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The effects of different levels B-adrenergic agonist (Ractopamine) on performance and some blood parameters in broiler chickens

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ABSTRACT

The objectives of this experiment were to investigate effects of different levels B-adrenergic agonist (Ractopamine) on performance and some blood parameters in broiler chickens. For this experiment 240 Ross 308 broiler chicks were randomly assigned to four dietary treatments (CRD; 4 treatments with 4 replicate (15 chicks in each replicate). From days 21 to 42 of the rearing period, ractopamine was fed (mixed in grower diet) daily at the rate of 0, 5, 7.5 and 12 mg per kg of the predicted dietary intake. In this experiment chickens performance including feed intake, weight gain and feed conversion ratio (FCR) were measured. At the end of experiment blood samples were taken via wing vein from one randomly-selected chicken per each replicate and sera stored at -20°C until analysis for glucose, cholesterol, triglycerides (TG), insulin and uric acid. The general linear model procedure of SAS software was used for data analysis and differences among treatment means determined using the Duncan's multiple-range test. The results showed that the inclusion of ractopamine had a significant effect on performance of broiler chickens ($P<0.05$). Adding ractopamine to the diet significantly increased serum glucose, cholesterol and triglyceride concentrations ($P<0.05$). From the results of the present experiment it could be concluded that utilisation of ractopamine in diets was effective for improving the performance of broiler chickens.

Key words: Broiler chickens, Blood parameters, Performance, Ractopamine

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INTRODUCTION

Increased demand at the consumer level for leaner meats has led the livestock industry to search for ways of producing lean meat more efficiently. This demand promote research to develop a class of compounds called growth stimulator, which have a repartitioning effect on nutrients in livestock. Feeding programs have primarily emphasized live performance of meat birds taking into account effect on live weight gain, feed conversation and some time live ability [16]. Commercial broiler stocks that have been bred for meat production possess rapid growth performance but have excessive fat deposition associated with adipose cellularity [4]. A number of experiments conducted to find alternative to antibiotics revealed that no single alternative exists with the effects comparable to antibiotics [15]. There is need to find more efficient alternatives or combinations of different alternatives for maintaining health and improving performance of poultry. Other group of stimulators are beta-adrenergic. The beta-adrenergic (βAR) belong to a large family of seven transmembrane domain proteins that couple and signal through

guanine nucleotide binding proteins (G-proteins). Three βAR subtypes have been cloned and all signal in a similar manner. The binding of β-agonist promotes the interaction between the intracellular domains of the βAR and the heterotrimeric G-protein Gs [12]. B-agonists specifically enhance the growth of muscle and give a small reduction in the growth of fat. b-agonists 'effects are mediated by modifying specific metabolic signals in muscle and fat cells with a resulting increase in nutrients directed toward lean growth. Directing nutrients to tissues of highest priority is a normal metabolic process. This nutritive flow takes place as an ongoing hourly, daily, and weekly adjustment directed by internal body signals. Excess carcass fatness in broiler chicks is now of focus to both whom consume and produce. In taking high amounts of fat could be certain cause for cancer and cardiovascular diseases [8]. Fat deposition can be influenced by environmental causes such as nutrition and genetic factors [13]. Genetic manipulate influences the quantity of fat while, nutrition factors cause both quantity and quality of fat. Therefore it's better to mostly focus on the nutrition factors [10]. Fat metabolism can be manipulated by some feed additives. The binding of b-agonists with specific receptors on the surface of muscle and fat cells (b-adrenergic receptors) generates these signals. When b-agonists bind to these receptors on the surface of the fat cell, signals are produced inside the cell that decrease fat synthesis and increase fat degradation, resulting in a slower rate of fat deposition. In muscle cells, the outcome of the internal signaling is a substantial increase in the rate of muscle protein synthesis and deposition. As a result, muscle synthesis is faster and fat synthesis is slower. Because it takes only half the energy to deposit lean compared to fat, the outcome is a leaner animal that utilizes feed more efficiently. Because this effect is primarily on muscle in the carcass, dressing percentage is increased [5]. For example one of b-agonists is ractopamine (RAC). The b-agonist ractopamine has recently been approved for use in many countries as an in feed ingredient to increase lean tissue growth and improve production efficiency. Ractopamine hydrochloride (RAC) is used for altering fat metabolism and deposition, according to their lipolytic and growth promoter properties. Since 1963, β-adrenergic (β-AR) agonist was used in broiler diets, due to its effects on growth and carcass traits [4]. In 2003 the Food and drug administration approved RAC is a β-AR agonist to be used in cattle and swine diets [21]. β-AR agonists modify effects on growth and fat metabolism [11]. Glucose lactate and insulin in the blood serum were increased by β-AR agonists [2, 13]. Treatment of animal with b-agonists, particularly ractopamine (RAC), generally has given dose-dependent improvements in ADG, FCR and carcass lean content [6]. In this experiment stimulator ractopamine was in form powder, added to diet. The aim of this research were to examine the effects of different levels ractopamine on growth performance and some blood metabolites in broiler chickens.

MATERIALS AND METHODS

This study was conducted in the Rezvan junior college aviculture farm in kerman provinces (latitude 25^0 $55^/$ N, longitude 53^0 $26^/$ E, altitude 1755m) from July to September 2010. 240 chickens (female and male) of the strain (Ross 308) were reared from 1 to 49 days old. Chickens were allocated to four groups with four replications per group and per replication including 15 chicken. This experiment was conducted by using completely randomized design and four dietary treatments were utilized. The treatment involved: control, basal diet plus 5 mg/Kg, basal diet plus 7.5 mg/Kg, basal diet plus and 12 mg/Kg ractopamine stimulator. These levels of stimulator selected base on optimum recommended level in some researches. Experimental diets were fed from 3 to 7 weeks of age. The birds were fed ad libitum with diet formulated to meet nutrient requirements of broiler chickens (NRC 1994). In this experiment chickens performance including feed intake, weight gain and feed conversion ratio (FCR) were measured. At the end of experiment blood samples were taken via wing vein from one randomly-selected chicken per each replicate and sera stored at -20°C until analysis for glucose, cholesterol, triglycerides (TG), insulin and uric acid.

Statistical Analyses

Data were analyzed by ANOVA using General Linear Models procedure of SAS software [18]. Means were compared using Duncan's multiple range test. Level of significance used in all results was 0.05. Least square treatment means were compared if a significant F statistic (5% level of P) was detected by analysis of variance.

RESULTS AND DISCUSSION

The effect of different levels of supplemental ractopamine on performance of broiler chickens are presented in Table 1. The results indicated that inclusion of ractopamine had a significant effect on feed intake, feed conversion ratio (FCR) and body weight gain ($P<0.05$). Feed intake (g/chick/day) was higher in control compared with other treatments. With increase ractopamine levels, feed intake was reduced that this differents was statistically significant between treatments ($P<0.05$). Feed conversion ratio (FCR) was lower in four treatment (12 mg) compared with that

of other treatments. Feed conversion ratio was reduced with increasing the levels of ractopamine. The body weight gain was statistically significant between treatments (P<0.05). The body weight gain was higher in four treatment (12 mg) compared with other treatments. The body weight gain also was increased with increasing the levels of ractopamine.

Table 1: Effects of supplemental dietary ractopamine on performance of brioler chicks.

Treatments	Performance Traits		
Ractopamine (mg/kg)	Feed Intake (g/chick/day)	Feed conversion ratio (g: g)	Body weight gain (g/chick/day)
0 (Control)	131.03±0.74^{c}	2.33±0.58^{d}	58.51±1.08^{d}
5	127.40±0.67^{b}	2.28±0.63^{c}	65.73±1.21^{c}
7.5	125.35±1.02^{b}	2.09±0.45^{b}	71.91±0.95^{b}
12	120.85±0.94^{a}	1.99±0.37^{a}	76.38±1.15^{a}
P-Values	0.0138	0.0051	0.0043
SEM	0.438	0.561	0.675

Means (±SD) within a column showing different super scripts are significantly different (P<0.05).

The results of this experiment were in agreement with several researchers have shown the positive effect of β-AR agonist on growth rate [17, 23]. Mersmann [11] reported an improvement in DBWG and FI of broilers according to supplemental β-AR agonist. The response of broilers to supplemental β-AR agonist can be different in type and dose of β-AR agonist, broiler strain, age and also duration of β-AR agonist consumption [11, 3]. Our results are in contrast with the finding of Kheiri et al. [9] who reported that the dietary ractopamine supplementation had no significant effect on growth performance of brioler chicks. Buyse et al. [3] demonstrated that the announced no significant effect of clenbuterol on weight gain and final body weight of broilers. The Addition of cimaterol to the diet of broiler did not improve DBWG [4]. The effects of different levels of supplemental ractopamine on concentration of some biochemical metabolites of broiler chickens are presented in Table 2. The results revealed that inclusion of ractopamine had a significant effect on concentrations of glucose, cholesterol and triglycerides (P<0.05). Adding ractopamine to the diet increased serum glucose, cholesterol and triglyceride significantly (P<0.05). The concentrations of these metabolites were higher in four treatment (12 mg) compared with other treatments. In addition, the concentrations of these metabolites were increased with increasing the levels of ractopamine. Results from tables 2 elucidated that the serum concentrations of insulin and uric acid were not affected by inclusion of ractopamine (P>0.05).

Table 2: Effects of supplemental dietary ractopamine on blood biochemical parameters of broiler chicks

Treatments	Blood Serum Parameters				
Ractopamine (mg/kg)	**Glucose**	**Cholesterol**	**Triglycerides**	**Insulin**	**Uric Acid**
0 (Control)	127.04±1.04^{c}	58.03±0.88^{d}	131.21±1.28^{d}	1.48±0.83^{b}	5.27±0.68^{b}
5	131.40±0.87^{b}	68.50±0.68^{c}	138.40±1.14^{c}	1.35±0.94^{b}	5.43±0.75^{b}
7.5	135.35±1.12^{a}	76.20±1.06^{b}	143.26±1.02^{b}	1.06±1.33^{b}	4.77±0.91^{b}
12	136.85±0.91^{a}	83.99±1.31^{a}	159.98±1.05^{a}	0.99±1.24^{b}	4.93±1.01^{b}
P-Values	0.028	0.035	0.043	0.128	0.241
SEM	0.348	0.431	0.278	0.612	0.491

Means (±SD) within a column showing different super scripts are significantly different (P<0.05).

In this experiment blood glucose was increased by using RAC (p<0.05). Blood insulin and uric acid were decreased by adding RAC (p>0.05). Many hormones are effective in releasing insulin. β-AR agonist (mainly epinephrine) with stimulating the secretion of glucose block the desertion of insulin [17]. The results of this experiment were in agreement with the several researchers have shown that the β-AR agonist increased blood glucose [1, 7, 14]. Increasing the amount of glucose by the utilization β-AR agonist could be the reason for enhance of hormone sensitive lipase on fats and their uses besides glucose as β-oxidation [19]. Using β-AR agonist decreased the amount of blood insulin of sheep [11]. This decreasing was the reason for the increase of blood glucose amount and lipolysis. On the other hand by using β-AR agonist gluconeogenesis and glucose increased [8, 20]. β-AR agonist increased blood glucose as the other researchers showed [7, 14]. β-AR agonist plus increasing gluconeogenesis, block glycolysis [22]. Blood cholesterol and triglyceride increased when RAC was added to the diet. These results indicated that RAC alters the trend of fat metabolism also shifts fat towards β-oxidation. RAC was effective in the mobilization of the fat and their movement according to the other researchers [10]. Added RAC to the diet was reduced uric acid. Changes in blood uric acid suggest an involvement of RAC in protein metabolism. Especially the reduction of uric acid results the increase of protein metabolism and maybe sparing effects in using protein after adding RAC. The results of RAC in increasing blood protein and also percentage of thigh confirm the finding of

[11], who reported simulative effect of RAC in protein synthesis. Our results are in agreements with the report [21], regarding simulative effect of RAC on protein synthesis.

CONCLUSION

The present investigation suggested that the adding ractopamine to the diet at a level of 12 mg/kg diet can improve growth performance of broiler chickens. Thus, supplementation of ractopamine at levels above recommended as nutritional requirements for improve performance. In addition, improving performance of broiler chickens by ractopamine supplementation is relatively a novelt results, so the immune effect of ractopamine could be the subject of further investigations.

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