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Effect of Organic Acids on the Performance of Japanese Quails

Rifat Ullah Khan,[1, 2] Naila Chand[2,*] and Akbar Ali[2]
[1]*Department of Animal production, College of Food and Agriculture Sciences, King Saud University, P.O. Box 2460, Riyadh 11451, Kingdom of Saudi Arabia*
[2]*Faculty of Animal Husbandry and Veterinary Sciences, The University of Agriculture, Peshawar, Pakistan*

ABSTRACT

Organic acid was administered to Japanese quails as 0.5, 1, 1.5 and 2ml of Aciflex® per liter of drinking water. Significantly low (P<0.05) feed and water intake was found in 2ml group compared to the control group. Highest weight gain, best feed conversion ratio (FCR), dressing percentage, liver weight and lowest mortality were obtained in 2ml compared to the control. Significantly higher feed cost was observed in the control group, while it was the same in all other groups. However, gross return was not affected by organic acids supplementation. Net return was significantly higher in 1.5 and 2ml groups and was the least in the control group. It was concluded that organic acid supplementation in drinking water at the rate of 2ml/L of drinking water improved performance and economic return in Japanese quails.

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NC designed the study. AA collected the data and wrote the article. RUK analyzed the data and helped in preparation of the article.

Key words
Japanese quail, organic acid, performance, economic

INTRODUCTION

Japanese quails are economically very important because of egg and meat production. Although the quail production is not established yet occupies an important place in poultry meat production (Genchev *et al*., 2008). The rearing of quail is now a common practice and could help to overcome the present gap in meat supply and demand (Minvielle, 2004). Quails play a key role in broiler meat industry and have better efficiency to convert feed into meat. The peculiar taste and characteristics of quail meat has resulted in growing interest of the consumers (Genchev *et al*., 2008).

Antibiotics are generally used in poultry industry as feed additive for the control of pathogenic microorganisms and to improve feed efficiency and growth (Islam *et al*., 2008; Sultan *et al*., 2015). Moreover, the use of antibiotics in poultry has been banned in many countries because of its residual effects and development of bacterial resistance. Moreover, the antimicrobial resistance of antibiotic has become a global concern. So alternatives to antibiotics are necessary and one of the possible alternatives is organic acids (Hyden, 2000; Sultan *et al.*, 2015). Treating drinking water of poultry farms has been advocated to improve the health, performance and well being of the birds (Sultan *et al*., 2015). One such alternative is organic acid. They are generally considered as safe and play a significant role in increasing profitability in poultry production.

Organic acids such as proponic acids, formic acids, citric acids increase protein and amino acids digestibility and gastric proteolysis (Haque *et al*., 2009; Sultan *et al*., 2014 & 2015). Organic acids increase digestion and absorption of the nutrients (Patten and Walddroup, 1988; Skinner *et al*., 1991; Haque *et al*., 2009). Organic acids reduce lethal bacteria metabolites for example amines and ammonia and increase feed proficiency and growth rate (Samanta *et al*., 2010). These acids inhibit intestinal bacteria growth and struggle for host feed nutrients. Organic acids help in stimulating/regulating gut microbial flora, endogenous enzymes, and maintain animal health. Organic acids change the pH of alimentary canal which leads to reduce pathogenic burden. Organic acids remain undissociated and after passing through bacterial cell split into hydrogen ion and $RCOO^-$ ions that disrupt protein synthesis and normal cell function. The targeted microbes multiply less efficiently and reduce their number in the digestive tract (Lückstädt *et al*., 2004; Freitag, 2007; Luckstadt, 2008; Sultan *et al*., 2015).

Keeping in view the above mentioned properties, in this study, a mixture of organic acids including lactic acid, citric acid and phosphoric acid was used in quails to study the effect on overall performance of Japanese quails and economics.

MATERIALS AND METHODS

A total of 300, day-old quails were obtained from market and adapted for one week. All the experimental quails were randomly distributed into 5 groups as OA-0 (control), OA-0.5 (0.5 ml/l), OA-1 (I ml/l), OA-1.5(1.5

* Corresponding author: rifatullahkhhan@gmail.com
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ml/l) and OA-2 (2 ml/l). Each group was replicated three times. The acidic mixture was composed of citric acid 80 g, lactic acid 52 g, phosphorus 92 g and cupper sulphate 10 g/ litter. The quails were reared in an open-sided shed in pens. Similar feeding, drinking and other equipments were provided. The feed composition is given in Table I. The experiment lasted for 42 days. The level of crude protein and metaboliazalbe energy were 22% and 2960 kcal/kg, respectively, to meet or exceed the requirements of NRC (2001).

Table I.- Composition of basal diets.

Ingredients	(%)
Maize	59.6
Soybean meal	36.6
Vegetable oil	0.45
Limestone	1.2
Dicalcium phosphate	1.3
DL Methionine	0.16
Salt	0.35
Vitamin + trace mineral premix	0.35
Total	100
Calculated nutrient composition	
Protein (%)	22%
Metabolizable energy, kcal/kg	2960

Each kg of premix consisted: pyridoxine, 12mg; folic acid, 0.45mg; molybdenum, 0.32mg; ethoxyquin, 26mg; choline chloride, 55mg; dI-α-tocopherol acetate; 5mg; iodine, 0.3mg; thiamine, 0.3mg; Ca pantothenate, 3mg; cyanocobalamin, 3µg; biotin, 0.02mg; Mn, 15mg; Zn, 10mg; iron, 4mg; Cu, 1mg; Co, 0.06mg; Se, 0.02mg; cholecalciferol, 0.018mg; *trans*-retinol, 0.66mg; menadione, 0.4mg; riboflavin, 1.6mg; niacin, 6mg.

Feed intake was offered to each replicate on daily basis. Daily feed refused was subtracted from feed offered to calculate feed intake. Daily feed and water intake was used to work out weekly feed and water intake. Water consumption per replicate was calculated on daily basis. Weekly weight gain was also calculated for each week. Weight gain was recorded with the help of digital balance. Weekly weight gain was used to work out total weight gain per quail. Feed conversion ratio (FCR) was recorded at the end of experiment. Two randomly selected quails from each replicate were slaughtered at the end of experiment to work out dressing percentage. All internal organs including intestine, heart, liver, gizzard and kidneys were removed and dressed carcass was weighted. Dressing percentage was calculated by dividing dressed weight by live weight multiplied by 100

Visceral organs including liver and heart weight were determined at the end of experiment. Mortality was also recorded on daily basis. The dead birds were dissected to determine the cause of mortality. Intestinal length was measured from duodenum to caecum after removing the contents. Feed cost per quail was calculated by adding feed cost plus organic acids. Gross return was determined on the basis of market price of quails during April, 2012 and net return per quail was calculated.

Data analysis

The data were analyzed through standard procedure of analysis of variance (ANOVA) using complete randomized design (CRD) as suggested by Steel and Torie (1981). Statistical package SAS (1998) was used to perform the above analysis on computer.

RESULTS

The research study showed that decreasing trend was found in feed intake with increasing level of organic acids. Feed intake was significantly low in OA-2 compared to the control (Table II).

Mean water consumption per chick is given in Table I. Water consumption was affected significantly ($P<0.05$) by organic acids supplementation. Water intake was decreased when level of organic acids was increased from 0 to 1ml/L of drinking water. However, water intake was increased when level of organic acids was increased to 1.5ml/L and was decreased when the level of organic acids was increased to 2ml/L drinking water.

Mean total weight gain is presented in Table II. Weight gain was significantly ($P<0.05$) high in OA-2. An increasing trend was found in weight gain with the increasing level of organic acids.

Table II.- Effect of organic acid blend (Aciflex®) on total feed intake (g), total water intake, and total weight gain of Japanese quail.

Group	Total feed intake (g)	Total water intake (ml)	Total weight gain 9g)
OA-0	690^{a}±9.58	1073.5^{a} ± 68.92	139.9^{c} ± 5.20
OA-0.5	579.5^{b} ±20.49	916.2^{bc} ± 44.25	142.1^{bc} ± 1.53
OA-1	571.5^{b} ±7.02	863^{c} ± 45.77	143.2^{abc} ± 1.41
OA-1.5	562.8^{bc} ±10.36	972.4^{ab} ± 43.33	154.3^{ab} ± 5.94
OA-2	541.3^{c} ±13.69	829^{c} ± 34.02	155.9^{a} ± 5.20

Means in the same column with different superscripts are significantly different $P<0.05$. OA-0: control; OA-0.05, OA-0.1, OA-1.5 and OA-2 were provided 0.5, 1, 1.5 and 2 ml/L organic acid in drinking water, respectively.

Mean FCR is shown in Table III. Feed conversion ratio was affected significantly ($P<0.05$) by organic acid supplementation. A decreasing drift was observed in FCR with the increasing level of organic acids. The best FCR

was recorded in group OA-2, OA-1.5, followed by OA-1, OA-1.5 and was the highest (poor) in group OA-0, respectively.

The mean dressing percentage per chick is given in Table III. Dressing percentage was significantly affected ($P<0.05$) by organic acids supplementation. Dressing percentage was signficnatly high in group OA-2 Dressing percentage was the same in group OA-0.5 and OA-0.

Mean weight of liver and heart per chick is presented in Table III. Liver weight was significantly ($P<0.05$) high in OA-2. Mean heart weight per chick is revealed in Table II. Heart weight was not affected by using organic acid supplementation.

Mortality rate of quail was 20.00, 13.00, 11.7, 10.00 and 6.7% in group OA-0, OA-0.5, OA-1, OA-1.5 and OA-2 respectively (Table IV). Mortality rate was significantly ($P<0.05$) high in the control group and was followed by group OA-0.5.

Table III.- Effect of organic acid blend (Aciflex®) on feed conversion ratio, dressing percentage, liver weight and heart weight of Japanese quail.

Group	feed conversion ratio (g/g)	Dressing percentage (%)	Liver weight (g)	Heart weight (g)
OA-0	$4.6^{a} \pm 0.115$	$60.1^{d} \pm 2.23$	$3.4^{b} \pm 0.17$	1.3 ± 0.15
OA-0.5	$4.1^{b} \pm 0.113$	$60.6^{d} \pm 0.47$	$4.6^{a} \pm 0.20$	1.5 ± 0.08
OA-1	$4^{b} \pm 0.037$	$65.^{c} \pm 0.87$	$4.7^{a} \pm 0.31$	1.6 ± 0.05
OA-1.5	$3.7^{b} \pm 0.090$	$68.1^{b} \pm 0.87$	$5.0^{a} \pm 0.30$	1.7 ± 0.14
OA-2	$3.5^{c} \pm 0.100$	$71.1^{a} \pm 4.48$	$5.1^{a} \pm 0.30$	1.7 ± 0.08

For statistical detail and description of experimental groups, see Table II.

Table IV.- Effect of organic acid blend (Aciflex®) on mortality (%) of control and experimental Japanese quails.

Group	Mean ± SE
OA-0	$20.0^{a} \pm 2.89$
OA-0.5	$13.0^{ab} \pm 4.41$
OA-1	$11.7^{ab} \pm 1.67$
OA-1.5	$10.0^{ab} \pm 0.00$
OA-2	$6.7^{b} \pm 1.67$

For statistical detail and description of experimental groups, see Table II.

Mean feed cost including cost of organic acids is presented in Table V. Higher feed cost was recorded in the control group, while it was the same in all other groups. Mean gross return per quail is presented in Table V. Gross return was increased with increasing level of organic acids. Maximum gross return was recorded in group OA-2 and lowest in the control group. However, results were non significant ($P>0.05$). Mean net return per quail is presented in Table V. Net return was significantly affected by organic acids supplementation. Net return was the highest in group OA-1.5 and OA-2 and was the least in the control group. Group OA-0.5 and OA-1 performed similarly.

Table V.- Effect of organic acid blend (Aciflex®) on feed cost (Rs.), gross return and net return in Japanese quail.

Group	Feed cost (Rs)	Gross return (Rs.) per Japanese quail	Net return (Rs.) per Japanese quail
OA-0	$24.8^{a} \pm 0.35$	50.9 ± 1.89	$26.0^{c} \pm 1.56$
OA-0.5	$21.1^{b} \pm 0.74$	51.7 ± 0.56	$30.6^{b} \pm 0.43$
OA-1	$21.0^{b} \pm 0.27$	52.1 ± 0.52	$31.1^{b} \pm 0.39$
OA-1.5	$20.9^{b} \pm 0.37$	56.1 ± 2.16	$35.2^{a} \pm 1.86$
OA-2	$20.3^{b} \pm 0.51$	56.7 ± 1.89	$36.4^{a} \pm 1.68$

For statistical detail and description of experimental groups, see Table II.
1Rs: 106 USD.

DISCUSSION

Organic acids increase the effect of proteolytic enzymes and improve protein digestibility (Samanta *et al*., 2010). Moreover, organic acids also decrease the pH in the intestines and ultimately enhance the performance of birds (Samanta *et al*., 2010). Findings of the current agreed with the findings of Mohamed and Bahnas (2009), who reported positive effect on feed utilization in response to malic acid supplementation. Samanta *et al.* (2010) reported significant reduction ($P<0.05$) in feed intake using organic acids. Results of the present trial are do not agree with the finding of Sacakli *et al.* (2006) who reported no change in feed intake by organic acid. The growth promoting effects of organic acids are accredited to their ability to control the growth of potential pathogens in the gastrointestinal tract of animals (Izat *et al*., 1990; Hadorn *et al*., 2001). Organic acids enhance energy and protein digestibility by decreasing microbial completion to the host and nutrient by decreasing subclinical infection (Dibner and Buttin, 2002). The results of the present trial are justified by Chaveerach *et al.* (2004) who obtained positive effect of organic acids on poultry growth. Muhamed and Bahnas (2009) recorded higher body weight by supplementation of malic acid in Japanese quails. In addition, formic acid supplementation caused enhancement in weight gain of broilers (Patten and Waldroup, 1988). Similarly Skinner *et al.* (1991) found a significant improvement in body weight of male broilers fed different levels of fumaric

acid. Organic acids have positive effect on poultry growth (Chaveerach *et al.,* 2004). Organic acids decrease the population of *E.coli* and other pathogenic bacteria and improve poultry growth (Samanta *et al*., 2010). Chimote *et al*. (2009) obtained significant effect (P<0.05) on FCR by using yeast and acidifier. The results are also supported by Parker *et al.* (2007) who also reported positive effect on FCR by organic acids supplementation. Results of the present study do not agree with Sacakli *et al*. (2006) findings reporting negative effect (P>0.05) on FCR by organic acid.

In the present study, the higher dressing percentage may be due to the action of organic acid to enhance energy and protein digestibility by decreasing microbial load of the host (Dibner and Buttin, 2002). Mohamed and Bahnas (2009) obtained a positive effect on dressing percentage in response to organic acid in Japanese quails. Chimote *et al.* (2009) recoreded improved dressing percentage by using acidifiers in quails. Islam *et al.* (2008) reported improved effect on liver weight by acetic acid and citric acid in broilers. Similarly, the results are also supported by Abdel-Mageed (2012) who fed organic acids to Japanese quails and recorded significant effect on liver. Results of the study are contrary to Adil *et al.* (2010) who reported no effect of organic acids supplementation on liver weight. Cakir *et al.* (2008) reported non significant effect of liver weight by combined probiotic, antibiotic and organic acids in the diet of Japanese quails. Results of the present study agreed with the findings of Sacakli *et al.* (2006) who reported no significant effect of organic acids supplementation on heart weight in quails. Similarly, results of the present study are also supported by Cakir *et al*. (2008) who reported non-significant effect on heart weight by combine supplementation of probiotic antibiotic and organic acid in quail. Present findings are contrasted by Mohamed and Bahnas (2009) on heart in Japanese quail.

Results of the current study are supported by the finding of Islam *et al*. (2008) who obtained reduced mortality in broiler chicks fed citric acid and acetic acid. Organic acids make the condition acidic that help the nutrients more available for absorption (Boling *et al.,* 2001) and hence reduce the feed requirements of the birds. The lower feed cost in treated groups may be due to reduced feed intake. Reduced feed cost and higher gross return resulted in higher net return in treated groups. Our findings are in agreement to Muhammad and Bahnas (2009) who supplemented malic acid to low protein low energy diet and reported higher body weight gain price and economical efficiency in Japanese quails. Results of the present study are in contrast to Islam *et al.* (2008) who recorded higher feed cost and low gross return and net profit in broiler chicks fed citric acid and acetic acid.

CONCLUSION

It can be concluded from the present study that organic acids supplementation at the rate of 2ml/L of drinking water improved weight gain, feed efficiency, dressing percentage and liver weight in Japanese quails. It also decreased feed intake and water consumption. Organic acids supplementation at the level of 1-2ml/L of drinking water reduced mortality. Finally, lower feed cost and higher net return was obtained when organic acid was used at the rate of 1-2ml/L drinking water.

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Statement of conflict of interest

Authors have declared no conflict of interest.

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