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Influence of Three Different Organic Acids on Broiler Performance

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Abstract: This study was conducted in order to evaluate three different organic acids on broiler performance. The broiler performance have compared together with using RCD design with 7 treatments and 4 replicates which 420 day-old commercial Ross 308 chicks were divided into 28 groups. The six groups out of seven groups birds fed a diet with organic acids (citric, benzoic and tartaric acids) consist 0.5 or 1% level and one group fed with a diet control without organic acids for 49 days. The average of body weight gain, feed intake, feed conversion ratio and carcass percentage were analyzed and compared finally. The results showed no significant effects of diets with 0.5% organic acids ($p < 0.05$) on all characters. One percent benzoic acid diets caused a significant decrease in the average of feed consumption from 21 to 42 days of age ($p < 0.05$). The average weight gain at 21 to 42 days showed a significant decrease ($p < 0.05$) that this effect was resulted of benzoic acid at 1% of dietary. There were no significant effects of organic acids dietary on carcass characteristics.

Key words: Broiler, organic acid, performance

INTRODUCTION

During the last 50 years, as a growth promoter in farm animal, the use of antibiotics has been questioned. It is clear that antibiotics benefit for growth, performance and health in animal and poultry. Most of antibacterial performance promoters have been prohibited, because feeding of antibiotics is risky which the last ones removed in January 2006 (Neu, 1992). The adjustments following the withdrawal of these products in animal production have been difficult at times and many replacement solutions have been proposed, more or less successfully, by the feed additive industry. Organic acids are important approach that have potential to improve performance in poultry (Patterson and Burkholder, 2003; Rieke, 2003) and also provided people with healthy and nutritious poultry products (Patten and Waldroup, 1988; Rieke, 2003).

Generally, organic acids are weak acids and do not dissociate completely in water. They are widely distributed in nature as normal constituents of plants or animal tissues and formed through microbial fermentation of carbohydrates mainly in the large intestine (Partanen and Mroz, 1999). Organic acids are also found in their sodium, potassium or calcium form.

Citric acid, in biochemistry, it is important as an intermediate in the citric acid cycle and therefore, occurs in the metabolism of virtually all living things. More than 50% of citric acid production is being used as acidulent in beverages and some 20% in other food applications.

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Benzoic acid has higher molecular weight and are insoluble in molecular form and tartaric acid is a white crystalline diprotic organic acid. It is used as an antioxidant.

Roy *et al.* (2002) used propionic acid and they observed highly significant reduction in turkey mortality. Boling *et al.* (2000) showed that using of citric acid to a P deficient broiler diet linearly increased weight gain, weight and percentage of tibia ash. Snow *et al.* (2004) reported that the effect of citric acid on phytate P utilization is additive with the effects of phytase and 1- α cholecalciferol supplementation. Falkowski and Aherne (1984) revealed that feed conversion efficiency was improved ($p < 0.05$) approximately 5 to 10% by addition of either acid to the diet. Supplementation of some organic acids to a P-deficient diet has been shown to improve phytate P utilization (Liem *et al.*, 2008). In this study, we investigated the potential benefit of three different organic acids in broiler.

MATERIALS AND METHODS

Four hundred twenty day old broiler chicks of the Ross 308 strain reared during 2009 in the Department of Animal Science, Islamic Azad University, Darab Branch, Darab, Fars, Iran. The chicks were allocated to 28 cages, in a completely randomized design, consisting of 7 dietary treatments (Control, 0.5% citric acid, 1% citric acid, 0.5% tartaric acid, 1% tartaric acid, 0.5% benzoic acid and 1% benzoic acid) with 4 replicates. The experiments were conducted in electrically heated wire mesh floor battery brooders. The fluorescent lights were on 24 h each day. The temperature of the room was maintained at 22°C. Environmental conditions during the trial were appropriate to the age of the birds. The mash basal diets are shown in Table 1. Feed and water were supplied *ad libitum*. Feed intake and body weights were recorded at allotment day 21, 42 and 49. Subsequently, feed conversion ratios were computed. After termination of the growth trial, three birds of median weight from each pen were sacrificed at day 49. Carcass yield, breast muscles, thigh muscles and abdominal fat were determined.

Data were analyzed using one-way ANOVA of SAS 9 for Windows when significant differences were found, means were separated. Comparisons of the treatment means were performed with Duncan's multiple range test (Duncan, 1955).

Table 1: Composition and chemical analysis of the organic basal diet and supplements for broiler chickens

Ingredients	Starter (0-21 days)			Grower (22-42 days)			Finisher (23-49 days)		
	I	II	III	I	II	III	I	II	III
Corn grain	62.14	61.69	61.49	69.12	69.12	68.62	73.16	73.66	72.16
Soybean meal (48% CP)	30.65	30.40	30.10	23.81	23.31	23.31	21.51	20.51	20.51
Fish meal (70% CP)	3.50	3.50	3.50	3.50	3.50	3.50	2.00	2.00	2.00
Oyster shell	1.95	1.95	1.95	1.88	1.88	1.88	1.67	1.67	1.67
Dicalciumphosphat	1.02	1.02	1.02	0.86	0.86	0.86	0.86	0.86	0.86
Salt (NaCl)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Premix (Vit.+Min.)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
DL-Methionine	0.14	0.14	0.14	0.03	0.03	0.03	--	--	--
Organic acid	--	0.50	1.00	--	0.50	1.00	--	0.50	1.00
ME (kcal kg ⁻¹)	2851.03	2834.84	2821.45	2936.76	2908.88	2908.88	2982.13	2943.08	2959.83
Crude protein (%)	21.11	21.05	20.90	18.81	18.54	18.54	17.19	16.70	16.75
Lysine (%)	1.21	1.21	1.20	1.04	1.02	1.02	0.89	0.87	0.87
Met+Cys (%)	0.85	0.85	0.85	0.67	0.67	0.67	0.59	0.59	0.59
Ca (%)	1.10	1.30	1.19	1.10	1.10	1.10	0.97	0.97	0.97
Avia. Phosphorus (%)	0.42	0.60	0.42	0.38	0.38	0.38	0.34	0.34	0.34
Na (%)	0.14	0.14	0.14	0.14	0.14	0.14	0.12	0.12	0.12

I: Diets without organic acid, II: Diets with 0.5% organic acid, III: Diets with 1% organic acid

RESULTS AND DISCUSSION

The results showed no significant effects of diets with 0.5% organic acids ($p < 0.05$) on average weekly feed intake, average weekly body weight gain and average weekly feed conversion (Table 2-4, respectively). The 1% benzoic acid diets caused a significant decrease in the average of feed consumption from 21 to 42 days of age ($p < 0.05$). The average weight gain at 21 to 42 days showed a significant decrease ($p < 0.05$) that this effect was resulted using benzoic acid at 1% of dietary. There were no significant effects of organic acids dietary on carcass characteristics (Fig. 1). The present finding are in conformity with the report of Fancher and Jensen (1988) that reported when propionic acid is supplemented up to 3% in the diet, no significant effects on feed intake. Liem *et al.* (2008) showed that addition of citric acid, malic acid and fumaric acid did not increase the 16-d body weight and gain:feed. The performance results were similar in birds fed the control diet and the diet with 0.1% of benzoic acid. The dietary inclusion of benzoic acid at 0.2% depressed the growth of broiler chickens ($p < 0.05$) (Józefiak *et al.*, 2008).

Table 2: Effect of different organic acids on average weekly feed intake in broiler chickens (g)

Treatments	Weeks			
	0-3	3-6	6-7	0-7
Control	839.000	2731.000 ^a	1121.000	4691.100
Citric acid (0.5%)	835.500	2725.250 ^a	1123.250	4684.110
Citric acid (1%)	841.250	2728.000 ^a	1133.250	4702.500
Tartaric acid (0.5%)	836.000	2734.000 ^a	1130.750	4700.750
Tartaric acid (1%)	827.000	2718.000 ^a	1107.750	4662.750
Benzoic acid (0.5%)	840.750	2744.250 ^a	1129.000	4714.000
Benzoic acid (1%)	835.500	2698.750 ^b	1101.250	4635.500
CV	1.497	0.536	1.253	0.847

Means having the same subscript letters do not differ significantly at 5% level

Table 3: Effect of different organic acids on average weekly body weight gain in broiler chickens (g)

Treatments	Weeks			
	0-3	3-6	6-7	0-7
Control	483.480	1223.600 ^a	465.780	2237.300
Citric acid (0.5%)	487.430	1224.600 ^a	452.830	2204.870
Citric acid (1%)	492.000	1251.580 ^a	464.880	2238.410
Tartaric acid (0.5%)	486.780	1225.600 ^a	445.430	2197.830
Tartaric acid (1%)	475.080	1220.250 ^a	437.550	2172.900
Benzoic acid (0.5%)	491.630	1240.580 ^a	468.200	2240.460
Benzoic acid (1%)	468.620	1191.430 ^b	444.730	2149.760
CV	3.434	1.485	5.831	2.243

Means having the same subscript letters do not differ significantly at 5% level

Table 4: Effect of different organic acids on average weekly Feed Conversion Ratio (FCR)

Treatments	Weeks			
	0-3	3-6	6-7	0-7
Control	1.735	2.635	2.632	2.057
Citric acid (0.5%)	1.715	2.057	2.707	2.076
Citric acid (1%)	1.710	2.028	2.655	2.054
Tartaric acid (0.5%)	1.717	2.062	2.772	2.091
Tartaric acid (1%)	1.745	2.066	2.767	2.095
Benzoic acid (0.5%)	1.712	2.047	2.627	2.105
Benzoic acid (1%)	1.785	2.089	2.702	2.103
CV	2.238	1.220	3.267	1.808

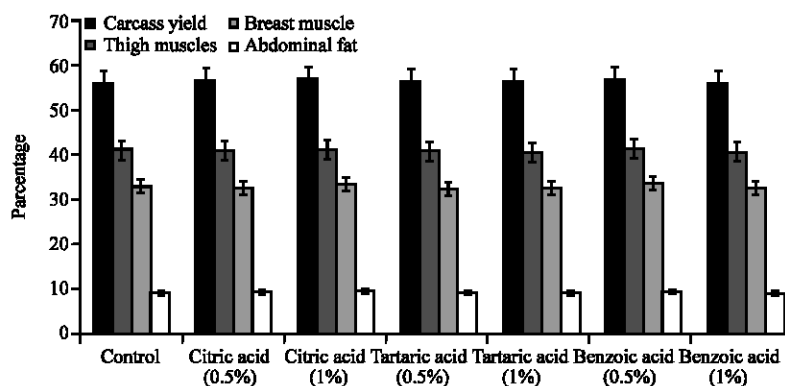


Fig. 1: Effect of different organic acids on slaughter comparison of broiler chickens

Garcia *et al.* (2007) revealed significantly better FCR in all the supplemented diets except for the 5,000 ppm of hydroalcoholic plant extract diet. Mroz *et al.* (1997) showed significant improvements of up to 5% in apparent ileal digestibility of crude protein and essential amino acids by dietary formic, fumaric and n-butyric acids. Bartov (1983) reported that supplementation with propionic acid (3%) however, significantly ($p < 0.05$) increased dietary ME, increased retention of dry matter and protein and improved performance of chicks fed the moldy grains. Chowdhury *et al.* (2009) demonstrated that the addition of citric acid improved feed conversion efficiency (kg of weight gain/kg of feed intake) significantly ($p < 0.05$) compared with control chicks or its combination with avilamycin.

Organic acids added to feeds should be protected to avoid their dissociation in the crop and in the intestine (high pH segments), where the bulk of the bacteria population is located. The beneficial effect of growth promoter substances on performance is related to a more efficient use of nutrients, which in turn results in an improved FCR.

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