Revista Brasileira de Zootecnia
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ISSN 1806-9290
www.sbz.org.br

R. Bras. Zootec., 45(5):230-235, 2016

Using juniper berry (*Juniperus communis*) as a supplement in Japanese quail diets

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ABSTRACT - The present study was conducted to determine the effects of supplemented juniper berry (*Juniperus communis*) on fattening performance and some carcass traits of quails. A total of 150 one-day-old Japanese quail chicks were randomly divided into five groups (one control and four treated groups) with three replicates. Four different juniper berry levels (0.5, 1, 1.5, and 2%) and a control treatment (0%) were added to the diet. Juniper berry supplementation to the diets initiated at the end of the 1st week and sustained for seven weeks. Live weight, feed intake, and feed conversion ratio during the trial and some carcass traits after slaughter were determined. Juniper berry supplementation in the diet during seven weeks of growing period significantly increased body weight, cumulative feed intake, and feed conversion ratio of the treated groups. Carcass weight, carcass yield, and breast yield were also significantly increased by supplemented juniper berry. No significant difference was observed between viability of different groups. Supplementation of 0.5-1% juniper berry in quail diets has positive impacts on fattening performance and carcass traits.

Key Words: aromatic plant, carcass traits, growth performance

Introduction

Various antibiotics have long been used in the poultry sector either to increase feed conversion ratios (FCR) or to prevent diseases and metabolic disorders. Such antibiotics mostly used to regulate the growth performance, FCR, and the feed intake are used in quantities almost five times higher than those used for therapeutic purposes (Turkusay and Onogur, 1998; Svoboda and Hampson, 1999; Adiyaman and Ayhan, 2010). However, using antibiotics in livestock and poultry diets was prohibited because of increasing concerns about resistant bacteria growth with potential risks to human health. Therefore, studies have been conducted to investigate possible feed additives as an alternative to antibiotics, and the use of natural additives was especially pointed out (Ozkan and Acıkgoz, 2007; Bilal et al., 2008).

Plant extracts are considered as an effective solution for feed additives (Wallace et al., 2002; Adiyaman and Ayhan, 2010). Medicinal and aromatic plants are commonly used in various sectors, especially in the food industry from past to present because of their several benefits (Adiyaman and Ayhan, 2010). Such extracts come to the forefront with their antifungal, antiviral, and antioxidant characteristics (Ilcim et al., 1998; Turkusay and Onogur, 1998; Svoboda and Hampson, 1999). Essential oils produced from various medicinal and aromatic plants provide the following general benefits: increase the flavor of the feed, prevent toxin development in the feed, prevent or kill microorganisms throughout the digestive system, provide better nutrient use with increased digestive enzyme activity, improve animal performance, support immune system, provide a healthy and lively appearance, and yield products with low cholesterol and free of residues (Turkusay and Onogur, 1998; Svoboda and Hampson, 1999; Ozkan and Acikgoz, 2007; Yurtseven et al., 2008). Positive impacts of medicinal and aromatic plants on appetite, digestive system, and weight gain and feed conversion ratios of broilers were also reported by Adiyaman and Ayhan (2010). Although there are limited studies about the effects of essential oils of aromatic plants on poultry traits, many studies focused on positive impacts of such additives to poultry diets (Jamroz and Kamel, 2002; Wallace et al., 2002). In recent years, decreased feed intake and mortality rates and improved FCR and carcass quality have been reported with the use of aromatic plants in broiler diets. Also, increased weight gains, positive impacts of digestive system and improved feed flavor were also reported with the use of aromatic plant additives to broiler diets (Ilcim et al., 1998; Lee et al., 2003).

Received November 19, 2015 and accepted March 7, 2016.
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http://dx.doi.org/10.1590/S1806-92902016000500004

Junipers (*Juniperus* spp) generally grow in regions with terrestrial climate; they appear over dry and stony slopes of entire regions of Turkey, except for Eastern Black Sea, as groups or separate trees. Fruits of this evergreen coniferous tree are not real fruits. Fruits of *Juniperus communis L.* contain flavonoids, glycoside, bitter compounds (juniperine), resin (10%), invert sugar (15-30%), catechin (3-5%), organic acids, essential oil (0.5% in fresh and 2.5% in dry fruit), terpenic acids, and leucoanthocyanidin (Koc, 2002; Sengül et al., 2008; Avan, 2010).

Juniper berries stimulate digestive glands and have disinfectant effect. They increase appetite with their bitter taste. Ground fruits strengthen the stomach and intestines, improve body resistance, support metabolism, and remove uric acid and salt from the body. Juniper fruits are sometimes used for treatment purposes in public; they contain essential oils, natural sugars, flavone glycosides, resin, tannin, and organic acids and are also used as flavor and smell substances in some foods and beverages. Wood and leaves of some juniper species are distillated, and the resultant juniper essence is used in the drug industry (Ebcioğlu, 2003).

It was reported in a study carried out with plants that thyme and nigella seed oil supplementation to quail diets had positive impacts on weight gain and feed conversion ratio and significantly decreased abdominal fat ratios (Bilal et al., 2008). In another study, nigella addition to broiler diets had significant effects on fattening performance and carcass traits (Sogut et al., 2012). Tucker (2002) reported increasing live weights and decreased mortality rates with supplementation of garlic, anise, cinnamon, rosemary, and thyme extracts to broiler diets. Lewis et al. (2003) indicated significantly improved feed conversion ratios with juniper berry supplementation to broiler diets. Supplementation of thyme oil extract to quail diets did not affect growth performances but decreased feed intake (Sengül et al., 2008). However, sage oil supplementation to quail diets did not affect fattening performance, carcass traits, or mortality rates (Yurtseven et al., 2008). In the present study, effects of different levels of juniper berry supplementation to Japanese quail diets on quail fattening performance and carcass traits were investigated.

Material and Methods

This study was approved by the Local Ethics Committee on Animal Experiments of Bingol University (Date: 05/20/2011, Decision No: 2), carried out with 150 one-day-old male and female Japanese quails (*Coturnix coturnix japonica*). The 150 quail chicks were randomly divided into five groups (one control and four treated groups) with three replicates each with 10 quails. After supplementing juniper berry (*Juniperus communis*), all the diets were prepared to be isonitrogenous and isoenergetic. Diets were arranged to meet approximate dry matter, energy, and other nutrient requirements of quails. The nutritional composition of the diets was prepared in accordance with NRC (1994) (Table 1). Animals fed freely on a starter diet containing 23% crude protein and 3,100 kcal/kg metabolizable energy (ME) during the 1st week and a grower diet containing 20% crude protein and 3,250 kcal/kg ME during the following six weeks. After the first week of age, different juniper berry supplementation levels (0.5, 1, 1.5, and 2%) were added to quail diets of treated groups.

Birds were housed in multi-story cages and received a light regime of 23L:1D. Quails were grown in brooders for the first week to eliminate variations among the groups because of the very low live weight (7-8 g) of the birds and incubation disorders, then separated into groups and placed into growing cages. During the experiments, individual live weight and feed intake were measured weekly using a 0.1 g sensitivity scale. Diets were given in granulated form and clean water was provided *ad libitum* throughout the experiments.

Juniper berries (Table 2) were supplied from a commercial firm. Dry berries were ground in a blender and added to diets in granulated form. Treated groups were fed for six weeks with berry-supplemented diets. Nitrogen content, phosphorus levels, and potassium, calcium, magnesium, iron, manganese, zinc, and copper contents of

Table 1 - Composition of quail feeds used in the experiments in percentage values

Ingredient	Starter feed	Grower feed
Corn	48.0	56.0
Wheat	6.0	6.0
Soybean meal (44 HP)	33.0	24.50
Vegetative oil	4.0	4.5
Fish meal (60 HP)	4.0	4.0
Meat-bone meal (35 HP)	2.5	2.5
Dicalcium phosphate	0.5	0.5
Limestone	1.0	1.0
Methionine	0.2	0.2
Lysine	0.1	0.1
Salt	0.4	0.4
Vitamin + mineral premix[1]	0.3	0.3
Calculated values		
Crude protein, %	23	20
Metabolic energy, kcal/kg	3100	3250

[1] Added per kg: vit. A - 11.00 IU; vit. D - 32,000 IU; vit. B1 - 2.5 mg; vit. B6 - 1.25 mg; vit. B12 - 0.01 mg; α-tocopheryl acetate - 50 mg; biotin - 0.06 mg; vit. K - 2.5 mg; niacin - 15 mg; folic acid - 0.30 mg; pantothenic acid - 10 mg; choline - 600 mg; Mn - 60 mg; Fe - 50 mg; Zn - 15 mg; I - 0.5 mg; Co - 0.5 mg.

Table 2 - Nutrient contents of juniper berry used in the experiment

Nutrient	Juniper berry	Juniper berry (analyzed values of our study)
N (%)	0.60	0.58
P (%)	0.18	0.20
K (%)	5.72	6.12
Ca (%)	1.43	1.45
Mg (ppm)	1.87	1.90
Fe (ppm)	79.32	80.12
Mn (ppm)	16.58	15.31
Zn (ppm)	17.84	18.80
Cu (ppm)	18.91	19.94

berries were determined by Kjeldahl, spectrometric, and atomic spectrophotometer methods, respectively (Kacar and Katkat, 2010).

Data were analyzed by SAS (Statistical Analysis System, version 6.12) statistical software package with Proc. GLM command, and an orthogonal polynomial test was used to compare the means.

Results

In the present study, juniper berries (*Juniperus communis*) were supplemented to quail diets, and effects of different supplementation levels on growth and development performances, feed intake, feed conversion ratios, and some carcass traits were investigated for seven weeks of fattening period.

For control and treated groups by the third week, supplemented juniper berry had a significant effect (P<0.01) on the live weights of female quails (Table 3). Fifth-week live weights of both male and female quails were significantly affected by juniper berry treatment and differences between the group averages were significant (P<0.01), as well.

At the sixth week of age, the treatment had a significant effect (P<0.01) on live weight of both genders. While the highest values were obtained from 2% groups of both males and females, the lowest value of the males and females were seen in control and 0.5% group, respectively. Seven-week live weights of both male and female quails were significantly (P<0.01) and linearly (for male quails, R^2 = 98%, and for female quails, R^2 = 87%; Table 6) affected by juniper berry supplementation to diets. While the highest values of males and females were obtained from 2% group, the lowest values were obtained from the control groups of males and females.

Supplemented juniper berry significantly affected feed intake (FI) (Table 4). The highest and the lowest FI were in 2% and control groups, respectively. Supplemented juniper berry also significantly (P<0.01) affected FCR during the initial four weeks. The control and 0.5% groups had the best FCR. Feed intake and FCR of quails during the initial five weeks were significantly (P<0.01) affected by supplemented juniper berry. While the highest FI was in 2% group, the lowest value was in the control group. The best FCR were obtained from the control and 0.5% groups. During the fattening period, covering 0-6 weeks, the differences between average FI and FCR of the groups were significant (P<0.01). The highest and the lowest FI were in 2% and control groups, respectively. The best FCR were obtained from the control and 0.5% groups. During the trial covering 0-7 weeks, supplemented juniper

Table 3 - Weekly live weights of male and female quails of control and treatment groups (g) and their standard errors (X±Sx)

Week	Sex	Juniper berry supplementation rates to diets (%)					Significance level
		Control	0.5	1	1.5	2	
1	M	30.9±1.8a	30.5±1.2a	31.2±1.3a	32.4±1.5a	31.9±1.8a	
	F	31.2±1.5a	31.3±1.9a	31.8±1.9a	32.4±1.8a	33.0±1.5a	
2	M	43.1±1.9a	44.8±1.3a	44.7±1.4a	43.7±1.6a	43.8±1.7a	
	F	44.0±1.4a	45.6±1.8a	43.8±1.8a	45.5±1.7a	45.7±1.4a	
3	M	92.1±3.7a	93.1±2.5a	93.8±3.0a	94.2±3.0a	95.6±3.3a	
	F	94.8±2.8a	95.8±3.7a	97.4±3.7ab	99.4±3.6abc	103.8±2.9c	**
4	M	129.2±5.0a	132.0±3.4a	133.6±3.5a	136.4±4.2b	133.4±4.5a	**
	F	138.2±3.4a	140.5±4.8a	142.2±4.5a	144.5±4.1abc	149.0±3.5c	**
5	M	150.3±7.1a	150.3±4.4a	154.2±4.5b	155.0±5.9b	159.5±6.6c	*
	F	170.1±6.8a	172.0±6.2a	175.2±6.2ab	178.1±5.7b	186.2±4.9c	**
6	M	154.3±7.1a	156.1±4.9a	162.5±5.0b	166.1±5.9bc	170.5±6.4c	**
	F	195.5±5.2a	195.1±6.9a	198.7±6.9ab	200.5±6.4b	206.4±5.4c	**
7	M	169.3±8.4a	174.3±5.9b	176.6±5.8b	179.2±7.0bc	183.1±7.6c	**
	F	212.1±6.4a	213.5±7.8a	215.7±7.8ab	216.9±7.2ab	223.7±6.1c	**

M - male; F - female.
Mean ± standart deviation.
a, b, c - differences between means in the same row with different letters are significant.
* P<0.05, ** P<0.01.

berry significantly affected FI (R^2 = 97%, Table 6) and FCR (R^2 = 94%, Table 4), and differences between groups were significant (P<0.01) and linear. While the highest FI was observed in 2% group and the lowest was in the control group, the best FCR were obtained from the control and 0.5% groups.

Carcass weights, carcass yields, breast weights, breast ratios, drumstick weights, and drumstick ratios of male quails of the control and treated groups at the end of the 7th week are given in Table 5.

Juniper berry supplementation to the quail diets had significant effects on entire carcass traits. Carcass weights and yields were significantly (P<0.01) and linearly (R^2 = 71%) affected by juniper berry supplementation. The highest carcass weight and yields were obtained from 2% group; the lowest value was obtained from control group. With regard to breast weight (P<0.01) and breast ratio (P<0.05), differences between the control and treated groups (0.5, 1, 1.5, and 2%) were found as significant. Breast weight, drumstick weight and breast ratio were affected linearly by juniper berry supplementation (Table 6). With regard to breast ratio, the highest values were seen in 1.5 and 2% groups and the lowest values in control and 0.5% groups. The differences of drumstick weight and drumstick ratio between the control and treated groups (0.5, 1, 1.5, and 2%) were significant (P<0.05). There was not any mortality in either control or treated groups during the seven-week fattening period. Different levels of juniper berry supplementation did not have any significant effects on viability of quails.

Table 4 - Cumulative feed intakes, feed conversion ratios, and standard errors (X±Sx) of control and treatment groups

Week	Juniper berry supplementation rates to diets (%)				
	Control	0.5	1	1.5	2
			Feed intake (g)		
0-4	365.5±7.8a	383.3±7.8ab	406.6±7.2bc	424.3±6.4cd	456.4±6.4d
0-5	511.5±8.2a	529.5±8.2ab	569.3±9.2bc	599.3±9.2c	648.4±9.2d
0-6	691.2±9.1a	707.2±10.8ab	759.3±8.2cd	791.8±7.8d	855.3±8.4e
0-7	878.4±6.2a	899.5±7.1ab	966.9±8.2cd	1003.8±8.2d	1085.7±9.0e
			Feed conversion ratio (g/g)		
0-4	2.9±0.02a	3.0±0.02a	3.1±0.02a	3.2±0.02ab	3.4±0.02b
0-5	3.4±0.67a	3.5±0.67a	3.6±0.67ab	3.8±0.67b	3.9±0.67b
0-6	4.1±0.09a	4.2±0.09a	4.4±0.09ab	4.5±0.09bc	4.7±0.09c
0-7	4.8±0.01a	4.8±0.14a	5.1±0.14ab	5.3±0.14ab	5.6±0.14b

Mean ± standart deviation.
a, b, c, d, e - differences between means in the same row with different letters are significant (P<0.01).

Table 5 - Average weights and yields of carcass and some carcass parts and their standard errors (X±Sx)

Traits	Juniper berry supplementation rates to diets (%)					Significance level
	Control	0.5	1	1.5	2	
Carcass weight, g	120.1±6.8a	127.1±6.8b	124.1±6.8b	126.5±6.8b	133.9±6.8c	**
Carcass yield, %	70.9±0.07a	72.9±0.07ab	70.3±0.07a	70.6±0.07a	73.1±0.07ab	*
Breast weight, g	54.1±2.1a	55.3±2.1a	57.6±2.1ab	60.9±2.1bc	64.5±2.1c	**
Breast ratio, %	45.1±0.2a	43.3±0.2a	46.2±0.4ab	48.0±0.7b	48.1±0.7b	*
Drumstick weight, g	31.1±1.5a	32.6±1.5a	33.6±1.5ab	33.4±1.5ab	33.7±1.5ab	*
Drumstick ratio,%	25.9±1.1a	25.6±1.1a	27.1±1.1ab	26.5±1.1a	25.2±1.1a	*

Mean ± standart deviation.
a, b, c - differences between means in the same row with different letters are significant.
* P<0.05, ** P<0.01.

Table 6 - Regression equations (R^2 = over 60%) of the parameters of experimental diets with juniper berry

Variable (y)	Prediction equation (regression)*	Mean	R^2
Live weight, 0-7 weeks for male, g	$y = 3.25x + 166.7$	176.50	0.98
Cumulative feed intake, 0-7 weeks, g/bird	$y = 52.69x + 8079$	966.06	0.97
Breast weight, g	$y = 2.64x + 50.56$	58.48	0.96
Feed conversion ratio, 0-7 weeks, g/g	$y = 0.21x + 4.49$	5.12	0.94
Live weight, 0-7 weeks for female, g	$y = 2.66x + 208.4$	216.38	0.87
Drumstick weight, g	$y = 0.602x + 31.07$	32.88	0.76
Carcass weight, g	$y = 2.656x + 118.3$	126.3	0.71
Breast ratio, %	$y = 1.07x + 42.93$	46.14	0.69

* Linear effect.

Discussion

Supplementations of medicinal and aromatic plants to poultry diets increase appetite, stimulate digestion, improve FCR, and consequently increase weight gains (Turkusay and Onogur, 1998; Sengül et al., 2008). Therefore, such plants are processed with different methods and supplemented into poultry diets. However, there is no research or study done on juniper berry (*Juniperus communis*) in quail diets so far. Our present study will be a first at universal literature. The effects of different juniper berry supplementation levels (0, 0.5, 1, 1.5, and 2%) to quail diets on quail growth and carcass traits were investigated. With regard to live weights, juniper berry supplementation to diets had significant effects throughout the entire experimental period except for the second week (Table 3). The higher live weights of treated groups than control group indicated that supplemented juniper berry had a positive effect on quail live weight (P<0.01). Effects of juniper berry on live weights were observed distinctively sometimes at 0.5% level but generally at 1% level. Increasing live weights were observed with increasing juniper berry supplementation levels. At the end of the 7th week, 2% treated group had the highest live weight but control group had the lowest one. Current findings were similar to findings of Lewis et al. (2003) in chicken.

Significant differences were observed between FI of the control and treated groups (P<0.01) (Table 4). Juniper berry supplementation to diets significantly increased FI. From the 4th week to the end of treatment, all treated groups had higher FI than control group. Feed intake was increased with increasing supplementation levels. At the end of the experiment, the highest FI was observed in 2% group and the lowest intake was seen in control group. It may be concluded herein that juniper berry supplementation to diets improved the flavor of feed and consequently increased FI. Such findings agree with the results of Lewis et al. (2003) and Sogut et al. (2012).

With regard to FCR, significant differences were observed between control and treated groups (P<0.01). The feed conversion ratio of treated groups generally increased with increasing supplementation levels. From the 4th week on, juniper berry supplementation beyond a certain level had negative effects on FCR. During the sixth and seventh weeks, while supplementation levels until 1% did not affect FCR, the levels beyond that had negative effects. It was concluded, at the end of experiments, that control and 0.5% groups had the best and 2% group had the worst FCR.

No significant differences were observed between viabilities of the control and treated groups. It may be concluded herein that juniper berry supplementation to quail diets did not have any negative impacts on viability of quails.

Juniper berry supplementation had significant effects on carcass traits. Differences in carcass weights of quails slaughtered at the end of the seventh week were found as significant (P<0.01). While treated groups had higher carcass weight than control group, the highest value was obtained from 2% group. It may be stated herein that juniper berry supplementation had positive impacts on carcass weights. Similarly to carcass weights, the differences between carcass yields of the treated groups were significant (P<0.01) and the highest values were observed in 0.5 and 2% groups. Carcass yields of control, 1, and 1.5% groups were similar. Significant differences were also observed between the groups with regard to breast weight (P<0.01), breast ratio, drumstick weight, and drumstick ratios (P<0.05), (Table 5). While these traits were similar in control and 0.5% groups, significantly increased values were observed in 1, 1.5, and 2% groups (except for drumstick ratio). The highest drumstick ratio was obtained from 1% group.

Conclusions

Low juniper berry supplementation levels (0.5 and 1%) have positive impacts on performance and yields (live weight, feed intake, and some carcass traits). Therefore, juniper berry can be used at 0.5 and 1% levels in quail diets.

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