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Effects of dietary ractopamine on growth performance and blood biochemical parameters in male Japanese quail (*Coturnix japonica*)

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Abstract

An experiment was designed to study the effects of a beta agonist, ractopamine, on body weight gain, feed intake, feed conversion ratio, carcass traits and blood biochemical parameters in male Japanese quail. Two hundred fifty six Japanese quail at the age of 14 d were randomly distributed to one of eight treatments which contained 0, 0.5, 1, 2.5, 5, 7.5, 10 and 20 ppm ractopamine in diet. The experiment lasted for four weeks. The average daily gain and feed conversion ratio and live body of the birds improved at the level of 7.5 ppm ractopamine. Carcass percentage, total protein and globulin increased significantly at the level of 7.5 ppm while blood cholesterol decreased ($P<0.05$) at the same level. From the results of this experiment, we concluded that dietary supplementation of ractopamine at 7.5 ppm in diet improved performance of Japanese quails.

Keywords: Beta agonist; feed conversion ratio; serum biochemical; Japanese quail

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Introduction

The β-adrenergic agonists are used to increase growth and muscle development of farm animals. The function of these compounds is similar to catecholamine (Ansari-pirsaraei et al., 2006). Reduction of fat content in animal body without any change on the bone mass and organs are important response of beta agonist in animal diet (Beerman, 2002). Apparently, the mechanism of this effect occurs through two metabolic pathways: reduction in lipogenesis and/or increase in lipolysis (Ferreira et al., 2013). Ractopamine is a β-adrenergic agonist and has growth promoter effect in pigs, beef cattle (Etherton, 2009) and fish (Jalali-Haji-Abadi et al., 2010). Research on the effect of other beta agonist such as clenbuterol, cimaterol, terbutaline, salbutamol, metaproternol and zilpaterol on various farm animals such as lamb, cattle and birds showed that these β-receptor agonists improved performance (Mersmann, 1998; Moody et al., 2000; Zare Shahneh et al., 2012). The growth response of various animals to dietary supplementation of β-adrenergic agonist may be affected by type, dosage and possibly strain of animal (Moody et al., 2000). Consuming various levels of terbutalin and salbutamol has improved the performance of chicken (Ansari-pirsaraei et al., 2006) and quail (Zare Shahneh et al., 2012) at 5 and 7 ppm levels, respectively. Also, dietary supplementation of cimaterol in diet of broiler chicks caused an increase in daily weight gain (Scholtyssek, 1998).

The performance response of quail to feeding various dietary levels of ractopamine has not been investigated by researchers until now, and this research has been conducted to study the effect of ractopamine on growth performance and serum biochemical parameters in Japanese quail.

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Materials and Methods

Two hundred fifty six Japanese quail at the age of 14 d were assigned randomly to one of eight dietary treatments containing 0, 0.5, 1, 2.5, 5, 7.5, 10 and 20 mg ractopamine per kg of diet and were fed for 4 weeks. All birds were located at 32 cages (8 birds in each cage). The basal diet was balanced on the basis of corn and soybean meal as recommended by National Research council (NRC, 1994). The composition of basal diet was: corn 51.25%, soybean meal 40.13%, fish meal 3.04%, soybean oil 2.30%, lysine hydrochloride 0.1 %, dicalcium phosphate 0.39%, carbonate calcium 1.27%, salt 0.2%, vitamin premix 0.25%, mineral premix 0.25%, DL-methionine 0.1% and sand 0.71%. Water and feed was available for the birds freely and lightning was consistent in the saloon. The body weight gain, feed intake and feed conversion ratio were measured during the whole period of the rearing (2-6 week old). At the end of experiment (42 days age), two birds were selected randomly from each cage and blood was collected from jugular vein for analysis of biochemical parameters. Serum was separated by centrifuge (2000×g for 10 min) and they were kept in the freezer at -20°C until assay. Total protein, albumin, uric acid, cholesterol and triglyceride in blood were measured by spectrophotometer enzymatic methods (Zist-Chem commercial kits) and globulin was calculated by differences between concentration of total protein and albumin in serum of birds. All quails were weighed, killed and weight of carcass (without feather, leg and internal organ) and some internal organs such as liver, heart, spleen, gizzard and testicle were weighed at the end of experiment.

Statistical analysis

The GLM procedure of SAS software (SAS, 2001) was used for data analysis of variance as completely randomized design. The significant difference among the mean were calculated by Duncan's multiple range tests at 0.05 level.

Results

The supplemental dietary effect of ractopamine on the body weight gain, feed intake and feed conversion ratio of quail are showed in Table 1. The addition of ractopamine at the level of 7.5 mg per kg of diet improved weight gain in quail. Although feed intake was not influenced by ractopamine supplement, but feed conversion ratio of birds reduced at the levels of 7.5 and 10 mg ractopamine per kg of diet.

Table 2 showed the effect of ractopamine on ratio weight of internal organs and carcass to the live body weight of male quail. The highest live body was found at 7.5 mg ractopamine per kg of the diet. Different dietary levels of ractopamine had no considerable effect on the relative weight of liver, spleen and gizzard, but it had significant ($P<0.05$) effect on relative weight of carcass, heart and testis of male quails.

Table 1: Effects of different dietary ractopamine level on growth performance of Japanese quail

Ractopamine (mg/kg)	Average daily gain (g/bird/day)	Feed intake (g/bird/day)	Feed Conversion Ratio
0	5.07^{c}	21.11	4.16^{a}
0.5	5.39^{bc}	21.31	3.95^{ab}
1	5.09^{c}	21.13	4.15^{a}
2.5	5.59^{ab}	21.75	3.89^{abc}
5	5.32^{bc}	21.17	3.97^{ab}
7.5	5.79^{a}	20.90	3.61^{c}
10	5.58^{ab}	21.30	3.81^{bc}
20	5.62^{ab}	21.11	3.75^{bc}
SEM*	0.1146	0.6303	0.0927

Columns values with same superscript or not superscript are not significantly different ($P<0.05$); *SEM: Standard error of mean

Table 3 shows the effect of ractopamine supplementation on biochemical parameter of blood in quail. Ractopamine supplement changed concentration of total protein and globulin ($P<0.05$) in serum of birds and had no effect on level of albumin, uric acid and triglyceride. Ractopmain supplement significantly increased ($P<0.05$) cholesterol level of quail serum.

Discussion

The current study demonstrated the positive dietary supplemental effect of ractopamine on performance of Japanese quail. Ractopamine, as a repartitioning agent, increased the blood flow to muscular tissues and as a result more nutrients are put at the disposal of these tissues (Mersmann, 1998; Mersmann, 2002). In the current study, the range of doses of ractopamine are similar as suggested by Ferreira et al. (2013).

Ractopamine improved weight gain and feed conversion ratio of quail at the level of 7.5 ppm in diet (Table 1) and this may be associated to the fact that beta agonist compounds decrease degradation of protein (Li and Jefferson, 1997; Lopez-Carlos et al., 2010) and increase protein accumulation (Zhang et al., 1995; Beerman, 2002). Beta agonists may also decrease lipogenesis and increase lipolysis (Ferreira et al., 2013); therefore energy utilization and the efficiency of consumed energy were improved for higher weight gain of animal (Mersmann, 2002). To produce one kilogram fat more energy is required compared to the same amount of protein and since this compound increases lipolysis and protein production and decreases their degradation, thus it enhances body weight gain and

Table 2: Effects of different dietary ractopamine level on live body weight and relative weight of carcass and internal organ to live body of male Japanese quail

Ractopamine (mg/kg)	Live body (g)	Carcass (%)	Liver (%)	Heart (%)	Spleen (%)	Gizzard (%)	Testis (%)
0	178.98^{c}	64.89^{b}	2.13	0.78^{ab}	0.06	2.30	1.29^{ab}
0.5	192.96^{abc}	67.94^{a}	2.22	0.76^{ab}	0.07	2.56	1.13^{ab}
1	185.71^{bc}	65.04^{ab}	1.86	0.73^{b}	0.06	2.29	1.31^{a}
2.5	195.66^{abc}	66.61^{ab}	1.83	0.72^{b}	0.05	2.49	1.20^{ab}
5	194.60^{abc}	66.75^{ab}	2.07	0.83^{a}	0.07	2.37	1.27^{ab}
7.5	203.87^{a}	66.35^{ab}	1.97	0.76^{ab}	0.06	2.22	1.06^{ab}
10	200.86^{ab}	66.26^{ab}	2.18	0.75^{ab}	0.05	2.53	0.95^{b}
20	201.55^{a}	66.78^{ab}	2.02	0.73^{b}	0.05	2.27	1.07^{ab}
SEM*	5.35	1.06	0.158	0.030	0.006	0.123	0.102

Columns values with same superscript or not superscript are not significantly different (P<0.05); *SEM: Standard error of mean.

Table 3: Effects of different dietary ractopamine level on blood biochemical parameters of male Japanese quail

Ractopamine (mg/kg)	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Uric acid (g/dl)	Cholesterol (mg/dl)	Triglyceride (mg/dl)
0	3.06^{b}	2.01	1.05^{b}	10.00	162.77^{c}	251.50
0.5	5.10^{a}	2.21	2.88^{a}	10.06	162.50^{c}	266.67
1	3.55^{b}	2.13	1.41^{b}	10.00	156.00^{c}	247.00
2.5	3.18^{b}	1.88	1.30^{b}	7.28	142.33^{c}	251.83
5	2.80^{b}	1.65	1.15^{b}	11.03	246.50^{a}	262.83
7.5	3.25^{b}	1.80	1.45^{b}	8.40	211.17^{b}	213.50
10	2.65^{b}	1.80	0.85^{b}	8.28	195.50^{b}	232.00
20	2.48^{b}	1.81	0.66^{b}	7.95	215.00^{b}	264.00
SEM*	0.444	0.182	0.359	1.561	7.497	20.16

Columns values with same superscript or not superscript are not significantly different (P<0.05); *SEM: Standard error of mean

growth (Ricks et al., 1984; Richardson et al., 1991; Zhang et al., 1995; Ferreira et al., 2013). Results in our study are consistent with the research of Zare Shahneh et al. (2012) who used salbutamol as a beta agonist in diet of quail. Also, Ansari-pirsaraei et al. (2006) reported using 5ppm terbutaline in diet of broiler chicks improve feed conversion ratio of chicks and Jalali-Haji-Abadi et al. (2010) showed that 10 ppm of ractopamine in dietary of fish has beneficial effect on growth of rainbow trout.

Ractopamine had no effect on feed intake in quail (Table 1). Some researchers showed that using β receptor agonists had no change in feed intake of lamb (Richardson et al., 1991), cow (Ricks et al., 1984) pig (Warriss et al., 1990) and broiler chick (Kheiri, et al., 2011). On the other hand, Richardson et al. (1991) observed improvement in feed conversion ratio by using β receptor agonists in the lamb's diets.

Ractopamine supplementation improved live body weight and ratio of carcass male quail (Table 2). In agreement to these results, other reports on beta agonist such as terbutaline showed that 5 ppm terbutaline in diet increased the live and carcass weight and ratio of carcass weight of male broiler chicken (Ansari-pirsaraei et al., 2006) and the same level of salbutamol improved the percent of breast weight in quail (Zare-Shahneh et al., 2012).

Some blood biochemical parameters of serum in quail were affected by ractopamine supplementation. The total protein and globulin at the level of 0.5ppm and cholesterol at the 7.5ppm ractopamine in diet were higher in the sera of birds. The higher level of total protein and globulin in blood serum of ractopamine supplemented treatments may be related to the enhancement of protein synthesis of ractopamine (Jalali-Haji Abadi et al., 2010). It is possible that increasing cholesterol level in serum is the result of degradation of fats in the body (Ansari-pirsaraei et al., 2006) and these results are in agreement with the findings of other reports (Hansen et al., 1997; Jalali-Haji Abadi et al., 2010; Kheiri et al., 2011).

The current investigation proved that dietary supplementation of ractopamine at the level of 7.5 mg improved weight gain and feed conversion ratio in Japanese quails. Further, higher dietary level of ractopamine had no beneficial effects on growth performance in quails.

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