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Growth Performance, Carcass Characteristics and Serum Biochemicals of Japanese Quails Fed with Oat Bran (*Avena sativa*) and Dill Seed (*Anethum graveolens*)

Research Article

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ABSTRACT

An experiment was conducted to evaluate the additional effects of two ground medicinal herbs oat bran (OB) and dill seed (DS) on serum lipids, carcass characteristics and growth performance in Japanese quails. A total of 240-twenty one day of age male Japanese quails were allocated randomly to 3 treatments with 4 replicates of 20 birds per cage. Birds during the 22-49 days on trial received 3 dietary treatments: 1) control diet, 2) diets with 3% OB and 3) diets with 3% DS. From 4-7 weeks of age, body weight gain was higher for OB-fed birds ($P<0.05$) compared to other treatments, while the body weight gain of DS-fed birds was intermediate ($P>0.05$). Birds that received diet containing DS consumed significantly ($P<0.05$) lower feed compared to two other groups. Over the experimental period feed conversion ratio (FCR) was significantly improved in the group that received 3% DS compared to other treatments ($P<0.05$). Carcass weight and carcass components was not positively influenced by the dietary treatments ($P>0.05$). Both DS and BO-fed birds showed significantly ($P<0.05$) lower very low density lipoprotein (VLDL) and triglyceride serum compared to control group. Furthermore, feeding DS significantly decreased the testosterone level of serum as compared to the control birds. DS group were very calm during the experiment which is a desirable effect from a management and nutrition points of view. Taken together, these results suggest the beneficial effects of DS on growth performance, efficiency of feed utilization and behavior of quails; thus, it can be considered as a potential natural growth promoter for quails breeding.

KEY WORDS carcass, dill seed, growth performance, oat bran, quail, serum biochemicals.

INTRODUCTION

In poultry industry, dietary antibiotics are used as growth and health promoters. However, using antibiotic in poultry diet has been banned in European countries from 2006 which is because of public concerns about their residues in the animal products and the development of antibiotics-resistant bacteria (Schwarz *et al.* 2001; Lee *et al.* 2004). Since removing antibiotics from animal nutrition would cause some harms, they are to be replaced with some edible material with antimicrobial activity. Scientific research has a tendency to use traditional feed additives which has a positive effect on the human health substituting for any synthetic drugs in animal feeds to avoid its hurtful effect. Therefore, the researches for alternative feed supplements have been increased extensively and considerable attention has been given to the medicinal plants. The efficiency of medicinal plants and some plant seeds as growth promoters (Abaza, 2001; Ayaşan, 2013), natural tonic, restorative, antibacterial and anti-parasitic drugs (Khodary *et al.* 1996)

on improving the productive performance in poultry have been proven. Reports indicate that medicinal plants increase the production of digestive enzymes and improve the utilization of digestive products (Williams and Losa, 2001; Hernandez *et al.* 2004). In addition improve in FI, FCR, weight gain and carcass weight has also been reported as consequences of adding herbal plants to poultry diet (Christaki *et al.* 2011; Bahadori *et al.* 2013).

Poultry production in Iran has become one of the biggest agriculture industries and its improvement is one of the main objectives of both private and public sectors. In recent years, public demand for healthy foods has forced government to put some restrictions on using antibiotics in poultry industry and commanded researchers to substituting antibiotics with safe-natural materials. In Iran, by-products of some medicinal and aromatic plants accumulated after preparing for export which causes an environmental pollution. These by-products are abundant in Iran after using their plants in different purposes. In the meantime, they could be used as possible optional feed ingredients for poultry.

In the current study we focused on oat bran and dill seed to test their influence on growth performance and serum biochemicals of Japanese quails. Oat (*Avena sativa*) belongs to Graminae family. Dill (*Anethum graveolens*) belongs to Umbilliferae family. Oat bran is a by-product of oat flour production. It is used as a health food for human consumption due to its hypoglycemic and hypocholesterolemic effects and high content of B vitamins (Sadiq Butt *et al*. 2008; Webster, 1986). Dill is an annual herb growing in the Mediterranean region, Europe, central and southern Asia and it is widely cultured in south eastern region of Iran. The plant is used both medicinally and as an aromatic herb and spice and in cookery. Dill has been used traditionally for gastrointestinal ailments such as flatulence, indigestion, stomach ache, cholic and to reduce tract intestinal gas (Yazdanparast and Bahramikia, 2008). Also, it is known for its anti-cholesterol, anti-cancerous, anti-diabetes and antioxidant effects. In chicken, it has been reported that dietary feeding of dill seed has some positive effects on growth performance, carcass characteristics and biochemicals of serum (Bahadori *et al.* 2013). However, most of proven information about the effects and nutritional value of oat and dill come from human or livestock studies (Yazdanparast and Bahramikia, 2008; Immerstrand *et al.* 2010; Cho and Kim, 2012) and in general, there is dearth of information on the influence of oat bran and dill seed on economic traits of quails.

Therefore, this study was conducted to determine the effects of dietary feeding of oat bran and dill seed on growth performance, carcass characteristics and serum biochemicals of Japanese quails.

MATERIALS AND METHODS

This experiment was carried out in Tehran, Iran. The Animal Science Group of Islamic Azad University, Varamin-Pishva branch (Varamin, Iran) approved all animal procedures for this experiment. Two hundred and forty 21-day old male Japanese quail (*Coturinx japanica*) were obtained from Animal Science Research Institute of Iran, Karaj, Alborz, Iran. Quail chicks were wing-banded and randomly allotted to three dietary treatments of four replicates of 20 birds each. Dietary treatments consisted of: 1) control diet with no supplementation; 2) control diet supplemented with 3% OB; 3) control diet supplemented with 3% DS. Quail chicks were raised in electrically heated batteries with raised mesh wire floors and had a free access of feed and water. The birds were reared under similar environmental conditions, and were given the experimental diets from 22-49 days of age. In the control group, birds were fed a standard diet (240 g crude protein (CP) and 2900 kcal/kg, according to NRC (1994). The ingredient and chemical composition of the diets are presented in Table 1. During the entire experiment, birds were housed under 16 h/d fluorescent lighting, standard temperature, humidity, and ventilation conditions, and had *ad libitum* access to water and food.

At the end of the experiment, the growth performance was evaluated by recording live body weight, cumulative feed consumption and cumulative feed conversion ratio. The feeds and feed residuals were weighed to determine the feed consumption. The feed conversion ratio was calculated as the amount of feed consumed by birds per total weight gain. At day 49, 4 quails per replicate whose body weights were similar to the group average were selected and anesthetized by an i.m. injection of 0.4 mL Ketamine in the leg muscle. The feather was removed and internal organs were collected and then weights of carcass, legs, breast, hearts, gizzard, digestive tract and livers were measured. Serum biochemicals such as testosterone, cholesterol, low density lipoprotein (LDL), very low density lipoprotein (VLDL), high density lipoprotein (HDL), triglyceride together with cholesterol of breast meat were also determined (Friedewald *et al.* 1972) by the enzymatic kits obtained from Pars Azmoon Co, Iran.

The dry matter, crude protein, ash and ether extract content of the diets were analyzed using AOAC (1990) procedures, and crude fiber was determined, using the Crampton and Maynard (1983) method. Data were subjected to a one-way analysis of variance using the general linear model (GLM) procedure of SPSS (2011). Means were compared by Duncan's new multiple range test (Duncan, 1955) when significant F values were obtained ($P<0.05$).

Table 1 Dietary ingredients and chemical composition of the experimental diets

Ingredients (%)	Control	DS	OB
Maize	55.74	52.44	53.14
Soybean meal (44% CP)	35.00	35.00	35.00
Corn gluten meal (60% CP)	5.58	5.29	5.06
Fat	0.14	0.68	0.28
Dicalcium phosphate	0.94	0.93	0.89
Ground limestone	1.68	1.70	1.71
Salt	0.30	0.30	0.30
Vitamin premix*	0.15	0.15	0.15
Mineral premix**	0.15	0.15	0.15
Threonine	0.14	0.16	0.14
Lysine	0.13	0.15	0.12
Methionine	0.05	0.05	0.06
Oat bran	-	-	3
Dill seed	-	3	-
Total	100	100	100
Diet specification			
Calculated AME_n (kcal/kg)	2900	2900	2900
Chemical analysis (%)			
Dry matter	92.62	92.85	92.87
Crude protein	23.74	23.71	23.64
Crude fiber	5.03	5.33	6.05
Fat	4.81	5.44	5.18
Ash	5.11	3.12	5.17

* Vitamin premix provided the following per kilogram of complete diet: vitamin A: 9000000 IU; vitamin D_3: 200000 IU; vitamin E: 18000 IU; vitamin K_3: 200000mg; vitamin B_1: 200000 mg; vitamin B_2: 6600 mg; vitamin B_3: 30000 mg; vitamin B_5: 10000 mg; vitamin B_6: 3000 mg; vitamin B_9: 15 mg; vitamin B_{12}: 100 mg; vitamin H2: 100 mg and Antioxidant: 500 mg.
** Mineral premix provided the following per kilogram of complete diet: Colin: 400000 mg; Fe: 50000 mg; Mn: 100000 mg; Zn: 85000 mg; Cu: 10000 mg; Se: 200 mg and I: 100 mg.
DS: dill seed and OB: oat bran.

RESULTS AND DISCUSSION

The effects of oat bran and dill seed on Japanese quails performance is presented in Table 2. Birds fed OB-diet showed a significantly (P<0.05) higher body weight gain (BWG) compared to other treatments at 4 weeks of age. At 5 weeks of age, both OB and DS-fed birds had an elevated BWG compared with the control group (P<0.05). Over the entire experimental period, birds fed supplemented diet with OB showed higher BWG compared to the control group and DS treatment was intermediate. There are lots of reports showing desirable effects of herbal plants or their essential oil on growth performance of birds (Lee *et al.* 2003; Garcia *et al.* 2007) which are mainly because of antibiotic activity and their stimulating effects on secretion of digestive enzymes (Zhang *et al.* 2007). However, the general paucity of reports on the effects of oat bran and dill seed on growth performance of poultry and in particular quails makes comparison difficult. In broilers, Bahadori *et al.* (2013) studied different level of dill powder on growth performance of broilers and reported that while dill powder supplementation had no significant effect on broiler daily weight gain in the starter period, it significantly increased weight gain of broiler in the growth phase between 21 to 42 days of age. Ibrahim (2005) demonstrated that dill and parsley (0.5 and 1%) or laurel (1%) supplementation significantly increased final live body weight of rabbits. Furthermore, feeding mice with OB-diet significantly increased body weight (Immerstrand *et al.* 2010).

In this study, feed intake was also influenced by dietary treatment of medicinal plant as birds that received diet containing DS showed a significantly (P<0.05) lower feed intake over the course of the experiment. In the first week of experiment, the quails treated with dill seed significantly eat less feed. Our result contradicted the results of Bahadori *et al.* (2013) who observed no significant effects of dill powder on FI of broiler in the starter period (P>0.05), but in the growth phase between 21 to 42 days of age, the broilers fed diet supplemented with dill powder had higher FI compared with those from the control group. In the present study, it was noticed that birds in DS group were very calm during the experiment while in other groups birds were fighting throughout the day and injuring each other. Thus, feeding less feed in DS group was probably due to the lower wasted energy compared to other groups. Analyses showed a decreased level of serum testosterone in the birds receiving DS diet (P<0.05); Table 8. In addition, testicles were smaller (not shown) in this group compared to the control and oat bran treatments that was in agreement with the results of Salamatmanesh *et al.* (2008) and Yazdanparast and Bahramikia, (2008). This may be due to some anti-gonadotrophic compounds in the DS which prevents testes growth in male quails, although this needs to be further investigated in future experiments. This could be an explanation for the behavior of birds receiving DS that seems to be desirable in animal nutrition where the main goal is increasing the efficiency of meat production because it eases management of the birds and decrease the feed cost. Reports regarding the effect of oat bran on FI of animals are rare. In mice, Immerstrand *et al.* (2010) reported non-significant effect of oat bran on FI which is in agreement with our results.

There are the best FCR in 35-d-old or younger than 35-d-old quails. Up to d 35 the FCR in quails will be too high and non-economic. Because of this fact, FCR was studied in three growth phases, week 4 and 5 and during the course of the experiment (Table 2). Addition of DS and OB to diet significantly improved FCR compared to the control group at 5 weeks of age (P<0.05). However, throughout the experiment (4-7 weeks), FCR was significantly decreased only by supplementation of dill seed. These results agree with the finding of El-Gendi *et al.* (1994) who indicated an improvement in feed conversion with feeding herbal products that was attributed to their effect on improving the digestibility of dietary protein in the small intestine.

Table 2 Effect of oat bran and dill seed on the performance of growing Japanese quails

BWG (g/bird/day)		Control	DS	OB	SEM	P-value
	4	6.10[b]	6.08[b]	7.14[a]	0.151	0.014
	5	2.10[b]	3.03[a]	2.85[a]	0.123	0.003
Week	6	1.18[b]	1.46[a]	0.99[b]	0.077	0.007
	7	0.56[a]	0.68[a]	0.52[a]	0.104	0.519
	Overall	2.48[b]	2.81[ab]	2.85[a]	0.074	0.001
FI (g/bird/day)						
	4	15.50[a]	14.26[b]	15.80[a]	0.163	0.001
	5	16.72[a]	16.15[a]	16.59[a]	0.172	0.306
Week	6	17.86[b]	16.88[c]	18.76[a]	0.231	0.001
	7	20.57[a]	18.26[b]	20.27[a]	0.139	0.001
	Overall	17.66[a]	16.39[b]	17.86[a]	0.135	0.001
FCR (g feed/g gain)						
	4	2.58[a]	2.37[a]	2.28[a]	0.086	0.079
Week	5	3.97[a]	3.38[b]	3.33[b]	0.097	0.001
	4-7	7.19[a]	5.89[b]	6.34[ab]	0.113	0.001

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
DS: dill seed; OB: oat bran; BWG: body weight gain; FI: feed intake and FCR: feed conversion ratio.
SEM: standard error of the means.

In contrast, Bahadori *et al.* (2013) reported non-significant effect of dill powder on FCR in broiler in different growth phases. However, in other animals such as rabbit, improvement in FCR has been reported following supplementation of diet with dill seed and parsley (Ibrahim, 2005). Any improvement in FCR is economically important. Soliman *et al.* (2003) found that the inclusion of herbal feed additives in Japanese quail or broiler diets resulted in the least feed cost/kg gain or the highest percent of economic efficiency as compared with control diet. It has been reported that herbal plants have an appetizing effect in diets and stimulates the digestive process in animals (Çabuk *et al.* 2003), which results in improved efficiency of feed utilization (Ather, 2000; Hertrampt, 2001). Osman (2002) reported that broilers fed hot pepper or black seed oil had significantly better protein and energy conversions than the control group.

According to Richter, (2010) dill improves the whole digestive process. It is known to be an antispasmodic which would help to relax the colon and relieves constipation and therefore, dill improves the digestibility of foods because the gut gets better at extracting nutrients from foods and fewer nutrients are lost in excrement. Changes in the efficiency of feed utilization are mainly depending on the difference in FI followed by the differences in live BWG. On one hand, dill seed decreased FI and in other hand it increased weight gain of quails (Table 2), all leading to improved FCR.

At the end of week 4, carcass weights differed (P<0.05) between the treatments (Table 3). The birds consuming the control diet had the highest cold carcass weight (73.98 g), followed by the birds on the diets containing dill seed (73.58 g) and oat bran (72.81 g). Breast weight, leg weight and liver weight, were not significant (P>0.05) among treatments.

As it was expected, birds fed on oat bran diet had heaviest gizzard, because a bigger gizzard is needed to digest diets containing high level of fiber. DS-fed birds had the highest gut weight that was followed by OB and the control groups (P>0.05). This may be due to high fiber contents of used medicinal plants. Bahadori *et al.* (2013) reported significant effect of dill powder on breast weight, though the effect on carcass, spleen, pancreases and gizzard weight was not significant.

Effect of OB and DS on serum biochemicals and cholesterol content of breast meat in Japanese quails are listed in Table 4. As observed, while the level of serum cholesterol and LDL was lower in DS and OB treatments compared to control group, these differences were not significant (P>0.05). Likewise, the concentration of cholesterol in breast meat did not differ between groups (P>0.05). In addition, birds in all three groups had similar HDL (P>0.05). However, DS and OB decreased the level of triglyceride and VLDL of serum significantly (P<0.05) in consistent with other reports (Yazdanparast and Bahramikia, 2008; Kojuri *et al.* 2007). The cholesterol-lowering effects of OB have been studied both in human subjects and animals since the beginning of the 1960s. This effect has mainly been ascribed to its content of the soluble fibre β-glucans, as 80% purified oat β-glucan has been shown to reduce cholesterol levels in hypercholesterolaemic human subjects. In most of clinical studies, the cholesterol-lowering property of OB has been proved (US Food Drug Administration, 1997). The mechanism by which OB decrease serum cholesterol is described by Marlett *et al.* (1994). Apparently, OB lowers serum cholesterol levels in part by altering bile acid metabolism. There is evidence that feed processing could have detrimental effects on the cholesterol-lowering properties of β-glucan from oat bran (Kerckhoffs *et al.* 2003).

Table 3 Effect of oat bran and dill seed on carcass characteristics of Japanese quails (g/100 g live body weight)

Item	Control	DS	OB	SEM	P-value
Carcass	73.98[a]	73.58[ab]	72.81[b]	0.319	0.045
Breast	28.06[a]	27.38[a]	28.31[a]	0.238	0.119
Thigh	18.31[a]	18.14[a]	18.41[a]	0.131	0.431
Gut	10.48[c]	12.47[a]	11.68[b]	0.214	0.001
Gizzard	2.12[c]	2.37[b]	2.59[a]	0.068	0.001
Liver	1.52[a]	1.45[a]	1.50[a]	0.050	0.355
Heart	0.93[b]	1.01[a]	0.88[b]	0.032	0.001

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
DS: dill seed and OB: oat bran.
SEM: standard error of the means.

Table 4 Effect of oat bran and dill seed on serum biochemicals and cholesterol content of breast meat in Japanese quails

Item	Control	DS	OB	SEM	P-value
Cholesterol (mg/dL)	176.44[a]	170.25[a]	165.313[a]	5.890	0.388
HDL (mg/dL)	93.13[a]	93.50[a]	89.13[a]	2.567	0.454
LDL (mg/dL)	71.38[a]	60.47[a]	64.70[a]	3.630	0.194
VLDL (mg/dL)	16.83[a]	14.33[b]	14.29[b]	1.666	0.002
Triglyceride (mg/dL)	84.13[a]	71.63[b]	71.44[b]	2.296	0.011
Testosterone (ng/mL)	2.41[a]	1.45[b]	2.21[ab]	0.307	0.019
Meat cholesterol (mg/100 g fresh tissue)	58.89[a]	54.30[a]	66.06[a]	5.109	0.481

The means within the same column with at least one common letter, do not have significant difference (P>0.05).
DS: dill seed; OB: oat bran; HDL: high density lipoprotein; LDL: low density lipoprotein and VLDL: very low density lipoprotein.
SEM: standard error of the means.

Accordingly, one plausible explanation for current result is that the interaction between OB with other diet ingredients may decrease its cholesterol-lowering activity. This phenomenon has not been studied in poultry species and need more research.

Scientific research on the effect of DS on serum biochemicals in poultry is limited. Bahadori *et al.* (2013) who studied different levels of DS in broiler diet (1%, 3% and 6%) reported no significant effects of DS on cholesterol and HDL levels of plasma in broilers. It has been argued that dill has dose-dependent cholesterol-lowering effects (Zhang *et al.* 2007). Therefore, the 3% DS used in this study may not be enough to decrease cholesterol concentration of plasma.

CONCLUSION

In conclusion, results obtained here indicated that including OB and DS in the diet would have desirable effects on growth performance of Japanese quails. In addition, improvement in efficiency of feed utilization and decrease in some undesirable serum biochemicals such as triglyceride and VLDL was also observed. Our results suggested that in particular DS could be considered a potential natural growth promoter for poultry because it increased body weight, decreased FI, improved FCR and had desirable effects on the behavior of quails. However, since it has been reported that the effect of herbal plant on animal health and production is dose-dependent, conducting experiments with different levels of oat bran and dill seed is recommended.

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