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The Effect of an Essential Oil Mix Derived from Oregano, Clove and Anise on Broiler Performance

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Abstract: This study was conducted to explore the usage of essential oil mix (EOM) in broiler nutrition as a natural growth promoting substance instead of antibiotics. Different levels of EOM were added to a standard diet, to determine its effect on feed intake, daily live weight gain and feed conversion ratio compared to control and antibiotic groups. Two hundred and fifty five day-old broilers (Ross-308, n = 250) were divided into five equal groups were as follow: Control group (no EOM or antibiotic), 100 ppm EOM group , 200 ppm EOM group, 400 ppm EOM group with and an Antibiotic group (0.1% Avilamycin). The diets were prepared freshly each day. Experiment carried out 35 days. The feed intake was similar between the groups ($p>0.05$), but the highest daily live weight gain was observed in the 200 ppm EOM group (71.31 g) followed by Antibiotic group (65.84 g), 100 ppm EOM oil group (63.40 g), control group (61.30 g) and 400 ppm EOM group (61.17 g). Thus, daily live weight gain increased in 200 ppm EOM group by approximately 16 % over the control group and approximately 8 % over the antibiotic group. Feed conversion ratio was improved in 200 ppm EOM group by approximately 12 % over the control group and approximately 6 % over the antibiotic group. The results show that, EOM could be considered as a potential natural growth promoter for poultry.

Key words: Essential oil mix, antibiotic, performance, broiler

Introduction

Plants have played a significant role in maintaining human health and improving the quality of human life for thousands of years, and have served humans well as valuable components of seasonings, beverages, cosmetics, dyes, and medicines. The World Health Organization estimated that ≈80% of the earth's inhabitants rely on traditional medicine for their primary health care needs, and most of this therapy involves the use of plant extracts or their active components. Those plants and their components are perceived as “natural” and “safe” by consumers. Such compounds are already established as flavorings in human and animal feeds; however, we now understand that certain materials also have added technical benefits that may be exploited to maintain animal performance. Furthermore, many Western drugs had their origin in a plant extract (Craig, 1999).

After the use of most antibiotic growth promoters as feed additives has been banned by the European Union due to cross-resistance against pathogens and residues in tissues, scientists have searched for alternatives to antibiotics. In this view, aromatic plants and essential oils extracted from these plants are becoming more important due to their antimicrobial effects and the stimulating effect on animal digestive systems. Aromatic plants have been used traditionally in the therapy of some diseases for a long time in the world. Essential oils in aromatic plants are used extensively in medicine and in the food and cosmetic industries. In addition to their antimicrobial activity (Singh *et al*., 2002; Elgayyar *et al*., 2001; Valero and Salmeron, 2003), they posses biological activities such as that of antioxidants (Lopez-Bote *et al*., 1998; Chithra and Leelamma, 1999; Botsoglou *et al*., 2002; Miura *et al*., 2002) and as hypocholesterolemics (Craig, 1999), and stimulate effect on animal digestive systems (Jamroz and Kamel, 2002; Ramakrishna *et al*., 2003) , to increase production of digestive enzymes and improve utilization of digestive products through enhanced liver functions (Langhout, 2000; Williams and Losa, 2001; Hernandez *et al*., 2004). As an aromatic plant, oregano (*Origanum vulgare L.)* has been used in medicine for a long time. Today, the plant is still sometimes used in folk medicine. As a medicinal plant, oregano has been used as a antimicrobial (Dorman and Deans, 2000; Elgayyar *et al*., 2001; Marino *et al*., 1999; Valero and Salmeron, 2003; Burt and Reinders, 2003), anticoccidial (Giannenas *et al*., 2003), antifungal (Pina-Vaz *et al*., 2004; Soliman and Badea, 2002), antispazmolytic (Meister *et al*., 1999) and antioxidant (Lee and Shibamoto, 2002; Miura *et al*., 2002; Youdim and Deans, 1999; Zheng and Wang, 2001). In addition, it has stimulating effect of digestion and antiseptic (Çabuk *et al*., 2003). Similarly, Clove

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Table 1: Composition of standard diets, %

Feeds Ingredients	0 to 7	7 to 14	14 to 21	21 to 28	>28
Corn	49.31	55.08	42.41	47.24	45.49
Wheat	-	-	20.00	20.00	20.00
Soybean meal (44 CP)	25.00	25.00	25.00	1.54	12.20
Full fat Soybean	12.05	10.57	1.55	17.50	10.00
Vegetable oil	0.90	0.63	1.12	1.25	2.47
Fish meal	10.00	5.62	7.00	10.00	7.40
Dicalcium Phosphate	0.46	1.08	0.93	0.58	0.44
Ground Limestone	1.13	0.89	0.90	0.80	0.92
$NaHCO_3$	0.20	0.20	0.20	0.20	0.20
Salt	0.20	0.11	0.06	0.06	0.06
DL-Methionine	0.15	0.22	0.23	0.23	0.25
L-Lysine	0.05	0.05	0.05	0.05	0.02
Choline	0.05	0.05	0.05	0.05	0.05
Vitamin Premix *	0.25	0.25	0.25	0.25	0.25
Mineral Premix**	0.25	0.25	0.25	0.25	0.25
Total	100	100	100	100	100
Analysis					
Dry matter	88.25	88.32	88.41	88.31	88.50
Crude protein	27.0	24.5	22.50	20.50	20.0
Crude fiber	3.46	3.48	3.27	2.83	3.01
Ash	6.61	6.54	6.35	5.69	6.08
Ether Extract	4.84	4.56	4.01	6.57	6.41
Ca	1.09	1.00	1.00	0.96	1.00
P	0.5	0.50	0.50	0.50	0.50
Methionine	0.64	0.65	0.66	0.65	0.65
Lysine	1.57	1.34	1.25	1.05	1.08
ME, Mcal/kg	3.0	3.0	3.1	3.25	3.25

*Vitamin Premix (Rovimix 124/V) supplied per 1 kg: vitamin A, 7 500 IU; cholecalciferol, 1 500 IU; vitamin E, 7 500 IU; menadione, 1.25 mg; vitamin B_1, 0.5 mg; vitamin B_2, 5 mg; niacin, 35 mg; d-pantothenic acid, 10 mg; vitamin B_{12}, 0.1 mg; folic acid, 1 mg; biotin, 50 mg. **Mineral Premix (Remineral CH) supplied per 1 kg: Mn, 40 mg; Fe, 12.5 mg; Zn, 25 mg; Cu, 3.5 mg; iodine, 0.15 mg; Se, 0.75 mg; cholinchloride, 175 mg.

(*Syzygium arimaticum L.*) has been used as an antiseptic (Robenorst, 1996; Çabuk *et al.*, 2003) antimicrobial (Dorman and Deans, 2000; Ouattara *et al.*, 1997; Teissedre and Waterhouse, 2000; Valero and Salmeron, 2003), analgesic and local anesthetic (Feng and Lipton, 1987). In addition, it has appetizing and stimulating effect of digestion (Çabuk *et al.,* 2003), antifungal (Velluti *et al.*, 2003), antipyretic (Feng and Lipton, 1987), antiparasitic (Kim *et al.*, 2004) and antioxidant (Gülçin *et al.*, 2004; Lee and Shibamoto, 2002). As a medicinal plant, anise has been used as a stimulating effect of digestion and antiparasitic (Çabuk *et al.,* 2003) antibacterial (Singh *et al.*, 2002; Tabanca *et al.*, 2003), antifungal (Soliman and Badea, 2002) and antipyretic (Afifi *et al.*, 1994).

Very few, performance in animal studies have been conducted on essential oils. In this study, we aimed the use of essential oil mix derived from oregano, clove and anis in animal nutrition as a natural growth promoting substance instead of antibiotics. For this purpose, the different level of essential oil mix were added in standard diet, and studied to determine of effect on performance compared to control and antibiotic groups.

Materials and Methods

Two hundred and fifty five day-old broilers (Ross-308) were divided into five treatment groups of 50 birds each and randomly assigned to the five treatment diets. Experiment was carried out 35 days. Each treatment group was further sub-divided into five replicates of 10 birds per replicate. The presence and levels of EOM and antibiotic in diets were the main factors tested. In the control group the birds were fed a standard diet (20-27.0 % CP and 3.0-3.25 MCal ME/kg) (Control group). Three different levels of EOM (Özdrog Co., Hatay, TURKEY) or an antibiotic (Avilamycin, Kartal Kimya, TURKEY) were added to the standard diets to generate the other four treatment groups. For the EOM treatments, 100 ppm (100 EOM group), 200 ppm (200 EOM group), and 400 ppm (400 EOM group) EOM were added to the standard diets. In the antibiotic treatment, the feed contained 0.1 % (10 mg/kg) antibiotic. Vegetable oil was used as fat source. EOM was dissolved in vegetable oil and than gently mixed with the standard diets. Antibiotic was

Table 2: The effect of diets varying in amounts of essential oil mix and antibiotic on the daily feed intake of broilers (g/bird/day) (n=5)

		EOM, ppm				
Weeks	Control	100	200	400	Antibiotic	P
1	41.86	42.09	42.63	43.27	41.77	NS
2	72.62	73.25	74.39	75.86	72.05	NS
3	93.69[b]	93.63[b]	96.61[a]	97.75[a]	94.99[ab]	*
4	132.19	132.62	134.68	135.93	132.69	NS
5	152.46	152.81	154.93	155.21	152.39	NS
0-5	98.56	98.88	100.61	101.60	98.78	NS

NS: Non significant, *: P<0.05, [a,b]: Mean values with different superscripts within a row differ significantly.

mixed carefully with the standard diet. The diets were prepared freshly each day. The EOM contained three different essential oils derived from oregano (*Origanum vulgare L.*) (90% purity), clove (*Syzgium aromaticum*) (85-90% purity) and anise (*Pimpinella anisum L.*) (87.5-90% purity). The diets were isocaloric and isonitrogenous. The ingredient and chemical composition of the diets are presented in Table 1. The diets and water were provided *ad libitum*.

Ten broilers were kept in 25 pens (1.5 x 1.5 m) ventilated broiler house containing straw as litter material. A photoperiod of 24 h/d in 4 week and 14 h/d in 4-6 was maintained. The birds were housed together first 5 d. The body weights of the birds were measured at 5, 12, 19, 26, 33 and 40th days of the experiment. Feed intake was recorded biweekly. Feed conversions ratio was calculated at the end of the 40 day experimental period. There was no mortality in any group during the trial.

Chemical composition of feed ingredients (dry matter, crude protein, ash and ether extract) as dried samples were analyzed using AOAC (1990) procedures, and crude fiber was determined by the methods of Crampton and Maynard (1983).

Data collected were subjected to analysis of variance, and where significant differences were observed, means were further subjected to Duncan's multiple range test by using SPSS for Windows: 10.1, SPSS inc., (1999). The results were considered as significant when p values were less than 0.05 and 0.01.

Results and Discussion

The effect of EOM and antibiotic on the feed intake is presented in Table 2. From 1-5 weeks feed intake was similar between groups but, a linear improvement was observed in EOM groups to be parallel amount of EOM in diet. This improvement may be due to the appetizing effect of active ingredient (such as *carvacrol, thymol, eugenol* and *anethole*) in EOM (Çabuk *et al.*, 2003).

The effect of EOM and antibiotic on daily live weight gain is presented in Table 3. At the end of the 5 week, daily live weight gains differed (p<0.05) between treatments. The highest live weight gain was recorded in 200 EOM group (71.31 g), followed by antibiotic group (65.84 g), 100 EOM group (63.40 g), control group (61.30 g) and 400 EOM group (61.17 g) (P<0.05). The live weight gains of birds fed the diets containing 100 and 400 ppm EOM were lower than those of the birds on the diet containing 200 ppm EOM (p<0.05). The addition of 200 ppm EOM to the diets was improved daily live weight gain by approximately 16 % compared to the control group. This improvement remained at 7.4 % level in antibiotic group and at 3.4 % level in 100 ppm EOM group. Furthermore, addition of 200 ppm EOM to the diets improved daily live weight gain by approximately 8 % compared to the antibiotic group.

The effect of EOM and antibiotic on feed conversion ratio is presented in Table 4. From weeks 1 to 5, feed conversion ratios differed significantly between the groups (p<0.05). Addition of 200 ppm EOM to the diets improved feed conversion ratio by approximately 12 % compared to the control group. This improvement remained at 6.8 % level in antibiotic group and at 0.9 % level in 100 ppm EOM group. Compared to the antibiotic group, addition of 200 ppm EOM to the diets improved feed conversion ratio by approximately 3.7%.

As shown, daily live weight gain and feed conversion ratio were increased statistically in 200 EOM group compared to the control and antibiotic groups. These differences among the groups may be due to active ingredient such as *thymol* and *carvacrol* in oregano oil, *eugenol* in clove and *anothole* in anise. Because, *thymol carvacrol, eugenol* and *anothole* have digestive stimulating effects (Çabuk *et al.*, 2003). Besides, *thymol*, *carvacrol*, *eugenol and anothole* affected pathogen microorganism in the digestive system and increased live weight gain and feed conversion. Essential oils derived from oregano, clove and anise have been reported to posses antimicrobial (Dorman and Deans, 2000; Valero and Salmerom, 2003; Burt and Reinders, 2003; Singh *et al.*, 2002; Tabanca *et al.*, 2003), anticoccidial (Giannenas *et al.*, 2003), antifungal (Pina-Vaz *et al.*, 2004; Soliman and Badea, 2002; Velluti *et al.*, 2003) and antioxidant effects (Lee and Shibamoto, 2002; Gülçin *et al.*, 2004). Additionally, clove and anise have been used as an antiparasitic (Kim *et al.*, 2004; Çabuk *et al.*, 2003) and antipyretic agents (Feng and Lipton,

Table 3: The effect of diets varying in amounts of essential oil mix and antibiotic on the daily live weight gain of broilers (g/bird/day) (n=50)

		EOM, ppm				
Weeks	Control	100	200	400	Antibiotic	P
1	31.41	32.31	34.24	32.60	32.69	NS
2	50.48^{c}	52.49^{b}	60.74^{a}	53.55^{b}	55.60^{b}	*
3	70.93^{c}	75.59^{bc}	85.35^{a}	73.75^{bc}	78.08^{b}	*
4	78.56^{c}	83.78^{b}	89.51^{a}	79.60^{c}	83.52^{b}	*
5	75.12^{c}	72.85^{c}	86.75^{a}	66.38^{d}	79.32^{b}	*
0-5	61.30^{c}	63.40^{bc}	71.31^{a}	61.17^{c}	65.84^{b}	*

NS: p>0.05, *: P<0.05, ^{a,b,c}: Mean values with different superscripts within a row differ significantly

Table 4: The effect of diets varying in amounts of essential oil mix and antibiotic on the feed conversion ratio g feed/g gain, (n=5)

		EOM, ppm				
Weeks	Control	100	200	400	Antibiotic	P
1	1.33^{a}	1.30^{b}	1.24^{d}	1.32^{a}	1.28^{c}	*
2	1.44^{a}	1.39^{a}	1.22^{c}	1.41^{a}	1.30^{b}	*
3	1.32^{a}	1.23^{b}	1.13^{c}	1.32^{a}	1.22^{b}	*
4	1.68^{a}	1.58^{c}	1.50^{c}	1.70^{a}	1.59^{b}	*
5	2.03^{a}	2.09^{b}	1.78^{c}	2.33^{a}	1.92^{b}	*
0-5	1.61^{a}	1.55^{b}	1.41^{c}	1.66^{a}	1.50^{b}	*

*: P<0.05, ^{a,b,c,d}: Mean values with different superscripts within a row differ significantly.

1987; Afifi *et al*., 1994). The improved feed utilization in 200 ppm EOM group in our study could be due to these positive effects of essential oils on the digestive system. The reason of reducing in 100 ppm EOM group may be due to low essential oil concentration in digestive system and high essential oil concentration in 400 ppm EOM group could be affected negatively digestive system. Besides, essential oils positively affected digestibility of nutrient. For example, essential oils increase digestion of protein, cellulose and fat (Jamroz and Kamel, 2002), improve apparent whole-tract and ileal digestibility of the nutrients (Hernandez *et al*., 2004) and increase the effects of pancreatic lipase and amylase (Ramakrishna *et al*., 2003). The improved daily live weight gains and feed conversion ratios of birds fed the diets containing 200 ppm EOM in this study agreed with results reported in literatures. Alçiçek *et al*. (2003) reported that addition of essential oil combination (derived from oregano, laurel, sage, myrtle, fennel and citrus) at 48 mg/kg level improved body weight and feed conversion ratio compared to control and antibiotic groups in broiler. Similarly, Ather (2000) reported that broiler performance was improved when using a poly herbal premix which contained five herbs. These results are in agreement with results of studies in which different essential oils were added to poultry diets. In these studies essential oils derived from different aromatic plants have been reported to improve feed intake, feed conversion ratio and carcass yield (Hertrampt, 2001; Williams and Losa, 2001; Tucker, 2002, Alçiçek *et al*., 2003, Bassett, 2000, Giannenas *et al*., 2003: Ather, 2000).

Unfortunately, reports on the value of essential oils in poultry are limited. This study showed that the supplementation of 200 ppm essential oil mix (include oregano, clove and anise oils) in broiler diets significantly improves the daily live weight gain and feed conversion ratio during a growing period of 5 week. Thus, essential oil mix could be considered as a potential growth promoter for poultry due to digestive stimulating effect, and antimicrobial effect, and positive effect on performance.

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