced pH and limited growth of *E. coli* bacteria. The results of present experiment match those of previous works.

Table 3 Effect of peppermint, aloe vera and antibiotic on feed intake (g/bird) of broilers

Growth phase	Dietary treatments					SEM
	CON	DPL	AVG	DPL + AVG	VM	
Starter (1-10 d)	245.30[c]	247.20[c]	249.12[c]	257.50[b]	277.85[a]	5.98
Grower (11-24 d)	1146.42[c]	1180.92[b]	1192.37[b]	1189.75[b]	1232.45[a]	13.74
Finisher (25-42 d)	2672.50[d]	2776.87[c]	2783.87[bc]	2790[b]	2815.90[a]	24.73
The entire period	4064.22[d]	4205[c]	4225.37[bc]	4237.25[b]	4326.2[a]	42.27

CON: control; DPL: dry peppermint leaves; AVG: aloe vera gel; DPL+AVG: mixture of DPL + AVG and VM: virginiamycin.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 4 Effect of peppermint, aloe vera and antibiotic on body weight gain (g/bird) of broilers

Growth phase	Dietary treatments					SEM
	CON	DPL	AVG	DPL + AVG	VM	
Starter (1-10 d)	200.25[d]	222.07[c]	226.07[bc]	228.50[ab]	232.77[a]	5.69
Grower (11-24 d)	727.57[d]	738.85[c]	748.87[b]	747.12[b]	755.87[a]	8.84
Finisher (25-42 d)	1401.25[b]	1452.37[a]	1460.30[a]	1454.25[a]	1462.50[a]	11.37
The entire period	2329.07[d]	2413.30[c]	2435.25[ab]	2429.87[bc]	2451.15[a]	21.52

CON: control; DPL: dry peppermint leaves; AVG: aloe vera gel; DPL+AVG: mixture of DPL + AVG and VM: virginiamycin.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 5 Effect of peppermint, aloe vera and antibiotic on feed conversion ratio (FCR) of broilers

Growth phase	Dietary treatments					SEM
	CON	DPL	AVG	DPL + AVG	VM	
Starter (1-10 d)	1.225[a]	1.113[c]	1.102[c]	1.126[c]	1.194[b]	0.065
Grower (11-24 d)	1.575[b]	1.598[b]	1.592[b]	1.592[b]	1.630[a]	0.090
Finisher (25-42 d)	1.907	1.912	1.906	1.918	1.925	0.073
Total period	1.745[b]	1.742[b]	1.735[b]	1.743[b]	1.765[a]	0.071

CON: control; DPL: dry peppermint leaves; AVG: aloe vera gel; DPL+AVG: mixture of DPL + AVG and VM: virginiamycin.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 6 Effect of peppermint, aloe vera and antibiotic on dressing percentage of broilers

Dietary treatments	CON	DPL	AVG	DPL + AVG	VM	SEM
Dressing percentage	68.42[c]	69.95[b]	71.25[ab]	71.27[ab]	72.10[a]	0.644

CON: control; DPL: dry peppermint leaves; AVG: aloe vera gel; DPL+AVG: mixture of DPL + AVG and VM: virginiamycin.
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Mehri *et al.* (2015) reported that adding peppermint powder (10, 20, 30 and 40 g/kg) to feed of Japanese quails could decrease the number of *E. coli* bacteria and increase the number of lactic acid bacteria.

In a similar pattern, Ghazaghi *et al.* (2014) added 3 percent of *Mentha spicata* powder to diet of Japanese quails. The antibacterial effects of peppermint essential oil are associated with menthol (Iscan *et al.* 2002) and antibacterial effects of *Mentha spicata* essential oil is related to carvone. The underlying mechanism of antibacterial property of main elements of those essences which contain Menthol and / or carvone is associated with their hydrophobic property and plasma membranous walls of microbes. Increased amount of some specific ions on or within plasma membrane exerts extensive influence on the driving force of protons, level of intercellular ATP and general activity of microbial cells. The phenol compounds not only invade the cytoplasmic membrane but also remove permeability of the membranes and releases the main intracellular elements. Consequently, they could eliminate electron transfer, absorption of nutritional materials and synthesis of nucleic acid (Mehri *et al.* 2015).

In order to examine the effect of aloe vera on intestinal microflora, Darabighane *et al.* (2012) added aloe vera gel (1.5, 2 and 2.5 percent) to the feed of broiler chickens. Similarly, Lin *et al.* (2005) added aloe vera gel (0.1 percent) to the feed of broiler chickens. Both of these works found out that adding aloe vera increased the number of *Lactobacillus* bacteria and reduced the number of *E. coli* bacteria. Jafarzadeh *et al.* (2015) found out that adding the aloe vera gel powder (0.1, 0.2 and 0.3 percent) to the feed of Japanese quails could increase the number of *Lactobacillus* bacteria and reduce the number of *E. coli* bacteria so that the treatment which received 0.3 percent of aloe vera gel powder had significant increase in the number of *Lactobacillus* bacteria. This improved intestinal microflora population in aloe vera receiving broiler chickens could be due to presence of polysaccharides in the aloe vera.

One of these polysaccharides is Acemannan which is believed to have anti-bacterial characteristics (Christaki and Florou-Paneri, 2010).

In this experiment, the treatment receiving the DPL + AVG significantly increased the number of *Lactobacillus* bacteria compared with other treatments. This could be related to the synergistic effect of peppermint and aloe vera on its antibacterial property. The medicinal plants have different complicated compounds which assign these plants multiple characteristics. When some medicinal plants are consumed together, the synergic effect could reveal more beneficial effects.

In regard to significance of intestinal microflora in health and growth performance of the birds, one should pay attention to the role of intestinal bacterial population on increased potential of immune system of the body. The bacteria which produce lactic acid could contribute to production of antibodies and phagocytic activity against pathogens in intestine and other tissues. Therefore, increased resistance against pathogens could contribute to higher growth of broiler chickens. Another noteworthy point in regard to intestinal microflora population is that intestinal microflora could change intestinal morphology (Pan and Yu, 2014).

Due to anti-microbial properties, medicinal plants can positively influence intestinal morphology and improve absorption of nutritional materials as well as improved growth performance of broiler chickens.

In alignment with the results on FI, in starter, grower and finisher periods as well as for the entire experiment period, the antibiotic receiving treatment had higher FI and BWG than the other experimental treatments. In this regard, Ramiah *et al.* (2014) reported that broiler chickens that had received virginiamycin antibiotic had significantly higher FI and BWG than control treatment. Miles *et al.* (1984) and Miles *et al.* (2006) also reported that adding virginiamycin antibiotic to the feed of broiler chickens increases their body weight. Emami *et al.* (2012) conducted a test on the effects of peppermint essential oil on broiler chickens when compared with administering virginiamycin antibiotic and prebiotics. They suggested that those broiler chickens which had received virginiamycin in their feed had higher FI and body weight than other treatments at 42^{nd} day. The body weight increase of broiler chickens could be associated with higher intake of feed and better absorption of nutritional materials (Belay and Teeter, 1994). Of course, morphological change of intestine (ratio of height of villus to depth of crypt) could be another reason of positive influence of virginiamycin on growth performance of these broiler chickens (Emami *et al.* 2012).

Among the experimental treatments received medicinal plants (DPL, AVG and a DPL+AVG), the highest FI was observed in birds fed AVG or the mixture of DPL + AVG.

The results on BWG also suggest that the BWG of treatments receiving AVG and DPL + AVG was higher than those received DPL and the control treatment. Although DPL increased FI and BWG than the control treatment, but the values of these variables were lower than those treatments which had received AVG, DPL + AVG and the antibiotic. Ocak *et al.* (2008) added 0.2 percent of peppermint powder to feed, Gurbuz and Ismael (2016) added 1.5 percent of peppermint into feed, Dosti *et al.* (2014) put 15 g/kg of peppermint into the feed, Nanekarani *et al.* (2012) added 0.3 percent of ethanolic extract of peppermint in drinking water and Emami *et al.* (2012) poured 200 mg per kilogram of peppermint to the feed; all of them reported that peppermint contributes to growth performance of broiler chickens. In contrast, some studies offer reports on lack of influence of peppermint on growth performance. Mehri *et al.* (2015) added peppermint powder (10, 20, 30 and 40 g/kg) to the rations of Japanese quails. In the same vein, Khaligh Gharetappe *et al.* (2015) adding 0.4 percent of peppermint leaves powder to the feed of broiler chicken had no significant influence on growth performance.

In this experiment, broiler chickens fed the AVG had higher growth performance than the control treatment. Similar finding was reported in previous studies where aloe vera powder or gel was added into feed or aloe vera gel was added into drinking water. Alemi *et al.* (2012) added 0.75 and 1 percent of aloe vera gel powder to the feed of broiler chickens and observed a better growth performance for treatments containing the supplements than the control. In addition, Mmereole (2011) added 1 percent of aloe vera leaves powder to the feed of chickens and reported higher body weight than the control treatment. The addition of 1.5, 2 and 2.5 percent of aloe vera gel to the feed of broiler chickens could increase FI, BWG and FCR in comparison with control treatment (Darabighane *et al.* 2011). In addition, adding aloe vera gel (1.8 percent) to the drinking water of broiler chickens could enhance body weight and FCR in comparison with control treatment (Hassanbeigy-Lakeh *et al.* 2012).

Despite increased FI, BWG and dressing percentage of those treatments which received medicinal plants, their FCR was not different from the control treatment. This finding was also observed for grower, finisher and total experiment period. It seems that some medicinal plants might change the bacterial population of intestine and health status of digestive system because of their antibacterial properties. As a result, the growth performance of these broiler chickens improves. In regard to tests of influence of medicinal plants on poultry and animal, one should note that the environmental factors such as weather, soil composition, and growth stage of a plant could affect the amount of effective materials of plants. In addition, method of preparing the powder, extract or essential oil or herbal parts could influence the effective materials. In conducted tests of influence of medicinal plants on poultry, it is observed that researchers usually use medicinal plants as complement for the mixture or in combination with drinking water. This factor could also influence the growth performance, immune system or intestinal microflora.

CONCLUSION

Based on the findings of the present experiment, one could conclude that adding the powdered leaves of peppermint, aloe vera gel or a mixture of peppermint-aloe vera to the feed of broiler chickens could improve ileum microflora (increase the number of *Lactobacillus* bacteria, reduce the number of *E. coli* bacteria) and improve growth performance of broiler chickens. Despite of the fact that antibiotic receiving treatment had higher growth performance than the birds fed medicinal plants, the application of a mixture of peppermint-aloe vera (5 g/kg dry peppermint leaves and 5 g/kg aloe vera gel) as feed additive could be a suitable alternative for antibiotic growth promoters.

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