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ORGANIC ACIDS AS POTENTIAL ALTERNATE FOR ANTIBIOTIC AS GROWTH PROMOTER IN JAPANESE QUAIL

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ABSTRACT :A gross of 180 growing Japanese quail at one day age classified into four groups as follows: a control group (with no additives), antibiotic group (control diet + sub-therapeutic dose of avilamycin, 8 mg/kg diet), ascorbic acid group (control diet + 1g ascorbic /kg diet) and citric acid group (control diet + 40g citric/kg feed) to evaluate the use of organic acids as probable alternate to antibiotic as growth promoter for quail groups. The most important results were:

Both ascorbic and citric acids supplemented to diets of growing Japanese quail improved growth performance as compared with avilamycin and control groups, favoring ascorbic acid.Both ascorbic and citric acid groups had significantly better serum biochemical serum blood lipids indices than either avilamycin or control ones.

Organic acids had significantly higher antioxidant parameters and immune response but lower thiobarbaturic acid- reactive substances values than both antibiotic and control groups.Fortunately, Organic acids showed to increase of beneficial (Lactobacillus) moreover reduced numbers of harmful bacteria (E. coli and Salmonella) as compared to the control.Females had better performance than males having heavier body weight at 38d, body weight gain, faster growth rate, better feed conversion, higher performance index during the 10-38 period and surpassed males in giblets absolute. However, sex insignificantly affected all slaughter parameters, carcass chemical composition, serum biochemical indices-except cholesterol, antioxidant parameters, immune response and intestinal microflora count.

Therefore, organic acids seemed to be used as growth promoters alternatives to antibiotics in growing Japanese quail.

Key words: Organic acids – alternatives – antibiotics - growth promoter - quail.

INTRODUCTION

Many years ago, antibiotics used as feed additives (AFAs) in birds feeding at sub-therapeutic doses for growth promoting property but the continuous and non-cautious use of AFAs resulted in selecting and spreading of antibiotic-resistant strains of poultry pathogens (i.e. Salmonella, Campylobacter and E. coli). Therefore, searching for organic acids as antibiotics alternatives considered the best possible choice for securing the safe food supply. Growth Performance and the gut morphology improved by Supplementing organic acids to broiler diets whereas reduced diseases and overcame other management problems (Hassan et al., 2015). Improving the birds performance may be due to the increase in gastric proteolysis, the digestibility of proteins and amino acids and utilization of mineral because of acidification (Hayat et al. 2014). Thus, supplementing broiler diets with propionic, butyric and citric acids efficiently substitute the antibiotics and improve the performance of growth and feed conversion (Hayat et al. 2014; Deepa & Purushothaman 2016). Furthermore, organic acids had several advantageous effects such as enhancing absorption of minerals and moreover recovery speeding from fatigue (Hassan et al. 2010; Waseem Mirza_et al. 2016), also give peoples safe, nutritious and good healthy poultry products.

In poultry the act organic acids not only as a growth promoter moreover as a prominent controlled for all enteritis bacteria, pathogenic and non-pathogenic (Wolfenden et al., 2007; Sultan et al.2015). Although the accurate mechanism for organic acids action is not fully understood, but may be due strong bactericidal and bacteriostatic activities (Abudabos et al. 2017). Moreover, feeding broiler chicken on diets with organic acids had higher globulin concentration and better immune response than the control however, serum cholesterol, low density lipoprotein (LDL) or total lipid significant reduced and elevation of triiodotyrosin (T3) concentration as well as T3:T4 ratio, GOT (Glutamic Oxaloacetic Transaminase) levels and the pH of small intestine were achieved due to dietary acidification (Kamal & Ragaa, 2014; Youssef et al.2017 and Naveenkumar et al. 2018). No significant changes were detected in TBAR (thiobarbaturic acid-reactive substances) and TAC (total anti oxidant capacity) for broilers fed acidified diets than untreated group at slaughter (Abudabos et al., 2017). On contrast, organic acids did not affect carcass yield, breast or organ weights while showed a numerical decrease in intestinal aerobes (a microorganism that grows in the presence of air or requires oxygen for growth or oxygen tolerant), fecal coliforms and E. coli counts (Youssef et al. 2017). Comparing with the control, supplementing broiler diets containing 0.5% of both propionic acid and formic acid or a commercial mixture containing both and their ammonium salts were improved some carcass traits, titers of antibodies to infectious bronchitis and increased Lactobacilli counts moreover decreased E coli counts (Fathi et al. 2016). Therefore, the objectives from this study was to determine the effect of using two organic acids (Ascorbic and Citric) to replace dietary antibiotic growth promoter on performance, carcass characteristics, blood biochemical, blood antioxidant, immune responses and some microflora of intestinal in growing Japanese quails.

MATERIALS AND METHODS

experimental design, birds and experimental diets

A gross of 180 growing Japanese quail at one day age were performed and adapted for 10 days and then randomly distributed at equal body weights into four groups as: a control group (with no additives), antibiotic group (control diet + sub-therapeutic dose of Avilamycin 8 mg/kg diet), Ascorbic acid group (control diet + 1g Ascorbic /kg diet) and Citric acid group (control diet + 40g citric /kg diet). Each group was replicated three times, (15 chicks /replicate). Chicks were housed in a five decks, quails were divided in cages from three section with stand and dropping pans with automatic watering. The tested antibiotic was Avilamycin which is an orthosomycin antibiotic complex manufactured for: Elanco Animal Health, A Division of Eli Lilly and Company, Indianapolis, IN 46285, USA, produced by the fermentation of Streptomyces viridochromogenes. Avilamycin is primarily active against gram-positive bacteria and is intended for using as a veterinary medicine to control bacterial enteric infections and was previously authorized as a feed additive for growth promotion in accordance with Council Directive 70/524/EEC.

The control diet was formulated to meet the nutrient requirements of the quails during the experiment period from 0 to 38 days (NRC, 1994). The basal diet composition is presented in (Table 1). Chicks were exposed to continuous lighting, feed and watered ad libitum. In 31 day of age birds were vaccinated against Newcastle virus (Lasota) by projection at eye.

growth and carcass traits measured

Live body weight of chicks (LBW) were individually weighed and feed consumptions per pen were weekly recorded (FI), the uneaten feed discarded, live body weight gain (BWG, g) as follows : $BWG_{10to38} = BW_{38} – BW_{10}$, feed conversion ratio (FCR) and performance index (PI_{10to38}) based on North (1981) formula were calculated as follows: $PI_{10to38} = BW_{g} / FCR_{10to38}$.

On the end of study 38 day of age, six birds from each group were reweighed and slaughtered by cutting the Jugular vein, defeathered and eviscerated. Carcass yield was calculated from eviscerated weight, edible giblets weighed while blood samples were collected for blood analysis. The carcass chemical composition was determined in triplicates according to the AOAC (1995) procedure.

blood biochemical, anti-oxidant and immunity

Individual 24 blood samples were collected in dry clean centrifuge tubes at slaughter and serum was separated by centrifugation at 3000 rpm for 15 minutes and assigned for subsequent determination. Quantitative determinations were done for the following: total cholesterol (Chol), high density lipoproteins (HDL), low density lipoproteins (LDL), very low density lipoproteins (VLDL) triglycerides (Tri G), Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT). All blood biochemical parameters were calorimetrically determined using commercial diagnosing kits (produced by Spectrum Diagnostics Company, Egypt). The glutathione peroxidase (GPx, EC 1.11.1.9) was calorimetrically determined according to Paglia and Valentine (1967) and thiobarbaturic acid- reactive substances' (TBARS) were performed according to Yagi (1998)___using commercial diagnosing kits produced by Cayman Chemical Company (USA). The method used for the assay of chicken Immunoglobulins Isotypes IgG, IgM, and IgA in Sandwich ELISA described by Erhard et al. (1992) the absorbance measured on an ELISA plate reader set at 450 nm.

Microbial Analysis

Immediately after slaughter, intestinal content was collected in sterile glass containers, digesta was evacuated and mixed. The sealed containers were kept in the laboratory at 4°C till enumeration of microbial population. Samples (1g of the mixed fresh mass) were taken into sterile test tubes, diluted 1:10 in sterile 0.1% peptone solution and homogenized for three min in a Stomacher homogenizer. Ten fold serial dilutions up to 10^{-7} of each sample were prepared in nine ml of 0.1% sterile peptone solution. Viable counts of Salmonella ssp, E. coli and Lactobacilli ssp were performed. One milliliter of the serial dilution was incubated into sterile Petri dishes and sealed with an appropriate medium. Lactobacillus spp. colony count was determined using MRS agar (Biokar Diagnostic, France) after incubation in an anaerobic chamber at 37° C for 72 h. Salmonella and E. coli colonies were counted on brilliant green agar plate and incubated at 37° C for 24 h). After cultivation in Petri dishes, the total colony count for Lactobacilli, Salmonella and E. coli was then calculated as the number of colonies by reciprocal of the dilution. The microbial counts were determined as colony forming units (cfu) per gram of sample.

statistical analysis

Using General Linear Models (GLM) procedure of SPSS (2013), studied traits were subjected to a two-way analysis of variance with treatment and sex as main effects as follows:

$$Yijk = \mu + Ti + Sj + eijk.$$

Where: Yijk: Observed value in the i^{th} treatment of the j^{th} sex of the k^{th} individual, μ: Overall mean, T_i: Treatment effect (i: 1 to 4), S_j: Sex effect (j: 1 and 2) and e_{ijk}: Random error term. Means were compared by Duncan's new multiple range test (Duncan's, 1955) when significant F values were obtained.

RESULTS AND DISCUSSIONS

performance and carcass traits

Supplementing diets of growing Japanese quail with organic acids (ascorbic or citric) meantime the interval from ten to 38 days of age, showed that organic acids surpassed ($P<0.01$) both avilamycin and control groups in LBW_{38d}, $BWG_{10\text{-}38,}$ had lower $FI_{10\text{-}38,}$ better FC $_{10\text{-}38}$, and higher PI $_{10\text{-}38}$, favoring ascorbic acid which was insignificantly better than citric acid in all the production standards as compared to the antibiotic (avilamycin) and control groups (Table 2).

Females had better performance than males, they having heavier LBW_{38d}, $BWG_{10\text{-}38}$ and better $FC_{10\text{-}38}$, and higher $PI_{10\text{-}38}$, however insignificantly differed than males in both FI $_{10\text{-}38}$ and FC $_{10\text{-}38}$ (Table 2). Adding organic acids improved all performance parameters in the present study which united in opinion with the results finding by Khan & Iqbal (2016); Youssef et al. (2017), that improvement in BW and BWG for the birds feeding on diets supplemented with organic acids meantime the growing period, is due to the effect of the keeping of beneficial bacteria population, improving nutrient digestion and may be impact the safety of microbial cell membrane or prohibit the nutrient transport and energy metabolism causing the bactericidal effect (Ricke, 2003). Protein and energy digestibility was improved by organic acids and their salts, this result from reducing microbial competition with the host for nutrients and endogenous nitrogen losses, by secretion of immune mediators and lowering the incidence of sub-clinical infections, also by reducing the production of ammonia and other growth inhibiting microbial metabolites (Dibner and Buttin, 2002). Maybe these ones could be the causes that organic acids and their salts improved feed employment leading to good accomplishment in the broiler chicks. Organic acids are moreover probability feed additive alternatives to antibiotic growth promoters in animal raising systems (Sultan et al. 2015). Organic acids maintain cellular safety of the bowels lining and increase digestive processes by serving to preserve normal bowel flora. Also,citric organic acid can enhance the digestibility of proteins and amino acids by increasing gastric proteolysis (Hayat et al. 2014) which united in opinion with current findings.

All slaughter parameters had insignificant differences due to treatment effect, except the dressed meat, in which antibiotics significantly ($P \leq 0.05$) exceeded all other treatments. With respect to sex, females significantly ($P<0.01$) surpassed males in giblets weight but insignificantly differed than males for other studied slaughter parameters (Table 3). Concerning to carcass traits the organic acids effects supported by the results of other investigations which found that the organic acids did not affect both dressing yield % and carcass characteristics of broiler chicken (Islam et al.2008, Sultan et al., 2015 ; Youssef et al. 2017).

blood constituents

Organic acids treatments significantly influenced each of Chol, HDL, LDL, VLDL and RBS, both ascorbic and citric acids had significantly better serum biochemical serum blood lipids indices than either avilamycin or control. The organic acids were superior ($P<0.01$) than both antibiotics and control. Ascorbic acid had desirably higher HDL whereas citric acid had the lowest significantly value of Chol, while insignificantly differed than ascorbic acid in HDL, LDL and VLDL (Table 4). Liver enzymes (AST and ALT) insignificantly influenced by treatment effect ($P>0.05$). The lowest levels of serum total lipids, serum Chol and LDL compared with the control group were obtained for birds fed organic acids (Abdo, 2004; Kamal and Ragaa, 2014) confirmed the present findings of serum lipid profile. The mode of act of organic acids for contraction the blood lipid profile may be explain through their impact in decreasing the microbial intracellular pH. Thus, block the action of important microbial enzymes and impose the bacterial cell to use energy to liberate the acid protons, leading to an intracellular accumulation of acid anions (Young and Foegeding, 1993). Also, Abdel-Fattah et al. (2008) showed that the observed lower FI during the period of growth and consequently lower fat intake that resulted in fat depletion may also contribute in reducing blood lipid content. No significant differences between females and males were found in all serum biochemical indices measured, except Chol favoring for females and AST where males were superior to females (Table 4).

blood antioxidants and immune globulins

Studying the effect of organic acids on the level of blood antioxidants and antibodies against Newcastle virus showed that organic acids had significantly higher GPX, IgG, IgA and IgM but lower TBAR values than both antibiotic and control groups. However, ascorbic acid was insignificantly higher than citric acid. No significant differences between males and females fed different alternatives were found for antioxidant parameters and immune response (Table 5). Results of immune response are in agreement with several studies which demonstrated that organic acids could stimulate the natural immune response in poultry (Lohakare et al.2005). Birds fed an organic acid supplemented diet had heavier lymphoid organs i.e. bursa of Fabricius and the Thymus which are major constituents of the avian immune system (Abdel-Fattah et al. 2008; Ghazala et al. 2011) and also a higher level of globulin in their serum which is used as an indicator for measuring immunity response, suggesting that the improvement in bird immunity could be related to the inhibitory effects of organic acids on gut system pathogens and enhancing the density of the lymphocytes in the lymphoid organs, enhancing the non-specific immunity (Haque et al. 2010).

Antioxidant activity results of the current study agreed with the findings of Ismail et al. (2013) who demonstrated that ascorbic acid stimulating the biosynthesis and secretion of antioxidant enzymes which scavenging the free radical**s** as reflected by increasing the activities of CAT, SOD and GST together with reduced MDA level preventing cells from lipid peroxidation.

intestinal microflora

Quails fed on a diet supplemented with antibiotics had a direct and significant decrease ($P< 0.01$) in the number of both beneficial (Lactobacillus) and harmful (E. coli and Salmonella) microbial populations as well as the birds fed the diets supplemented with organic acids had increases in the number of Lactobacillus ($P>0.05$) compared to control and to significantly reduced the number of harmful bacteria (E coli and Salmonella, $P \leq 0.001$) as compared to the control and this indicated the good effect of organic acids as growth stimulants and alternatives to antibiotics (Table 6).

However, no significant differences were found due to sex effect on all tested intestinal microflora count. Results of the present study showed significant reduction in total Salmonella and E. coli counts as compared to the control group which agreed with the results reported by Chowdhury et al. (2009), Samanta et al. 2010 and Sultan et al. (2015) who reported that the use of organic acids produced acidic environment in the gut thus favoring the development of Lactobacilli and inhibits the replication of Salmonella, E. coli and other Gram negative bacteria and eliminated the coliforms from the gut and other harmful bacteria which may have enhanced poultry growth. These studies explained that the non-dissociated organic acids can penetrate the cell wall of bacteria and interrupt the normal physiology of definite types of bacteria that called 'pH sensitive' which cannot tolerate a varied internal and external pH grade. Moreover, the organic acids in poultry might have a direct effect on the gut bacteria population, reducing some pathogenic bacteria and mainly controlling the population of certain types of bacteria that participate with the birds for nutrients (Khan and Iqbal, 2016). In the present study the birds fed diets with organic acids showed a reduction in harmful and increased beneficial bacteria which reflect the chemical pharmaceutical mechanism.

CONCLUSION

Organic acids supplemented to diets of growing Japanese quail improved growth performance as compared with avilamycin and control groups favoring ascorbic acid. Organic acids had significantly better serum biochemical serum blood lipids indices, higher antioxidant parameters, immune response and lower TBAR values than either avilamycin or control moreover increasing the count of beneficial (Lactobacillus) also reduced the count of harmful bacteria (E.coli and Salmonella) as compared to the control.Sex insignificantly affected all studied traits, except growth performance favoring females. Therefore, treatment effect resulted in significant variations on most of the studied traits more than the sex effect. In conclusion, both ascorbic and citric acids adequate are applied as potential substitutional to avilamycin (antibiotics) for growth promoters in Japanese quail.

Table (1): Composition of the experimental diet %

Ingredient	**%**
Maize, ground	56
Soybean meal (44 CP %)	32
Plant concentrate meal[1] (50 CP %)	10.3
Vegetable oil	0.5
DL-methionine	0.1
Salt(NaCl)	0.3
Vitamin and mineral premix[2]	0.3
Dicalcuom phosphate	0.5
Calculated analysis	
Metabolizable energy (kcal/kg	2919
Crude protein	24.00
Crude fiber	3.5
Calcium	0.8
Available phosphorus	0.5

[1]-Plant concentrate contains (%): CP 50, CF 1.3, Ca4.72, Av P 3.1, lysine 2.8, methionine 2.1 and ME 2650 kcal/kg.

[2]-Premix provided per kg of diet: vitamin A, 12.000 IU; vitamin D3, 2.400 IU; vitamin E, 30 mg; vitamin K3, 4 mg; vitamin B1, 3 mg; vitamin B2, 7 mg; vitamin B6, 5 mg; vitamin B12, 15 µg; niacin, 25 mg,Fe, 80 mg; folic acid, 1 mg; pantothenic acid, 10 mg; biotin, 45 mg; choline, 125,000 mg; Cu, 5 mg; Mn, 80 mg; Zn, 60 mg; Se, 150 µg.

Table (2): Effects of treatment and sex on growth traits of Japanese quail (Main effects)

Item	LBW_{10d} (g)	LBW_{38d} (g)	BWG_{10-38} (g)	FI_{10-38} (g)	FC_{10-38} (g/g)	PI_{10-38}
Treatment effect:						
Control	41.00	201.10^{b}	160.00^{b}	584.00^{a}	3.70^{a}	201.1 :3.7^{c}
Antibiotic	41.40	220.00^{a}	178.00^{a}	583.00^{a}	3.30^{b}	219.6:3.3^{b}
Ascorbic acid	41.45	221.78^{a}	180.34^{a}	561.67^{b}	3.13^{c}	221.8:3.1^{a}
Citric acid	41.54	221.27^{a}	179.74^{a}	566.48^{b}	3.17^{c}	221.3 :3.2^{ab}
S.E	0.77	2.58	2.28	2.96	0.04	0.15
Probability (P)	N.S	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$
Sex effect:						
Females (F)	41.95	221.57	179.62	576.02	3.39	221.6:3.4^{a}
Males (M)	40.59	210.30	169.72	571.85	3.24	210.3:3.2^{b}
S.E	0.54	1.71	1.55	2.08	0.03	0.10
Probability (P)	N.S	$P \leq 0.001$	$P \leq 0.001$	NS	$P \leq 0.001$	$P \leq 0.001$

S.E: Standard error, N.S: Not significant. BWG: Body weight gain= LBW_{38d} - LBW_{10d}, FI: Feed intake, FC: Feed conversion= FI_{10-38} / BWG_{10-38},
[a-c] :Means within the same column with different superscript are significantly different.

Table (3): Carcass traits of growing quails at slaughter as affected by treatment and sex (Main effects).

Item	Edible parts(g)	Dressed meat(g)	Giblets(g)
Treatment effect:			
Control	156.00	80.00^{b}	12.74
Antibiotic	176.90	94.90^{a}	14.18
Ascorbic acid	164.08	74.10^{b}	12.95
Citric acid	169.80	77.72^{b}	13.53
S.E	5.88	5.04	0.69
Probability (P)	N.S	$P \leq 0.05$	N.S
Sex effect:			
Females (F)	169.93	82.95	15.32
Males (M)	163.39	80.19	11.38
S.E	4.16	3.56	0.49
Probability (P)	N.S	N.S	$P \leq 0.001$

[a...c:] Means within the same column with different superscript are significantly different;
N.S: Not significant. S.E: Standard error; Edible parts (g) = Giblets weight (g) + Carcass weight (g) and Dressed meat (g)= boneless meat (g)

Table (4): Serum biochemical indices at slaughter as affected by treatment and sex (Main effects).

Item	Chol, mg/dl	HDL mg/dl	LDL mg/dl	VLDL mg/dl	RBS mg/dl	Tri G mg/dl	AST U/L	ALT U/L
Treatment effect:								
Control	190.00[a]	104.00[ab]	68.00[a]	18.00[b]	236.00[a]	125.00	99.00	17.00
Antibiotic	188.40[a]	100.00[b]	64.00[a]	24.30[a]	233.00[a]	121.00	99.00	22.00
Ascorbic	168.30[b]	112.47[a]	43.40[b]	12.44[c]	218.62[b]	123.03	98.09	19.96
Citric acid	160.95[c]	103.91[ab]	43.00[b]	14.05[bc]	216.67[b]	117.02	99.06	17.07
S.E	2.02	2.9	2.88	1.7	2.63	3.88	1.84	1.52
Probability (P)	$P \leq 0.001$	$P \leq 0.05$	$P \leq 0.001$	$P \leq 0.001$	$P \leq 0.001$	N.S	N.S	N.S
Sex effect:								
Females (F)	180.90	104.73	57.34	18.83	224.05	123.57	96.68	17.55
Males (M)	172.71	105.50	51.69	15.52	228.19	119.35	100.91	20.55
S.E	1.43	2.05	2.04	1.20	1.86	2.74	1.30	1.08
Probability (P)	$P \leq 0.001$	N.S	N.S	N.S	N.S	N.S	$P \leq 0.05$	N.S

Chol: Cholesterol, HDL: High density lipoprotein , LDL:Low density lipoprotein, VLDL: Very low density lipoprotein, RBS :Random blood sugar ,Tri G: Triglycerides, AST: Aspartate aminotransferase , ALT: Alanine aminotransferase. [a...c:] Means within the same column with different superscript are significantly different.

N.S: Not significant, S.E: Standard error

Table (5): Antioxidant parameters and immune response as affected by different dietary treatments and sex (Main effects).

Item	Antioxidant parameters		Immune response		
Treatment effect:					
	GPX (nmol/min/ml)	**TBAR (nmol /ml)**	**IgG(mg/dl)**	**IgA (mg/dl)**	**IgM (mg/dl)**
Control	6.09^{b}	1.90^{a}	936.08^{a}	175.71^{a}	93.93^{a}
Antibiotic	6.99^{ab}	1.79^{a}	848.96^{b}	159.09^{b}	84.90^{b}
Ascorbic	7.08^{a}	1.49^{b}	989.02^{a}	185.44^{a}	98.90^{a}
Citric acid	6.99^{ab}	1.77^{a}	981.63^{a}	184.06^{a}	98.16^{a}
S.E	0.16	0.07	21.41	4.01	2.14
Probability (P)	$P \leq 0.05$	$P \leq 0.01$	$P \leq 0.01$	$P \leq 0.01$	$P \leq 0.01$
Sex effect:					
Females (F)	6.79	1.66	945.45	177.27	94.55
Males (M)	6.84	1.78	932.35	174.82	93.24
S.E	0.11	0.05	15.14	2.84	1.51
Probability (P)	N.S	N.S	N.S	N.S	N.S

GPX: Glutathione peroxidase ; TBAR: thiobarbaturic acid IgG, IgA ,IgM Immunoglobulins G,A,M ;
S.E: Standard error
[a...d:] Means within the same column with different superscript are significantly different.
N.S: Not significant,

Table (6): Useful and harmful intestinal bacteria in growing quails as affected by different dietary treatments and sex (Main effects).

Item	**Lactobacillus (log 10 cfug)**	**E coli (log 10 cfug)**	**Salmonela (log 10 cfug)**
Treatment effect:			
Control	6.45^{a}	8.05^{a}	8.19^{a}
Antibiotic	5.00^{b}	5.07^{c}	5.10^{c}
Ascorbic	6.77^{a}	7.28^{b}	7.42^{b}
Citric acid	6.97^{a}	7.27^{b}	7.67^{ab}
S.E	0.26	0.19	0.21
Probability (P)	P ≤0.001	P ≤0.001	P ≤0.001
Sex effect:			
Females (F)	6.18	7.05	7.14
Males (M)	6.31	7.02	7.03
S.E	0.18	0.14	0.15
Probability (P)	N.S	N.S	N.S

E coli: Escherichia coli S.E: Standard error

cfug: logarithm of colony forming unit per gram of digesta

a...d: Means within the same column with different superscript are significantly different.

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Organic acids – alternatives – antibiotics - growth promoter - quail.

الملخص العربي

الأحماض العضوية كبدائل محتملة للمضادات الحيوية المنشطه للنمو في السمان الياباني

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تم تقسيم 180 كتكوت سمان يابانى عمر يوم واحد الي أربعة مجموعات على النحو التالي: مجموعة كنترول (مع عدم وجود إضافات) ، مجموعة المضادات الحيوية (كنترول + جرعة دون علاجية من أفيلاميسين 8 ملغم / كغم من النظام الغذائي) ، ومجموعة حمض الاسكوربيك (كنترول + 1 جم أسكوربيك / كجم عليقه) ومجموعة حمض الستريك (كنترول + 40 جم حمض الستريك / كجم عليقه) لتقييم استخدام الأحماض العضوية كبدائل محتملة للمضادات الحيوية كمنشطات للنمو في مجموعات السمان من عمر 10- 38 يوم. وكانت أهم النتائج كالتالى:

أظهرت العلائق المضاف لها حامض الأسكوربيك وحامض الستريك أفضل أداء انتاجي بالمقارنة مع مجموعات الأفيلاميسين و الكنترول ، وكانت الافضلية لحمض الأسكوربيك.

أظهرتحليل سيرم الدم أن الطيور المغذاة علي علائق مضاف لها حامض الاسكوربيك وحامض الستريك كانت أفضل من مجموعات الكنترول و الأفيلاميسين في كل المقاييس البيوكيميائية المأخوذة كما أظهرت أعلي قيم لمضادات الأكسدة والأجسام المناعيه بالمقارنة مع الأفيلاميسين و الكنترول، وقد زادت الأحماض العضوية من عدد البكتريا المفيدة (Lactobacillus) وخفضت عدد البكتيريا الضارة (E. coli و Salmonella) مقارنة بالكنترول.

وكان أداء الإناث أفضل من الذكور حيث كان للاناث أثقل وزن جسم عند d38 و أسرع معدل نمو و تحويل أفضل للعلف ، ومؤشر أداء أعلى خلال الفترة من 10 إلى 38، في حين تفوقت الذكور في النسبه المئوية والقيمة المطلقه للاحشاء المأكوله.

لذلك يبدو أن من الممكن استخدام الأحماض العضوية كبدائل منشطة للنمو بدلا من المضادات الحيوية في السمان الياباني.