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EFFECTS OF BACTERIOCIN AND ORGANIC ACIDS ON GROWTH PERFORMANCE OF JAPANESE QUAILS

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Abstract

The aim of this study was investigate the effects of bacteriocin and organic acids on growth performance of Japanese quails. 600-day-old Japanese quails of mixed sex were randomly divided into six experimental groups. Each group included five replicates of 20 chicks per pen. Chicks were fed a control diet, 150 mg/kg bacteriocin, 300 mg/kg bacteriocin, 3 g/kg organic acid, 150 mg/kg bacterocin + 3 g/kg organic acid (Selacid® GreenGrowth MP), 300 mg/kg bacteriocin + 3 g/kg organic acid for 35 days. Active ingredients of Selacid® GreenGrowthMPweresorbicacid, formicacid, aceticacid, lacticacid, propionicacid, ammoniumformate, citricacid 1,2-propanediol, coconut/palmkernelfattyaciddistillate, silicondioxide (SiO2). There were no effects of dietary treatments on body weight, body weightgain, feedintakeandfeedconversionratio of Japanesequails.

Key words: *bacteriocin, organic acid, growth performance, quail.*

INTRODUCTION

Maintaining microflora balance and gut health of chicks is one of the major issues of modern poultry nutrition to prevent diseases by controlling the proliferation of potentially pathogen microorganism (Józefiak et al., 2010; Jothi et al., 2012). Therefore, antibiotics have been widely used as growth promoters and therapeutic treatments for more than 50 years in animal nutrition (Dibner and Richards, 2005; Diez-Gonzalez, 2007). But, the appearance of antibiotic resistant bacteria and residual antibiotics in meat caused to ban of antibiotics. Ban of antibiotics in 2006 and increasing demand of organic production have increased interest in searching for alternative to antibiotics (Dahiya et al., 2006; Shin et al., 2008; Tatsadjieu et al., 2009). Probiotics, prebiotics, organic acids, essential oils and plant extracts, bacteriocins, antimicrobial peptides, bacteriophages and feed enzymes take place among these alternatives (Joerger, 2003; Józefiak et al., 2007; Shin et al., 2008; Alloui et al., 2013). Bacteriocins, which are one of these alternatives, are ribosomally synthesized antimicrobial substances of proteinaceous character and are active against bacteria more or less related to the producing bacteria (Klaenhammer, 1993; Cigánková et al., 2004; Gillor et al., 2005, 2008). Bacteriocin received much attention because of their wide antibacterial spectrum and their potential application in foods and feeds for controlling spoil age and pathogenic microorganism (Cleveland et al., 2001; Stern et al., 2006, Rihakova et al., 2009; Józefiak et al., 2010; Musikasang et al., 2012). As food preservative, Nisin is a bacteriocin produced by certain strains of *Lactococcus lactis subsp. Lactis* and widely used in the world uptodate (Kišiyadová et al., 2003; Ogunbanwo et al., 2003; Li et al., 2005). Organic acids are another alternative feed additives to antibiotics (Soltan, 2008; Hermans et al., 2010; Menconi et al., 2013). Organic acids are considered to be any organic carboxylic acid, including fatty acids and amino acids, of the general structure R-COOH and widely used in animal nutrition as feed acidifers (DibnerandButtin, 2002; Ricke, 2003). They reduce feed buffering capacity and decrease pH of feed, crop and intestinal contents and thus inhibit the growth of pathogen bacteria in food, gastrointestinal tract and also improve the solubility of minerals though increase digestive enzymes activity (Yesilbag ve Colpan, 2006; Liem et al., 2008; Housmand et al., 2011; Swiatkiewics and Arczewska-Wlosek 2012 a, b). Despite the reare many studies that researched the effects of organic acids on performance of quails, studies that investigated the effects of bacteriocins on performance of quails are limited. Therefore, the objective this study was to determine the effects of bacteriocin and organic acids on performance of Japanese quails.

MATERIALS AND METHODS

Experimental procedures were approved by Institutional Animal Care and Use Committee of Adnan Menderes University.

BIRDS, DIETS AND MANAGEMENT

In this study, 600-day-old Japanese quail chicks (*Coturnix coturnix japonica*) of mixed sex were used. Chicks were weighted and randomly divided into six experimental groups. Each group included five replicates of 20 chicks per pen (6x5x20). The experiment was lasted for 35 days. Chicks were fed a control diet, 150 mg/kg bacteriocin (B150), 300 mg/kg bacteriocin (B300), 3 g/kg organic acid(Selacid® GreenGrowth MP) (OA), 150 mg/kg bacterocin + 3 g/kg organic acid (B150+OA), 300 mg/kg bacteriocin + 3 g/kg organic acid (B300+OA) for 35 days. Active ingredients of Selacid® GreenGrowth MP weresorbicacid, formicacid, aceticacid, lacticacid, propionicacid, ammoniumformate, citricacid 1,2-propanediol, coconut/palm kernel fatty acid distillate, silicon dioxide (SiO2). Nisin was used as bacteriocin in this study and it was microencapculated according to Stern et al., (2006). The diets formulated to meet requirements of quail according to the NRC (1994) in Table 1.

Table 1 Ingredients and chemical composition of experimental diets

Ingredients (%)	Control	B150	B300	OA	B150+OA	B300+OA
Corn	47.90	47.89	47.87	47.70	47.70	47.70
Soybean meal	45.5	45.5	45.5	45.5	45.49	45.47
Vegetable oil	3.7	3.7	3.7	3.6	3.6	3.6
Bacteriocin	0	0.015	0.030	0	0.015	0.030
Organic acid	0	0	0	0.3	0.3	0.3
Dicalcium phosphate	0.65	0.65	0.65	0.65	0.65	0.65
Calcium carbonate	1.4	1.4	1.4	1.4	1.4	1.4
Salt	0.3	0.3	0.3	0.3	0.3	0.3
DL-Methionin	0.2	0.2	0.2	0.2	0.2	0.2
Vitamin premix[1]	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix[2]	0.1	0.1	0.1	0.1	0.1	0.1
Nutrient Composition (%)						
Dry matter	87.55	87.53	87.52	87.28	87.26	87.25
Crude protein	23.97	23.97	23.97	23.95	23.95	23.94
Crude fiber	4.26	4.26	4.26	4.26	4.26	4.26
Ether extract	5.78	5.78	5.78	5.68	5.68	5.68
Ash	5.84	5.84	5.84	5.83	5.83	5.83
Metabolizable energy (kcal/kg)	2897.72	2897.23	2896.74	2882.36	2882.03	2881.70
Calcium	0.87	0.87	0.87	0.87	0.87	0.87
Available phosphorus	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.56	0.56	0.56	0.56	0.56	0.56
Methionine + Cystine	0.95	0.95	0.95	0.95	0.95	0.95
Lysine	1.33	1.33	1.33	1.33	1.33	1.33

[1] Each 2.5 kg vitamin premix contained: 15000000 IU Vit. A, 3000000 IU Vit. D_3, 50000 mg Vit. E, 5000 mg Vit. K_3, 3000 mg Vit. B_1, 6000 mg Vit. B_2, 5000 mg Vit. B_6, 30 mg Vit. B_{12}, 50000 mg Vit. C, 25000 mg Niacin, 12000 mg Cal.D-Pantothenate, 75 mg D-Biotin, 1000 mg Folic Acid.
[2] Each 1 kg mineral premix contained: 80000 mg Mn, 60000 mg Fe, 60000 mg Zn, 5000 mg Cu, 1000 mg I, 200 mg Co, 150 mg Se, 200000 mg Choline Cloride %60.

The quails were allowed access to the feed and water *ad libitum* during the experimental period. The chemical composition of the diets was determined based on the methods of Association of Official Analytical Chemists (AOAC, 1997). During the experiment, the body weight and feed consumption of quails were recorded weekly. Body weight gain was determined by taking body weight differences between weeks.
Feed conversion ratio (feed consumed per 1 g of body weight gain) was calculated.

STATISTICAL ANALYSIS

Data were analysed by ANOVA using the GLM procedure with SAS 8 software. The differences among the means were tested using Duncan's multiple range tests. All statements of significance were based on a probability of P<0.05.

RESULTS AND DISCUSSIONS

Effects of bacteriocin and organic acids on growth performance of Japanese quails were given in Table 2. Bacteriocin supplementation slightly increased performance of quails. But, there were no statistically differences between body weight, body weight gain, feed consumption and feed conversion ratio in the groups (P>0.05). Studies investigated the effects of bacteriocin on performance of quails could not be found. However, there are many studies conducted with broilers and laying hens. Many studies reported positive effects of bacteriocin on performance of broilers (Wang et al., 2011; Jozefiak, 2013; Jothi 2012) and laying hens (Wang et al., 2014;Loh et al., 2014). Our results are in agreement with several reports indicating that bacteriocin addition had no effects on performance of broiler and laying hens (Ogunbanwo et al., 2004; Chen et al., 2012; Guo et al., 2012; Józefiak et al., 2012). Józefiak et al., (2011) reported that despite the liquid bacteriocin had no effect on performance of broilers, lyophilized non-encapsulated bacteriocin improved performance of broilers.

Table 2 Effects of bacteriocin and organic acids on growth performance of Japanese quails

	Diets	Week 1	Week 2	Week 3	Week 4	Week 5
Body Weight (g)	Control	22.85±1.53	63.12±7.19	102.51±6.00	138.69±5.09	169.45±5.95
	B 150	23.46±1.98	63.32±2.18	102.52±8.27	139.21±1.26	171.00±7.22
	B 300	23.64±2.59	63.47±1.27	102.68±3.76	139.12±4.34	170.43±3.58
	OA	23.93±2.30	63.81±9.54	102.47±5.28	139.10±3.36	170.39±6.40
	B 150+OA	23.17±0.93	63.52±2.26	102.13±2.33	138.81±1.58	170.18±3.67
	B 300+OA	23.12±2.55	63.96±1.89	103.67±3.74	141.28±3.29	171.60±4.80
Body Weight Gain (g/day/bird)	Control	2.11±0.22	5.76±1.12	5.63±0.60	5.17±0.39	4.40±0.24
	B 150	2.20±0.28	5.69±0.23	5.60±1.29	5.24±1.28	4.54±1.09
	B 300	2.23±0.37	5.69±0.39	5.60±0.52	5.21±0.31	4.48±0.31
	OA	2.27±0.33	5.70±1.25	5.52±1.02	5.23±0.48	4.47±0.59
	B 150+OA	2.16±0.13	5.76±0.33	5.52±0.51	5.24±0.39	4.48±0.43
	B 300+OA	2.15±0.37	5.83±0.47	5.67±0.60	5.37±0.22	4.33±0.10
Feed Consumption (g/day/bird)	Control	2.86±0.42	8.29±0.10	17.59±0.15	19.33±1.67	20.97±2.57
	B150	2.88±0.40	8.39±0.27	17.86±0.49	18.94±2.43	20.76±2.82
	B 300	2.86±0.53	8.41±0.24	17.67±0.43	18.76±3.25	20.75±3.79
	OA	2.85±0.27	8.36±0.21	17.65±0.57	18.34±4.37	20.74±1.87
	B 150+OA	2.82±0.20	8.27±0.10	17.73±0.63	18.61±2.77	20.87±2.78
	B 300+OA	2.66±0.24	8.22±0.20	17.62±0.40	18.42±0.58	20.64±1.18
Feed Conversion Ratio	Control	1.36±0.25	1.48±0.28	3.15±0.32	3.75±0.33	4.76±0.39
	B150	1.32±0.22	1.48±0.08	3.36±0.96	3.76±0.92	4.68±0.63
	B 300	1.30±0.27	1.48±0.12	3.18±0.34	3.62±0.68	4.67±1.02
	OA	1.28±0.23	1.54±0.43	3.28±0.54	3.53±0.91	4.69±0.61
	B 150+OA	1.31±0.13	1.44±0.08	3.23±0.28	3.55±0.48	4.70±0.82
	B 300+OA	1.26±0.24	1.41±0.10	3.13±0.29	3.43±0.21	4.76±0.23

Values are means ± standard deviation (SD).

Additionally, Józefiak et al., (2013) investigated the effects of bacteriocin supplementation at 100 IU, 300 IU, 900 IU and 2700 IU on broiler chicks and reported that only 900 IU and 2700 IU levels of bacteriocin positively affected the performance of broilers. In this study, organic acid supplementation did not affect the body weight, body weight gain, feed consumption and feed conversion ratio of quails (P>0.05). Similarly, several studies reported that organic acids had no effects on performance of quails (Abdel-Mageed, 2012;

Fazilat et al., 2014; Yusuf et al., 2015). Ocak et al., (2009) showed that addition of malic acid did not affect the feed efficiency. But, it increased body weight gain and feed consumption of quails. Another study reported that weight gains and feed efficiency of quails were improved with butyric acid supplementation. However, feed intake only numerically decreased with butyric acid (Salmanzadeh, 2013). Peyman et al., (2014) showed that organic acid supplementation improved body weight, body weight gain, feed intake and feed efficiency. Our results showed that combination of organic acids and bacteriocin had no effects on performance of quails. Similar results were observed by Çakır et al., (2008). They compared the effects of combined probiotic-prebiotic mixture and organic acid supplementation and reported that dietary treatments did not affect performance of quails. However, Ghosh et al., (2007) observed that performance of quails was improved with organic acid-prebiotic mixture.

CONCLUSIONS

In conclusion, single and combined dietary supplementation with bacteriocin and organic acid had no beneficial effects on quail performance in present study. However, performance characteristics numerically improved with dietary treatments. Various results have been observed in studies conducted with organic acids and bacteriocins in poultry. Thus, it is needed to more studies conducted under different conditions to understand the mode of action of bacteriocin and organic acid on performance of poultry.

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