Original Research

Effect of Ginger and Thyme Essential Oils as an Alternative to Antibiotic Growth Promoters on Performance, Immune Status and Economics of Broiler Production

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Rec. Date:	Sep 04, 2018 00:34
Accept Date:	May 18, 2019 06:38
DOI	10.5455/ijlr.20180904123407

Abstract

An experiment was conducted on 300 day old Vencobb-400 straight run chicks which were weighed and distributed randomly into five treatment groups viz. A, B, C, D, and E with four replicates of 15 chicks each. The treatment group A was without essential oil and antibiotic. The treatment groups B was with growth promoting antibiotic (BMD) @ 30 mg/kg of feed and without EOs. The treatment groups C, D and E were with Thyme oil @50mg /kg, Ginger oil @25mg/kg and Thyme oil @50mg /kg + Ginger oil @25mg/kg of feed, respectively. The cumulative weight gain was significantly affected (P <0.05) by supplementation of essential oils, however, feed consumption and feed conversion ratio were found to be non-significant. Ginger oil @ 25mg/kg supplemented group (D) had numerically higher antibody titer against IBD but the differences were statistically non-significant. The net profit per bird was highest for ginger oil group D compared to control. The results inferred that ginger oil @ 25 mg/kg of feed improved profitability and immune status. It may be used as alternative to antibiotic growth promoters.

Key words: AGP, Broiler Performance, Economics, Essential Oil, Immune Status

How to cite: Aniket, S., Nikam, M., Dhumal, M., Deshpande, K., & Gaikwad, S. (2019). Effect of Ginger and Thyme Essential Oils as an Alternative to Antibiotic Growth Promoters on Performance, Immune Status and Economics of Broiler Production. International Journal of Livestock Research, 9(7), 32-39. doi: 10.5455/ijlr.20180904123407

Introduction

In past several years, antibiotic growth promoters had been used in poultry feed aiming to improve growth performance and to increase some useful microorganism in intestinal microflora. However, because of emergence of bio-resistance, researchers are now exploring alternatives in place of antibiotic growth promoters. Essential oils (EOs) are found to have antibacterial ability, and also exhibit growth promoting

(Kansal *et al.*, 2017), antioxidant, anti-inflammatory, anti-carcinogenic, digestion stimulating, and hypolipidemic activities (Gomathi *et al*., 2017).

Thyme (*Thymus vulgaris L*.) is a popular medicinal plant belonging to *Lamiaceae sp*. and it has been paid more attention due to its antibacterial (Dorman and Deans, 2000), anticoccidial and antifungal properties (Jamroz *et al*., 2003). Volatile oils from thyme were assessed as inhibitors of microbial growth (Toghyani *et al*., 2010). The major active components of thyme plant are thymol and carvacrol with antibacterial activities and exhibit beneficial effects in poultry health and production (Demir *et al.*, 2008). Ginger (*Zingiber officinale*) is widely used in many countries as a food condiment and as a medicinal herb (Chrubasik *et al.*, 2005). The main important compounds in Ginger are gingerol, gingerdiol and gingerdione which have the ability to stimulate digestive enzymes, affect the microbial activity (Dieumou *et al*., 2009). The pungent taste of ginger is caused by gingerol that aids digestion (Jolad *et al.*, 2004; Shariq *et al*., 2011). There are few reports dealing with single and combined effects of thyme and ginger on performance and immune response in chicken. Hence, experiment was planned to evaluate effects of thyme and ginger EOs through diets on growth performance of broilers.

Materials and Methods

Experimental Site

The experiment was approved by Institutional Animal Ethics Committee vide resolution no. IAEC/28/18 dated 11/05/2018. The experiment was carried out at Department of Poultry Science, COVAS, Parbhani, affiliated to MAFSU, Nagpur, India.

Formulation of Experimental Ration

The feed ingredients were purchased from local market and rations were prepared as per BIS (2007), at feed mixing plant, Department of Poultry science, COVAS, Parbhani, MAFSU, Parbhani (Table 1). The pre-starter, starter and finisher rations were offered for first seven days, 8th day to 20thday and thereafter up to 42nd day of age, respectively. The *iso-caloric and iso-nitrogenous* diets were formulated for all the treatment groups. Ginger and thyme essential oils were purchased from M/s Fame drugs, Shastrinagar, Meerut (U.P.) and added in the feed at dose levels: ginger @ 25mg per kg and thyme @ 50mg per kg of feed. Similarly, ginger and thyme were also used in combination with the same dose levels.

DOI 10.5455/ijlr.20180904123407

Table 1: Percent ingredient and nutrient composition of (basal diet) pre-starter, starter and finisher rations with supplementation of Eos

Feed Ingredients	Pre-Starter	Starter	Finisher
Maize	55.45	55.2	60.2
*Vegetable oil	1.6	3	4
Soya-bean meal	40.15	39	33
Di-calcium phosphate	1.5	1.5	1.5
Limestone powder	1	1	1
Salt	0.3	0.3	0.3
Total	100	100	100
Supplements/Additives (g/100kgs)			
Mineral mixture	300	300	300
Vitamin mixture	150	150	150
Methionine	180	190	160
Lysine	170	130	100
Choline chloride	60	60	60
Coccidiostat	60	60	60
Nutrient Composition Calculated			
Crude protein (%)	23.05	22.12	20.26
Metabolizable energy (Kcal/kg)	3015.32	3101.82	3213.32
Analyzed Nutrient Composition			
Dry matter %	24.53	22.56	20.53
Crude Protein %	93.77	93.56	93.18
Total Phosphorus %	0.68	0.61	0.68
Calcium %	1.17	1.12	1.16

**An essential oil was added in vegetable oil in the diet as per the dose rate mentioned in experimental design.*

Experimental Birds and Data Collection

The experiment was carried out on 300-day old Vencobb-400 broiler chicks for duration of 42 days. The chicks were weighed and distributed randomly into five treatment groups *viz.* A, B, C, D and E with four replicates of 15 chicks each. Experimental design used for housing of broilers is presented in Table 2. The feeding, watering, floor space and vaccination schedule were provided as per standards.

Table 2: Experimental design for housing of broilers with supplementation of EOs

Treatment Group	Treatment Group Details	No. of Birds/Pen/Replication	No. of Replications	Total No. of Birds
A	Control –Basal Diet	15	4	60
B	Basal diet + 30 mg/kg BMD*	15	4	60
C	Basal diet + 50 mg/ kg thymol oil	15	4	60
D	Basal diet + 25 mg/kg ginger oil	15	4	60
E	Basal diet +50 mg/kg thymol oil + 25 mg/kg ginger oil in combination	15	4	60
	Total	5	20	300

** Bacitracin methylene disalicylate*

DOI 10.5455/ijlr.20180904123407

Performance Parameters

The weight gain, feed consumption and FCR were recorded replicate wise at weekly interval. The economics of broiler production was calculated by consideration the cost of chick, cost of feed, litters, vaccination and medication. However, gross profit per bird was calculated by subtracting the cost of production per bird from the price fetched per bird.

Immune Status

IBD Titre

An indirect ELISA for IBD antibody test kit was developed by PDRC (Poultry Diagnostic and Research Centre, Pune) and ELISA antibody titre against IBD (Infectious Bursal Disease) was estimated at PDRC laboratory, Pune.

Statistical Analysis

Data, thus collected, was subjected to statistical analysis by using Randomized Block Design as described by Snedecor and Cochran (2002). The treatment means were compared by critical differences (CD) and analysis of variance.

Results and Discussion

Cumulative Weight Gain

Significant ($P < 0.05$) influence on cumulative weight gain was observed. The improvement in weight gain for thyme and ginger Eos groups were found due to important role of EOs in promoting growth stimulating activity (Lee *et al.*, 2003) compared to control. However, combination of EOs suppressed weight gain indicating no synergetic action. Similar findings were recorded by Abdulkarimi *et al.* (2011), Rahimi *et al.* (2011), Saleh *et al.* (2014) and Attia *et al.* (2017). In contrast, significant influence on weight gain by supplementation of either thyme or ginger EOs were revealed (Feizi *et al*., 2013; Habibia *et al*., 2014; Saki *et al*., 2014; Pati *et al*., 2015 and Wade *et al*., 2018).

Cumulative Feed Consumption

From the data (Table 3 and Table 4) it was observed that cumulative feed consumption was found to be non-significant. However, decreased feed consumption was observed for combination of thyme and ginger Eos indicating no synergistic effect. The results in present study are in agreement with the findings of Nidaullha *et al.* (2010), Onu *et al.* (2010), Toghyani *et al.* (2010), Abdulkarimi *et al.* (2011), Bemidele *et al.* (2012), Ali (2014) and Wade *et al.* (2018). In contrast, Feizi *et al.* (2013), Saleh *et al.* (2014), and Attia *et al.* (2017) revealed significantly decreased feed intake by either thyme or ginger. However, Pati *et al.* (2015) and Karangiya *et al*. (2016) reported significantly higher feed intake.

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Table 3: Cumulative weight gain (g), feed consumption (g) and FCR in broiler at different age groups supplemented with EOs

Age (weeks)	Groups/Treatments				
	Cumulative Weight Gain				
	A	B	C	D	E
	(Control diet)	Basal diet + 30 mg/kg BMD*	Basal diet + 50 mg/ kg thymol oil	Basal diet + 25 mg/kg ginger oil	Basal diet +50 mg/kg thymol oil + 25 mg/kg ginger oil in combination
I	59.67	58.57	53.7	56.88	55.87
II	238.73	237.48	233.03	238.48	213.32
III	496.45	505.58	504.57	506.1	407.2
IV	861.08	864.18	791.1	864.42	731.26
V	1247.9	1230.96	1180.62	1246	1151,83
VI	2120.86	2247.2	2144.38	2166.22	1936.37
Overall Mean	**837.449^{b}**	**860.306^{b}**	**817.900^{b}**	**846.351^{b}**	**749.307^{a}**
Cumulative Feed Consumption					
I	69.57	60.52	56.6	63.47	59.07
II	288.98	290.88	282.63	286.5	262.73
III	648.12	647.25	641.76	646.08	523.6
IV	1213.93	1207.77	1046.05	1153.85	1055.74
V	1837.95	1858.03	1761.61	1803.97	1801.79
VI	3482.79	3633.72	3556.77	3456.96	3397.92
Overall Mean	**1153.871**	**1175.153**	**1117.177**	**1127.457**	**1096.209**
Cumulative FCR					
I	1.17	1.03	1.05	1.12	1.07
II	1.21	1.22	1.21	1.2	1.23
III	1.31	1.28	1.27	1.28	1.29
IV	1.41	1.4	1.32	1.34	1.44
V	1.47	1.51	1.49	1.45	1.57
VI	1.65	1.62	1.66	1.62	1.76
Overall Mean	1.37	1.34	1.33	1.33	1.39

Table 4: Antibody titre against infectious bursal disease (IBD) at 21stand 28th day of age of broiler supplemented with EOs

Treatments	Infectious Bursal Disease (IBD)			
	21st day		28th day	
	Mean	SE	Mean	SE
A	428.5	107.419	336.5	108.948
B	500.75	179.709	388.75	146.733
C	521	127.209	410.5	117.875
D	735.25	170.241	642	165.903
E	676.5	93.204	581.75	91.521
CD	N.S.		N. S.	
CV%	48.838		54.669	

 DOI 10.5455/ijlr.20180904123407

Feed Conversion Ratio

The superior cumulative feed conversion ratio was observed for treatment group D compared to rest of the treatment groups; however, the differences were non-significant. The findings are in close agreement with Toghyani *et al*. (2010), Abdulkarini *et al.* (2011), Pati *et al*. (2015), Attia *et al.* (2017) and Wade *et al*. (2018). On the other hand, Onu *et al.* (2010), Barazesh *et al.* (2013), Feizi *et al.* (2013), Hashempour *et al.* (2014), Ali (2014), Awaad *et al.* (2014) Saleh *et al.* (2014) and Narender *et al*. (2018) recorded improvement in FCR by supplementation of thyme and ginger. It may be due to positive effect of thyme and ginger EOs on nutrient digestibility.

Immune Status

IBD Titre

Non-significant influence of thyme and ginger essential oils on antibody titer against infectious bursal disease (IBD) was observed. It may be due to low dose levels which are in accordance with Saki *et al.* (2014). They revealed that the mean titer of serum antibodies of IBD did not recorded significant differences between different treatments at 21st and 42nd day of age. However, Nidahullah *et al.* (2010), Saleh *et al.* (2014) and Attia *et al.* (2017) reported higher ($p<0.01$) IBD titer in thyme oil groups than control.

Economics of Broiler Production

The results inferred that the diet supplemented with antibiotic and ginger EOs recorded highest net profit per bird. Similarly, Wade *et al*. (2018) revealed highest profitability with diet supplemented thyme oil compared to control. In contrast, Karangiya *et al.* (2016) revealed a significantly lower return over feed cost in ginger treated group as compared to control.

Table 5: Economics of broiler production supplemented with essential oils

S. No.	Particulars	A	B	C	D	E
1	Chick cost (Rs)	35	35	35	35	35
2	Feed consumption	3482.79	3633.72	3556.77	3456.96	3397.92
3	Feed cost /bird	98.6	102.88	101.58	98.68	97.78
4	Misc. cost (Rs)	7	7	7	7	7
5	Production cost	140.6	144.88	143.58	140.68	139.78
6	Av. Live wt. (g)	2155.61	2282.95	2180.13	2201.47	1972.37
7	Sale receipt @ 83/kg wt	178.86	189.4	180.84	182.68	163.76
8	Net profit/ bird	38.26	44.52	37.26	42	23.98

Conclusion

The present study it can be concluded that the supplementation of ginger Eos @ 25 mg/kg of feed improved the growth performance, immune status and profitability, followed by thyme Eos @ 50 mg/kg of feed. Both

 DOI 10.5455/ijlr.20180904123407

ginger and thyme essential oils may be used as an alternative to commercial growth promoting antibiotic (BMD) through broilers feed.

Acknowledgement

The authors are highly grateful to Dr. N. M. Markandeya, Associate Dean, College of Veterinary and Animal Sciences, MAFSU, Parbhani for providing necessary facilities and for her help at various stages of the experiment. The authors are also thankful to Poultry Diagnostics and Research Institute, Pune for providing facilities for serum estimation.

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 DOI 10.5455/ijlr.20180904123407