EFFECT OF ACETIC ACID ADDED TO DRINKING WATER OF TWO BROILER STRAINS ON PERFORMANCE AND SMALL INTESTINE HISTOLOGICAL.

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ABSTRACT

In this experiment we study the effect of acetic acids on the performance of broiler chickens. A total of one day old broiler chicks 215 of Cobb-500 strain and 215 of Ross-308 strain were distributed randomly into 3 treatments and 3 replicates.

Broiler chickens in control group (T1) were drinking only tap water, T2 and T3 were added 1% and 2% acetic acid mixed in drinking tap water.

The results showed significantly increase ($P<0.05$) in body weight, body weight gain, better feed conversion, Villi height and crypt depth of (duodenum, jejunum and ileum) and *Lactobacillus* content when added acetic acid 1% and 2% in the treatments T2 and T3 respectively in the both strains Ross-300 and Cobb-500 as compared with T1 (control), While, the results showed significant decrease ($P<0.05$) in mortality, *Enterococcus* and *E. Coli* content in the treatments T2 and T3 for both strains especially T3 when added 2% acetic acid to drinking water. While, there were non- significant effect between the two strains (Ross-308 and Cobb-500).

Keywords: acetic acid; water; broiler; performance; histological

INTRODUCTION

Poultry sector is one of the most vibrant segments of agriculture sector in Iraq. Currently, drinking water acidification is another implementation in the broiler industry used for improving performance (Cornelison *et al*., 2005). Organic acids are widely accepted as an alternative to in-feed antibiotics in poultry production, the addition of organic acid to the drinking water helps to reduce the level of pathogens in the water crop and proventriculus, to regulate gut microflora, to increase the digestion of feed and to improve growth performance (Philipsen, 2006), and used for dual purposes-as feed preservatives as well as growth promoters. Reducing the pH of the feed organic acids can decrease bacterial contamination of feeds prior to consumption by birds, making them useful as feed preservatives (Mroz *et al.,* 1997). Hudha *et al.* (2010) showed the supplementation of acetic acid in drinking water might improved

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growth, feed conversion and meat yield of broilers, such an improvement in biological performance would be counteracted by the cost of acetic acid making poultry rearing non-profitable. Supplementing layer feed with acetic acid may provide an effective, cost efficient method of achieving significant reductions in the negative effects of heat-stress, resulting in major improvements in egg production and quality, according to Anitox , a world-leader in pathogen elimination and mould control products for the feed milling and primary meat, egg and fish production industries, Acetic acid is an organic acid which is used primarily to control mold and reduce bacterial growth in feed, but it can also inhibit the growth of micro-organisms in the gastrointestinal tract, modify pH levels and improve feed utilization (Cooksley , 2011). Organic acid (e.g., acetic acid) and their salts inhibit microorganism growth in the gastrointestinal tract, modifying intestinal pH and improving feed utilization (Adams, 1999).

MATERIALS AND METHODS

The experiment was conducted with 215 one day old broiler chicks (Cobb 500) and 215 one day old broiler chicks (Ross 308) reared for a period of 42 days. In each strain the chicks were randomly distributed into 3 treatments, the treatments contain 3 replicates (25 chicks). In Cobb-500 and Ross-308 chicks added acetic acid (its concentration 10%) to drinking water 1% and 2% for treatments T2 and T3 respectively, while T1 control treatment in both strain. Feed and water were supplied *ad libitum,* the feed content 3003 , 2968 , 2985 kcal/kg metabolized energy, 21 , 19.75 , 20.35% crude protein in (starter, grower and finisher) diet respectively.

Throughout this experiment body weight was recorded weekly intervals up to 6 weeks, feed intake, feed conversion ratio, body weight and body gain. For the histological study of intestinal villi, at 42 days age, three broilers per replicate were sacrificed and cut 2 cm length of duodenum (from pylorus to the distal portion of the duodenal loop), jejunum (from the distal portion of the duodenal loop to the Meckel's diverticulum) and of ileum (anterior portion to the cecum). These fragments were opened longitudinally on Styrofoam plates and washed with saline. The samples were fixed with Bouin's solution for 24 h for histological analysis, according to Uni *et al*. (1999). The fragments cuts of 5 μm thick and stained with hematoxylin and eosin. morphometric data from villus height and crypt depth were obtained from images captured by photomicroscope (Olympus) All data were analyzed by a three treatments and two strains by factorial arrangement in a randomized complete design by Statistical Analysis System (SAS, 1998), as per variance, significant differences among treatment means were determined by Duncan's multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

The effect of acetic acids added to broilers drinking water is presented in Table (1) significant increases (P<0.05) in body weight at 42 days and body weight gain when added acetic acid at the concentration 1% and 2% in T2 and T3 respectively in the both strains Ross-300 and Cobb-500 as compared with T1 (control), at the same table showed that FCR differ significantly (P<0.01)

Table 1: *Effect of acetic acid added to drinking water on broiler Performance.*

Strains	Treatments	Initial weight 1 d old	Body weight 42 d g	Feed intake (g)	Feed conversion ratio (FCR)	Body weight gain g/d	Mortality (%)
Cobb -500	T1	42.6	2615 [c]	5047.0	1.93 [a]	61.25 [d]	7.3 [a]
	T2	42.5	2695 [c]	5120.5	1.90 [ab]	63.15 [c]	6.5 [ab]
	T3	42.1	2788 [b]	5102.0	1.83 [b]	65.38 [b]	5.1 [b]
Ross-308	T1	43.0	2700 [c]	5103.0	1.89 [ab]	63.26 [c]	6.9 [a]
	T2	42.3	2775 [b]	5106.0	1.84 [b]	65.06 [b]	5.7 [b]
	T3	42.5	2890 [a]	4999.7	1.73 [c]	67.80 [a]	4.3 [c]
	S.E	1.05	123.5	265.6	0.035	2.33	0.65
Treat-ment effect	T1 T2 T3	42.8 42.4 42.3	2657.5 [c] 2735.0 [b] 2839.0 [a]	5075.8 5114.5 5053.4	1.91 [a] 1.87 [b] 1.78 [c]	62.25 [c] 64.11 [b] 66.59 [a]	7.1 [a] 6.1 [b] 4.7 [c]
	S.E	0.15	102.6	85.3	0.018	1.45	0.55
Strains effect	Cobb-500 Ross-308	42.4 42.6	2699.3 [b] 2788.3 [a]	5101.7 5074.7	1.89 [a] 1.82 [b]	63.26 [b] 65.37 [a]	6.3 5.6
	S.E	0.15	77.3	44.6	0.021	0.67	0.20

T1=control (tap water only), T2 and T3 added acetic acid to drinking water (1 and 2% respectively

[a–d] Means within columns with different superscripts differ significantly at (P≤0.05) and (P≤0.01).

Non-Significant differences within columns without letters.

among treatments, better feed conversion was found in T3 and lower in treatment T1 during 0-6 weeks of age. While, the results showed significant induces (P<0.01) in mortality at the end of the experiment in T3 than in T2 as compared with T1, but there were no significant differences between the two strains Ross-308 and Cobb-500.

The highest feed conversion on the administration of acetic acid was in agreement with the findings of Afsharmanesh *et al*. (2005) and Islam (2008). Moreover organic acids decrease colonization of pathogens and production of toxic metabolites, improve digestibility of protein, availability of Ca, P, Mg and Zn (Kirchgessner and Roth, 1988). Live weight and Feed intake almost linearly increased with the increasing level of acetic acid (AA) added to drinking water, noted in the present study might have been occurred for improved protein and energy digestion and retention by reduced microbial competition for nutrient (Dibner and Buttin, 2002) reduced ammonia production and lowered sub-clinical infection.

In Table (2) showed significant increases (P<0.05) at 42 days in Villi height of (duodenum, jejunum and ileum) when added acetic acid at the concentration 1% and 2% in T2 and T3 respectively in both strains Ross-300 and Cobb-500 as compared with T1 (control), also there were significant increases (P<0.05) in crypt depth of jejunum and ileum in T3 as compared with T1 and T2 in the both strains. Treatment 3 showed significant increases (P<0.05) in duodenum, jejunum and ileum (Villi height and crypt depth) as compared with T2 and T1. The strain Ross-300 showed significant increases (P<0.05) in duodenum, jejunum and ileum (Villi height and crypt depth) as compared with Cobb-500. So organic acidifiers especially acetic acid reduce the growth of many pathogenic or non-pathogenic intestinal bacteria, therefore, reduce intestinal colonization and reduce infectious processes, ultimately decrease inflammatory processes at the intestinal mucosa, which increase villus height and function of secretion, digestion and absorption of nutrients can be appropriately performed by the mucosa (Iji and Tivey, 1998; Loddi *et al*., 2004 and Pellicano *et al*., 2011).

Table 2: *Effect of acetic acid added to drinking water on small intestine histological of broiler.*

Strains	Treat-ments	Duodenum		Jejunum		Ileum	
		Villi height µm	crypt depth µm	Villi height µm	crypt depth µm	Villi height µm	crypt depth µm
Cobb-500	T1	880 ^{e}	137 ^{c}	437 ^{c}	105 ^{c}	328 ^{d}	79 ^{b}
	T2	1054 ^{c}	146 ^{c}	461 ^{b}	108 ^{b}	337 ^{d}	80 ^{b}
	T3	1310 ^{b}	174 ^{ab}	510 ^{ab}	115 ^{ab}	455 ^{b}	84 ^{ab}
Ross-308	T1	988 ^{d}	135± ^{c}	456 ^{b}	113 ^{b}	345 ^{ab}	81 ^{b}
	T2	1217 ^{bc}	168± ^{b}	483 ^{b}	119 ^{ab}	375 ^{c}	85 ^{ab}
	T3	1520 ^{a}	196± ^{a}	560 ^{a}	122 ^{a}	490 ^{a}	88 ^{a}
	S.E	25.5	11.3	0.2	3.4	11.6	3.6
Treat-ments effect	T1	934.0 ^{c}	136.0 ^{c}	446.5 ^{c}	109.0 ^{b}	336.5 ^{c}	80.0 ^{b}
	T2	1135.5 ^{b}	157.0 ^{b}	472.0 ^{b}	113.5 ^{ab}	356.0 ^{b}	82.5 ^{b}
	T3	1415.0 ^{a}	180.0 ^{a}	535.0 ^{a}	116.5 ^{a}	472.5 ^{a}	86.0 ^{a}
	S.E	35.8	9.7	12.6	3.7	11.8	2.0
Strains effect	Cobb-500	1081.3 ^{b}	152.3 ^{b}	469.3 ^{b}	109.3 ^{b}	373.3 ^{b}	81.0 ^{b}
	Ross-308	1241.7 ^{a}	163.0 ^{a}	499.7 ^{a}	118.0 ^{a}	403.3 ^{a}	84.7 ^{a}
	S.E	30.6	8.5	11.2	3.0	10.0	2.0

T1=control (tap water only), T2 and T3 added acetic acid to drinking water (1 and 2% respectively

$^{a–d}$ Means within columns with different superscripts differ significantly at ($P \leq 0.05$) and ($P \leq 0.01$).

Non-Significant differences within columns without letters.

The microbiological results in the table (3) showed significant increases($P<0.05$) in *Lactobacillus* content in the treatments T2 and T3 for both Cobb-500 and Ross-308. While, there were significant decreases ($P<0.05$) in *Enterococcus* and *E. coli* content in the treatments T2 and T3 for both strains especially T3 when added 2% acetic acid to drinking water. While, there were non- significant effect between the two strains. The Organic acids are used for dual purposes-as feed preservatives as well as growth promoters. Reducing the pH of the feed organic acids can decrease bacterial contamination of feeds prior to consumption by birds, making them useful as feed preservatives (Mroz *et al.*, 1997).

Table 3: *Effect of acetic acid added to drinking water on small intestine microbiological of broiler.*

Strains	Treatments	Lactobacillus (cfu×10^5/g)	Enterococcus (cfu×10^5/g)	*E.coli* (cfu×10^5/g)
Cobb-500	T1	4.93 ^{c}	7.22 ^{a}	8.65 ^{a}
	T2	5.77 ^{b}	6.78 ^{b}	7.95 ^{ab}
	T3	7.05 ^{a}	5.55 ^{c}	6.88 ^{b}
Ross-308	T1	4.84 ^{c}	7.30 ^{a}	8.40 ^{a}
	T2	5.82 ^{b}	6.54 ^{b}	7.55 ^{b}
	T3	7.68 ^{a}	5.15 ^{c}	5.99 ^{c}
	S.E	0.65	0.35	0.53
Treatments effect	T1 T2 T3	4.89 ^{c} 5.80 ^{b} 7.37 ^{a,}	7.26 ^{a} 6.66 ^{b} 5.35 ^{c}	8.53 ^{a} 7.75 ^{ab} 6.34 ^{b}
	S.E	0.45	0.95	0.58
Strains effect	Cobb-500 Ross-308	5.92 6.11	6.52 6.33	7.83 7.31
	S.E	0.11	0.06	0.13

T1=control (tap water only), T2 and T3 added acetic acid to drinking water (1 and 2% respectively

$^{a–d}$ Means within columns with different superscripts differ significantly at ($P\leq0.05$) and ($P\leq0.01$).

Non-Significant differences within columns without letters.

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تأثير إضافة حامض الخليك الى ماء الشرب لسلالتين فروج اللحم في الأداء الإنتاجي والتشريح النسيجي لمنطقة الأمعاء .

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المستخلص

درس في هذه التجربة تأثير حامض الخليك في الأداء الأنتاجي لفروج اللحم باستخدام 215 فرخة فروج اللحم من سلالة Cobb-500 و215 فرخة من سلالة Ross-308 بعمر يوم واحد ووزعت عشوائيا الى 3 معاملات و3 مكررات. قدمت ماء البئر في شرب أفراخ فروج اللحم في معاملة السيطرة T1، وأضيفت الى ماء الشرب في المعاملتين T2 وT3 (1% و 2%) حامض الخليك على التوالي في كلتا السلالتين.

أظهرت النتائج إرتفاعا معنويا ($p<0.05$) في وزن الجسم، معدل الزيادة الوزنية و تحسن في كفاءة التحويل الغذائي و ارتفاع الزغابات و عمق الخبايا في (الأثني عشري، الصائم واللفائفي) والعد البكتيري لحامض اللاكتيك (اللبنيك) في معاملات إضافة حامض الخليك 1% و 2% الى ماء الشرب في المعاملات T2 و T3 على التوالي وفي كلا السلالتين Ross-300 و Cobb-500 مقارنة بمعاملة السيطرة T1، في حين وجد انخفاض معنوي ($p<0.05$) في النسبة المئوية للهلاكات والعد البكتيري لـ *Enterococcus* و *E.coli* في المعاملات T2 و T3 على التوالي وفي كلتا السلالتين Ross-300 و Cobb-500 مقارنة بمعاملة السيطرة T1. ولم توجد أية فروق معنوية بين السلالتين Ross-300 و Cobb-500.

الكلمات المفتاحية : حامض الخليك ، فروج اللحم ، الصفات التشريحية .