Annual Research &Review in Biology
4(24): 4336-4343, 2014

SCIENCEDOMAIN *international*
www.sciencedomain.org

The Effect of Savory (*Satureja khuzistanica*) Essential Oils on Performance and Some Blood Biochemical Parameters of Ross and Cobb Broilers

Majid Goodarzi[1*], Nosratollah Mohtashami Pour[1] and Davood Modiri[1]

[1]Department of Animal Science, College of Agriculture, Boroujerd Branch, Islamic Azad University, Boroujerd, Iran.

Authors' contributions

This work was carried out in collaboration between all authors. Authors NMP and MG designed the study. Author MG performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author NMP managed the analyses of the study. Author DM managed the literature searches. All authors read and approved the final manuscript.

Original Research Article

Received 13th June 2014
Accepted 20th July 2014
Published 10th August 2014

ABSTRACT

This experiment was conducted to compare the performance and some blood biochemical parameters of Ross and Cobb broilers fed diets containing savory essential oils (SEO). Two hundred twenty four, 1-d-old broiler chickens (mean initial weight: 36.5±1g) of mixed sex (Ross-308 and Cobb) were randomly assigned to each of the 4 treatment groups, each with 4 replicate pens of 14 chicks. The experimental groups included two treatments for Ross strain – control (RC) and the group contain 500mg/Kg SEO (RS) - and two treatments for Cobb strain –control (CC) and the group contain 500mg/Kg SEO (CS). To measure some blood biochemical parameters at the age of 30 days, from each repetition, two broilers were selected and blood sampling was performed through a wing vein.As a result of this study fed essential oil in diet had not significant effect on feed intake, but DBWG (54.10 and 55.00 for RS and CS respectively) and FCR (1.8 and 1.75 for RS and CS respectively) improved significantly (P≤0.5). Broilers receiving SEO had a significantly (p≤0.05) lower cholesterol, HDL and glucose concentrations compared to control groups. In general, the results indicate that dietary inclusion of 500 mg/kg savory essential oils can

**Corresponding author: Email: majidgoudarzi117@gmail.com;*

improve performance and some blood biochemical parameters in Ross and Cobb broiler strains.

Keywords: Blood biochemical parameters; cobb strain; performance; ross strain; savory essential oil.

ABBREVIATIONS

SEO = Savory Essential Oil; FCR = Feed conversion ratio; HDL = High-density lipoprotein; LDL = Low-density lipoprotein; BW = Body Weight; ADFI = Average daily feed intake; SEM = Standard error of mean.

1. INTRODUCTION

For the past several decades, different strategies have been used to improve poultry productivity and profitability. Subtherapeutic feeding of antibiotics has historically been a practice in some sectors of the commercial broiler industry to promote growth performance and protect flock health [1]. Recently, the use of antibiotic growth promoter has been banned in many countries for prevent the risk of developing bacteria resistant and the entrance of drug residues into the food [2]. As a result of new alternatives are being introduced to livestock producers, among which phytogenic and herbal products have been given considerable attention as possible in-feed antibiotics substitutions. In recent years, the use of phytogenic compounds has gained momentum for their potential role as natural alternatives to antibiotic growth promoters in animal nutrition [3].

Satureja khuzistanica - known as 'marzehkhuzestani' in Iran- is an annual, herbaceous aromatic and medicinal plant belonging to the Lamiaceae family distributed in the southwest of Iran [4]. *Satureja khuzistanica* (savory) is well known for its therapeutic values as an analgesic and antiseptic in traditional medicine [5]. This plant has up to 4.5% essential oil that contains considerable amounts of two phenolic ketones known as carvacrol and thymol [6]. It has been also reported that this plant contains other compounds such as phenols, flavones, triterpenoids, steroids, and tannins [7]. It has been shown that the essential oils of *Satureja spp*. have anti inflammatory [8], antispasmodic, anti diarrhea [8] and antioxidant [9] effects in mammals, as well as antiviral [10], antibacterial, and antifungal [11] effects, mainly in vitro. The present study was designed to survey the effect of high dose (base on previous reports) of essential oils of *Satureja khuzistanica* on growth performance and some blood biochemical parameters of Ross and Cobb broiler chickens. Due to the using one level, we used high dose of essential oils.

2. MATERIALS AND METHODS

2.1 Animals and Feeding

Two hundred twenty four, 1-d-old broiler chickens (mean initial weight: 36.5±1g) of mixed sex (Ross-308 and Cobb) were randomly assigned to each of the 4 treatment groups, each with 4 replicate pens of 14 chicks. The experimental groups included two treatments for Ross strain – control (RC) and the group contain 500mg/Kg SEO (RS) - and two treatments for Cobb strain –control (CC) and the group contain 500mg/Kg SEO (CS). Table 1 lists the basal diet formulated according to the nutrient requirements (NRC 1994) of broilers base on digestible amino acids. The savory essential oils were prepared from a local market. Chicks

were raised on floor pens (120 × 120 × 80 cm) for 6wk and had free access to feed and water throughout the entire experimental period. The lighting program included of 23h light plus 1h of darkness. The house temperature was maintained at 32ºC during the first week, and it was decreased by 3ºC in following weeks until it was stabilized at 22ºC.

2.2 Performance

The live weight and feed intake of birds were determined at 1 day and the end of starter (10 d), grower (20d) and finisher (42 d) periods. Average daily feed intake (ADFI), average daily weight gain (ADWG) and feed conversion ratio (FCR) was calculated. Mortality was recorded as it occurred and ware used to adjust the total number of birds to determine the total feed intake per bird and FCR.

2.3 Biochemical Analysis

At the end of experimental period after 12h of fasting, blood samples were collected in non-heparinised tubes from 2 birds in each replicate by puncturing the brachial vein. Then the blood sample was centrifuged at 2000×g for 15 min to obtain serum (SIGMA 4 - 15 Lab Centrifuge, Germany). Individual serum samples were analyzed for glucose, total cholesterol, high-density lipoprotein (HDL), low- density lipoprotein (LDL) cholesterol, urea and creatinine. A Pars Azmoon Kit (Hitachi Analyzer 902, Germany) was employed to perform the tests.

Table 1. Composition of experimental diets

Item	Starter (0-14)	Grower (15-28)	Finisher (29-42)
Ingredient, g/kg			
Corn	554.6	591.0	629.2
Soybean meal (43.8%)	363.0	319.2	275.1
Fish meal (65%)	25.0	25.0	25.0
Soybean oil	20.0	29.3	38.2
Mono calcium phosphate	12.7	12.1	11.0
CaCO3	12.0	11.1	9.8
NaHCO3	0.1	0.1	0.1
NaCl	2.1	1.9	1.8
Mineral premix	2.5	2.5	2.5
Vitamin premix	2.5	2.5	2.5
DL-Methionine	2.6	2.5	2.1
L-Lysine	2.1	2.0	1.8
L- Threonine	0.3	0.3	0.4
Choline	0.5	0.5	0.5
Metabolizable energy (kcal/kg)	2925	3025	3125
Crude protein (g/kg)	223	203	186
Calcium (g/kg)	9.8	9.3	8.6
Available phosphorus (g/kg)	4.8	4.5	4.2
Digestible Methionine(g/kg)	5.5	5.1	4.5
Digestible Lysine(g/kg)	11.5	1.5	9.4
Digestible Methionine + Cysteine (g/kg)	8.5	7.9	7.25
Digestible Threonine (g/kg)	7.3	6.8	6.3

1- Ingredients per kg: Mg, 60g; Fe, 80g; Cu, 10g; Zn, 50g; Co, 2g; I, 1 g,2- Ingredients per kg : vitamin A, 1000,000 IU; D3, 1500000 IU; E, 15000 IU; K, 3g; B1 2g; B2, 4 g; B6, 3g; B12, 0.015g; pantothenic acid, 10g; nicotinic acid, 2g; folic acid, 1 g; choline, 250g ; Se, 100g

2.4 Statistical Analysis

The experimental data were statistically analyzed as a completely randomized design using the General Linear Model procedures of SAS Institute [12]. The mean differences among different treatments were compared using Duncan multiple test. Statements of statistical significance are based on $P \leq 0.05$.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The experimental data about performance have been shown in Table 2. The impact of experimental treatment on feed intake was significant ($p \leq 0.05$) only in starter period, but it was not significant in grower, finisher and total periods. The using SEO in diet resulted in decreasing feed intake for both strains. This reduction in feed consumption in starter period may be due to unpalatability and adaptation with SEO. Even though fowl have far less number of taste buds than mammals, they do have an acute sense of taste and changes in taste [13].

The ADWG increased significantly ($p \leq 0.05$) for grower, finisher and total periods by using SEO in diet. In total period, the highest and the lowest amount of ADWG were related to CS and RC treatments respectively. The average daily weight gain was greater for the Cobb than the Ross strain.

Broilers receiving SEO had a lower FCR compared to controls groups in different experimental periods. The best and the worst FCR were related to CS and RC treatments respectively. In general, FCR was better in Cobb strain than the Ross strain. No differences because of treatment effects were observed on mortality.

The use of SEO in diet resulted to significantly reduction of glucose concentration. It is possible that the SEO stimulated growth of broilers by increasing the inflow of glucose into tissue, thyroid hormone like activity [14]. The better performance can be the consequence of improving the balance of gastrointestinal microflora. Jamroz et al. [15] showed the reduction of E. coli, Clostridium perfringens and fungi and increasing *Lactobacillus spp* population in gut by using 100mg/kg plant extract consisting of capsaicin, cinnamaldehyde and carvacrol (predominant constituent of essential oils in savory). It is believed that the activity of the intestinal micro biota in the host is an important factor that may impact gut function. Unsuitable micro flora population in the gastrointestinal tract will lead to unfavorable nutrient absorption [16] and the increasing energy requirements for maintenance [17]. This may be a possible mechanism for higher growth and better FCR in broiler consuming SEO. Also, Khosravinia [18] reported that the using 0.3g/L carvacrol in drinking water increased serum testosterone in broilers. The elevated serum testosterone can be a possible mechanism for better performance at our experiment. The results of the present experiment are consistent with Ghalamkari et al. [19] who by using 5g/Kg savory in diet observed positive effect on body weight. In contrast to this report, Khosravinia et al. [20] observed negative effect on performance parameters by using different levels of essential oils of *Satureja khuzistanica* into drinking water.

Table 2. Effect of treatments on performance parameters of broilers

Performance parameters	Diets				
	RC	RS	CS	CC	SEM[5]
DFI[1]					
0-14 d	31.14^{b}±0.21	29.59^{c}±0.32	30.04^{c}±0.27	32.01^{a}±0.20	0.125
14-28 d	107.00±2.49	105.00±2.60	103.00±0.32	104.00±2.44	0.981
28-42 d	159.00±1.37	157.00±1.70	156.00±1.45	157.00±4.81	1.170
0-42d	98.99±1.02	97.27±1.43	96.14±0.18	97.12±2.09	0.590
DWG[2]					
0-14d	20.57^{ab}±0.21	20.07^{b}±0.12	20.29^{b}±0.10	20.93^{a}±0.19	0.078
14-28d	61.14^{b}±1.18	63.07^{ab}±0.45	64.29^{a}±0.50	63.50^{ab}±1.41	0.440
28-42d	73.50^{b}±1.99	79.14^{a}±0.69	80.43^{a}±1.58	73.57^{b}±0.94	0.650
0-42d	51.74^{c}±1.09	54.10^{ab}±0.45	55.00^{ab}±0.59	52.67^{bc}±0.13	0.283
FCR[3]					
0-14 d	1.51^{ab}±0.01	1.47^{b}±0.02	1.48^{b}±0.01	1.53^{a}±0.02	0.008
14-28 d	1.75^{a}±0.02	1.66^{b}±0.03	1.60^{c}±0.01	1.64^{b}±0.01	0.009
28-42 d	2.16^{a}±0.07	1.98^{b}±0.03	1.94b^{c}±0.04	2.13^{a}±0.09	0.029
0-42d	1.91^{a}±0.02	1.80^{bc}±0.02	1.75^{c}±0.02	1.84^{ab}±0.04	0.013
BW[4](g)					
14d	288.00^{ab}±2.89	281.00^{b}±1.62	284.12^{b}±1.34	293.06^{a}±2.60	1.056
28 d	1144.20^{bc}±16.49	1164.00^{b}±6.28	1184.10^{a}±7.03	1182.60^{a}±19.8	6.200
42d	2173.017^{c}±45.69	2272.00^{ab}±19.08	2310.00^{a}±24.83	2212.20^{b}±5.51	9.390

Values in the same row not sharing a common superscript differ significantly (P≤0.05). RC=Ross control; RS= Ross+ savory essential oils; CS= Cobb + savory essential oils CC=Cobb control
1.Daily Feed Intake (g per bird/day).2.Daily Weight Gain (g/day) 3. Feed Conversion Ratio (g/g).4. Body Weight (g) 5.Standard error of mean

3.2 Serum Biochemistry

Table 3 summarizes the impact of treatments on serum constituents at day 42 of age. Treatments had significant (p≤0.05) effect on the serum concentration of glucose, total cholesterol and HDL, but these differences were not significant for creatinine, urea and LDL. The use of SEO in diet led to a significant reduction in the concentration of the serum glucose in the both strain of broiler, but this reduction was prominent in Cobb strain. Broiler receiving SEO in diet had lower cholesterol and HDL concentrations compared to control groups, but these differences were not significant. The difference between RC and CS groups was significant (p≤0.05). The highest and the lowest concentration of cholesterol were related to CS and RC treatments respectively.

Table 3. Effect of experimental diets on serum biochemical parameters of broilers at day 42

Parameter	Diets				
	RC	RS	CS	CC	SEM[1]
Glucose	233.00^{a} ±5.46	201.00^{b}±4.54	172.00^{b}±15.73	198.00^{b}±9.69	4.428
Triglyceride	62.83±9.34	64.83±4.16	58.83±7.21	69.17±13.56	4.284
Total Cholesterol	138.50^{a}±5.76	129.00^{ab}±3.35	114.00^{c}±6.30	122.00^{bc}±2.13	2.193
LDL- cholesterol	64.67±6.72	61.33±3.92	52.00±4.52	57.50±2.10	2.158
HDL- cholesterol	57.17^{a}±1.30	55.50^{ab}±3.68	47.17^{b}±1.11	50.67^{ab}±3.68	1.221
Urea	3.62±0.19	3.40±0.42	3.87±0.21	4.28±0.27	0.136
creatinine	0.38±0.02	0.34±0.02	0.37±0.03	0.40±0.04	0.014

Values in the same row with no common superscript differ significantly (p≤0.5). RC=Ross control; RS= Ross+ savory essential oils; CS= Cobb + savory essential oils CC=Cobb control 1. Standard error of mean

The attributed anti hyperglycemic effects of medicinal plants are due to their ability to restore the function of pancreatic tissues by causing an increase in insulin output or a decrease in the intestinal absorption of glucose. Hence, treatment with herbal drugs has an effect on protecting β-cells and smoothing out fluctuation in glucose levels [21]. The present study corroborates earlier study [22] showing that the oral administration of 25 and 50mg/kg body weight carvacrol to diabetic rats resulted in a slightreduction in serum glucose level and significant reduction in serum total cholesterol. Ebrahimi et al. [23] found that 300ppm savory extract in drink water reduced total cholesterol, but had not effect on HDL. Khosravinia [18] reported that the using 0.5g/l carvacrol in drinking water reduced serum cholesterol, LDL, and HDL. Crowell, [24] suggested that the reduction of cholesterol and other lipids by carvacol can mainly induced through the inhibition of 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase, the rate controlling enzyme of the cholesterol synthetic pathway. In contrast to these reports, Ghalamkari et al. [19] and Nobakht et al. [25] did not find any significant effect on cholesterol concentration by using savory in diet.

4. CONCLUSION

The results showed that the dietary inclusion of 500mg/kg savory essential oils can improve daily weight gain and FCR in broiler chickens. Also, the using savory essential oils in diet reduced serum total cholesterol. It can be important in human nutrition. The performance of the Cobb strain was better than the Ross strain in our experimental conditions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Landy N, Ghalamkari GH, Toghyani M. The effects of *Echinacea purpurea L.* (Purple Coneflower) as an antibiotic growth promoter substitution on performance, carcass characteristics and humoral immune response in broiler chickens. Journal of Medicinal Plants Research. 2011;5:2332-2338.
2. European Union. Regulation (EC) No 1831/2003 of the European ParliMEnt and of the Council of 22 September 2003 on additives for use in animal nutrition. Off. J. Eur. Union L. 2003;268:29–43.
3. Toghyani M, Gheisari AA. Evaluation of cinnamon and garlic as antibiotic growth promoter substitutions on performance, immune responses, serum biochemical and haematological parameters in broiler chicks. Livestock Science. 2011;138:167-173.
4. Hadian J, Mirjalili MH, Kanani MR, Salehnia A, Ganjipoor P. Phytochemical and morphological characterization of *Satureja khuzistanica* Jamzad populations from Iran. Chemist. And Biodiver. 2011;8:902–915.
5. Zargari A, Medicinal Plants. 4th Edition. Tehran University Publications, Tehran, pp. 42–45 Hajhashemi V, Sadraei H, Ghannadi AR, Mohseni M. 2000. Antispasmodic and anti-diarrhoeal effect of *Satureja hortensis L.* essential oil. J. Ethnopharmacol. 1990;71:187–192.
6. Farsam H, Amanlou M, Radpour MR, Salehnia AN, Shafiee A. Composition of the essential oils of wild and cultivated *Satureja khuzistanica* Jamzad form Iran. Flavour Fragr. J. 2004;19:308–310.

7. Moghaddam FM, Farimiani MM, Salahvarzi S, Amin G. Chemical constituents of dichloromethane extract of cultivated *Satureja khuzistanica*. Evid. Based Complement. Altern. Med. 2007;4:95–98
8. Hajhashemi V, Sadraei H, Ghannadi AR, Mohseni M, Antispasmodic and anti-diarrhoeal effect of *Satureja hortensis L.* essential oil. J. Ethnopharmacol. 2000;71:187–192.
9. Abdollahi M, Salehnia A, Mortazavi SH, Ebrahimi M, Shafiee A, Fouladian F, Keshavarz K, Sorouri S, Khorasani R, Kazemi A. Antioxidant, antidiabetic, anti hyperlipidemic, reproduction stimulatory properties and safety of essential oil of *Satureja Khuzistanica* in rat in vivo: A toxico pharmacological study. Med. Sci. Monit. 2003;9:331–335.
10. Yamasaki K, Nakano M, Kawahata T, Mori H, Otake T, Ueba N, Oishi I, Inami R, Yamane M, Nakamura M, Murata H, Nakanishi T. Anti-HIV-1 activity of herbs in Labiatae. Biol. Pharm. Bull. 1998;21:829–833.
11. Skocibusić M, Bezić N. Phytochemical analysis and in vitro antimicrobial activity of two Satureja species essential oils. Phytother Res. 2004;18:967–970.
12. SAS Institute. SAS User's Guide. Version 8 ed. SAS Inst. Inc., Cary, NC; 2001.
13. Gentle MJ. In: Neural and Endocrine Aspects of Behaviour in Birds. Wright P, Caryl PG, Vowles DM, Editors. Amsterdam: Elsevier. 1975;305-318.
14. Goodarzi M, Landi N, Nanekarani Sh. Effect of onion (*Allium cepa L*.) as an antibiotic growth promoter substitution on performance, immune responses and serum biochemical parameters in broiler chicks. Health. 2013;5:1210-1215. Available: http://www.scirp.org/journal/health/.
15. Jamroz D, Wiliczkiewicz A, Wertelecki T, Orda J, Skorupinska J. Use of active substances of plant origin in chicken diets based on maize and locally grown cereals. Br. Poult. Sci. 2005;46:485–493.
16. Partanen K, Jalava T, Valaja J, Pertilla S, Siljander-Rasi H, Lindeberg H. Effect of dietary carbadox or formic acid and fibre level on ileal and faecal nutrient digestibility and microbial metabolite concentrations in ilealdigesta of the pig. Anim. Feed Sci. Technol. 2001;93:137–155.
17. Furuse M, Yokota HI. Tasaki. Influence of energy intake on growth and utilisation of dietary protein and energy in germ-free and conventional chicks. Br. Poult. Sci. 1985;26:389–397.
18. Khosravinia H. Hypolipidemic effects of carvacrol in relation with sex hormones in broiler chicken. Biotechnology in Animal Husbandry. 2014;30:89-102.
19. Ghalamkari G, Toghyani M, Tavalaeian E, Landy N, Ghalamkari Z, Radnezhad H. Efficiency of different levels of *Satureja hortensis L.* (Savory) in comparison with an antibiotic growth promoter on performance, carcass traits, immune responses and serum biochemical parameters in broiler chickens African J. of Biotech. 2011;10:13318-13323.
20. Khosravinia H, Ghasemi S, Rafiei Alavi E. The effect of savory (*Satureja khuzistanica*) essential oils on performance, liver and kidney functions in broiler chicks. Journal of Animal and Feed Sciences. 2013;22:50-55.
21. Malviya N, Jain S, Malviya S. Antidiabetic potential of medicinal plants. Acta Poloniae Pharmaceutica Drug Research. 2010;67:113-118.
22. Bayramoglu G, Senturk H, Bayramoglu A, Uyanoglu M, Colak S, Ozmen A, Kolankaya D. Carvacrol partially reverses symptoms of diabetes in STZ-induced diabetic rats. Cytotechnology. 2014;66:251–257.

23. Ebrahimi A, AlawQotbi AA, Pourhossein Z. The effect of different levels of savory (*Satureja hortensis L.*) on blood parameters and gastrointestinal microbial population of broiler chickens. Annals of Biological Research. 2013;4:332-336.
24. Crowell PL. Prevention and therapy of cancer by dietary monoterpenes. Journal of Nutrition.1999;129:775-778.
25. Nobakht A, Norany J, Safamehr AR. The effects of different amounts of *Mentha pulegium* (pennyroyal) on performance, carcass traits, hematological and blood biochemical parameters of broilers. J. Med. Plant. Res. 2011;5,3763-3768.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=582&id=32&aid=5712