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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2018; 7(7): 278-282

www.thepharmajournal.com
Received: 21-05-2018
Accepted: 23-06-2018

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The effects of supplementation of salts of organic acids on production performance in layers: A Review

Ravinder Dahiya, Kapil Dev and Kiran

Abstract
The poultry industry is a well-organized and fast growing sector of Indian economy. Introduction of improved breeds, nutritional standards, knowledge of disease prevention and scientific management practices have increased meat and egg production significantly. Antibiotics have been widely used in poultry production for decades to improve growth rate and feed conversion efficiency, however, their use as growth promoters in the poultry industry has been intensively controversial because of the development of bacterial resistance and potential consequences on the human health (Ratcliff, 2000). In response to this apparent threat, the European Commission (EC) decided to phase out, and ultimately ban (January, 2006), the marketing and use of antibiotics as growth promoters in feed (EC Regulation No. 1831/2003). Now the poultry sector is continuously searching for new feed additives in order to improve the feed efficiency with minimum deleterious effects on animal health. A modernistic challenge in the poultry production is to exploit the use of specific dietary supplements to boost the intrinsic potential of poultry birds in order to perform better.

Keywords: organic acids, antibiotics, growth promoters, poultry

Introduction
India is emerging as the world's 2nd largest poultry market with an annual growth of more than 14%, producing 61 million tones or 3.6% of the global egg production and annual growth rate of egg production is 5-8%. Apart from this, India ranks 6th in broiler production with an annual output of 2.39 million tones of broiler meat (4th International Poultry and Livestock Expo, 2015) [12]. Annual per capita availability of eggs and meat is 57 and 2.9 kg, respectively (ICAR rating feature June 2014), however, according to National Institute of Nutrition recommendation per capita requirement of eggs and meat is 180 and 11 kg per year, respectively (ICMR-2012) [11]. In search of efficient alternative to antibiotic growth promoters, a number of agents were being tried; among them organic acids have been found to be one of the most promising alternatives (Gunal *et al*., 2006) [9] in animal production. Organic acids associated with specific antimicrobial activity are short chain acids (C_1-C_7) which are widely distributed in nature as normal constituents of plants or animal tissues and also formed through microbial fermentation of carbohydrates predominantly in the caeca of poultry (Van Immerseel *et al*., 2006) [27]. Organic acids are simple monocarboxylic acids such as formic, acetic, propionic, butyric acid or carboxylic acid bearing hydroxyl group such as citric, tartaric, lactic and malic acid. Many are also available as sodium, potassium or calcium salts. The advantages of salts over acids is that they are generally odourless and easier to handle in the feed manufacturing process owing to their solid and less volatile form (Huyghebaert *et al*., 2011) [10]. Organic acids and their salts are generally regarded as safe (GRAS) and have been approved by most member states of European Union (EU) to be used as feed additives in the animal production (EFSA, 2011) [7].
Health of the gut is one of the major factors governing the performance of birds and thus, the economics of poultry production and the profile of intestinal microflora plays an important role in gut health (Samik *et al*., 2007) [21]. Organic acids can serve as a meaningful tool to controlling all enteric non-pathogenic and pathogenic especially acid-intolerant bacteria like *Escherichia coli, salmonella* and *campylobacter* species (Wolfenden *et al*., 2007) [29]. The organic acids in non-dissociated form are able to pass through the bacterial cell membrane inside the cell, where they dissociate in H^+ which lower the pH of the cell and $RCOO^-$ ions that can disrupt the normal physiology of certain types of bacteria and consequently, preserve the microbial balance in the gastrointestinal tract (Dhawale, 2005) [6].

Organic acids have made a great contribution to profitability in poultry production and also provided people with nutritious poultry products (Moharrery and Mahzonieh, 2005) [16]. There is a common observation of decreased digestive capacity due to impaired quality of the mucosal cells in the intestine and decreased length of the intestinal villi. This caused lower laying percentage, feed conversion and egg shell calcification (Schwarzer, 2006) [23]. Organic acids salts play an important role by restoring the function of damaged cells that are resulted from fat deposition. From the use of organic acids salts in poultry layers, one can expect an improvement in performance better than that of antibiotics growth promoters, with public health concern. In India, there is scant literature available on the use of organic acid salts in the ration of layers. Feed acidifiers act as growth promoters and feed preservatives in poultry where they can maintain feed hygiene, also improve protein and energy digestibility by reducing the microbial competition with the host for nutrients, endogenous nitrogen losses, by lowering the incidence of subclinical infections and secretion of immune mediators, and by reducing ammonia production and other growth-depressing microbial metabolites (Adil *et al.*, 2010) [1]. Previous studies reported that organic acids such as propionic, fumaric, ascorbic and lactic acids and their salts have shown variable effects on egg production and egg quality parameters.

Review on effect of organic acid salts on body weight changes, feed intake and mortality

Yesilbag and Colpan (2006) [30] observed no significant effect of supplementation of various levels (0.5, 1.0 and 1.5%) of organic acids mixture on growth performance (body weight and food consumption). Soltan (2008) [25] supplemented the control group 1 with 260 ppm (group 2), 520 ppm (group 3) and 720 ppm (group 4) of organic acids mixture and found a significant ($P<0.05$) improvement in live body weight in group 2 and group 3 and non-significant increase in group 4 when compared with control group 1. It was further reported that a non-significant effect on daily feed intake was observed. Group 2 showed an increase in mortality of the laying hens, moreover the other groups had no effect on the mortality of laying hens during the experimental period. Similarly, Rahman *et al.* (2008) [20] studied the efficiency of organic acids mixture supplementation as growth promoters in laying hens at age between 67 and 74 weeks and observed no significant effect on body weight changes and feed intake (g/hen/day). Park *et al.* (2009) [19] observed no significant effect of available phosphorus and organic acid on average daily feed intake. Wang *et al.* (2009) [28] reported that there was no significant effect on average daily feed intake by supplementing the basal diet with phenyl lactic acid in the layers. Swiatkiewicz *et al.* (2010) [26] studied the effect of supplementation of the diets with prebiotics and organic acids in laying hens and observed no significant effect on daily feed consumption. Ozek *et al.* (2011) [18] studied the effect of dietary supplementation of herbal essential oil mixture and organic acid in layers and observed no significant effect on live body weight gain and feed consumption. Bonos *et al.* (2011) [5] studied the effect of dietary supplementation of mannan-oligosaccharides and calcium formate in Japanese quails (Coturnix japonica) and found that live weight, mortality and feed consumption of birds were not significantly affected by the treatments. Sari *et al.* (2012) [22] studied the effect of supplementation of phytase alone or in combination with organic acid in laying hens and reported significantly ($P<0.05$) higher body weights in hens fed diets supplemented with phytase, organic acid or mixture of phytase and organic acid than control group. Youssef *et al.* (2013) [31] reported that supplementation of probiotic, prebiotics and organic acids significantly ($P<0.05$) improved body weight compared with control group but non-significant effect on feed intake (g/hen/day) was found. However, symbiotic supplementation had no significant effect on body weight. Kaya *et al.* (2013) [14] studied the effect of zeolite and organic acids mixture supplementation in the layer diet and found that feed intake and body weight gain were not significantly affected by the treatments.

Review on effect of supplementation of organic acid salts for production performance and feed conversion ratio

Boling *et al.* (2001) [4] studied the effect of organic acid (OA) addition according to the available phosphorus (AP) level and found that lowering the AP level (0.2% or less) and feeding OA decreased the productivity, hen-day egg production, and feed conversion ratio. Nollet *et al.* (2004) [17] studied the effect of sodium butyrate (Adimix butyrate C) in layer nutrition and found a positive effect of sodium butyrate on laying performance increasing from 83.1% (control) to 83.8, 84.3, 84.8 and 86.1% (50, 100, 250 and 500 ppm of sodium butyrate supplementation), respectively. Yesilbag and Colpan (2006) [30] reported that dietary supplementation of various levels (0.5, 1.0 and 1.5%) of organic acids mixture had significant ($P<0.05$) effect on hen day egg production but the feed conversion ratio was improved to a lesser extent. Sengor *et al.* (2007) [24] studied the effect of short chain fatty acid (SCFA) supplementation in 66 week old white Bovans laying hens and found that hen day egg production was significantly ($P<0.05$) higher (71.5%) in SCFA supplemented group than control group. Soltan (2008) [25] supplemented the control group 1 with 260 ppm (group 2), 520 ppm (group 3) and 720 ppm (group 4) of organic acid mixture in laying hens and found that hen day egg production was significantly ($P<0.05$) increased by about 5.77% at 780 ppm (group 4) level when compared with the control group 1. However, the lower levels (group 2 and group 3) showed non-significant effect on hen day egg production and it was also reported that egg mass and feed conversion efficiencies were significantly ($P<0.05$) improved by the treatments. Similarly, Rahman *et al.* (2008) [20] studied the efficiency of organic acids mixture supplementation as growth promoters in laying hens at age between 67 and 74 weeks and observed that egg production was significantly ($P<0.05$) improved by about 2.26, 8.0, and 9.84% and feed conversion efficiency by about 1.85, 8.48 and 7.78% at 260 ppm (group 2), 520 ppm (group 3) and 720 ppm (group 4) levels, respectively when compared with the control group 1. Kadim *et al.* (2008) [13] studied the effect of supplementation of the diet with various levels (200, 400 and 600 ppm) of acetic acid in commercial Brown leghorn laying hens and found that average egg production was significantly ($P<0.01$) increased by about 10, 15 and 20% in 200, 400 and 600 ppm groups when compared with the control group, respectively. Wang *et al.* (2009) [28] studied the effect of phenyl lactic acid in 240 Brown 36-wk-old layers which were divided in to 4 treatments: 1) control (basal diet), 2) control+ 0.1% PLA, 3) control+ 0.2% PLA, and 4) control+ 0.3% PLA and found that egg production was significantly ($P<0.01$) improved by 1.55% (control+ 0.1% PLA), 2.64% (control+ 0.2% PLA) and 2.69% (control+ 0.3% PLA) compared with the control group (basal diet), respectively. Park *et al.* (2009)

[19] reported that dietary available phosphorus and organic acids in laying hens had significant (P<0.05) effect on hen-day egg production and feed conversion ratio. Swiatkiewicz *et al.* (2010) [26] observed that mean egg production, daily egg mass production (g/hen) and feed conversion ratio (kg/dozen of eggs) were not significantly affected by supplementing the basal diet with prebiotics and organic acids in laying hens. Ozek *et al.* (2011) [18] studied the effect of dietary herbal essential oil mixture and organic acid in laying hens and observed that hen-day egg production, egg mass, feed conversion ratio were not significantly affected by the treatments. Bonos *et al.* (2011) [5] found that laying percentage was significantly (P<0.01) improved by addition of mannan-oligosaccharides and calcium format in the diet of Japanese quails. Sari *et al.* (2012) [22] studied the effect of phytase alone or in combination with organic acid in laying hens and reported significantly (P<0.05) higher egg production in hens fed diet supplemented with phytase, organic acid or mixture of phytase and organic acid than hens fed basal diet. Grashorn *et al.* (2012) [8] studied the influence of dietary organic acid supplementation in 24 Hisex Brown laying hens of 30 weeks of age which were divided into two groups, 12 hens in each group. One group (control) fed on standard diet and other group fed on diet supplemented with organic acids preparation (*SALMO-NIL DRY*) @ 2kg/ton of feed and found that laying rate and feed conversion ratio were significantly (P<0.05) improved by supplementing the diet with the organic acids in the layers. Youssef *et al.* (2013) [31] studied the effect of probiotics (0.01% Protexin), prebiotics (0.05% Clostat) and organic acids (0.06% Galliacid) in layers and found that diet supplemented with organic acids significantly (P<0.05) increased the egg production by about 9.94% and egg mass by 14.18%, respectively and also reported non-significant effect on feed conversion ratio. However, supplementation with probiotics or prebiotics had no significant effect on egg production and egg mass production compared with control group. Youssef *et al.* (2013) [32] supplemented the basal diet with various levels (0.1, 0.2 and 0.3%) of sodium formate in 96 laying hens aged 53 weeks under heat stress condition and reported that egg production and feed conversion ratio were significantly (P<0.05) improved by different dietary treatments when compared with control group. Kaya *et al.* (2013) [14] studied the effect of zeolite and organic acids mixture supplementation in the layers' diet and found that egg production and feed conversion ratio were not significantly affected by the treatments. Attia *et al.* (2013) [2] supplemented the diet with various levels (0, 1.5, 3 and 6%) of acetic acid in Japanese quails and found that laying rate and egg mass were significantly (P<0.05) improved by 3% level of acetic acid supplemented diet as compared with control and other supplemented groups. Dahiya (2015) reported non-significant effect by supplementing the diets with different levels of salts of organic acids in the layers. It was also noticed that as the inclusion level of salts of organic acids increased in the diet of layers, the feed intake was non-significantly improved as compared to control group. Similarly, body weight gain was not significantly affected by different dietary treatments. Dahiya (2015) also found there was significant (P<0.05) positive effect on per cent hen day egg production by supplementation of different levels (0.5, 1.0 and 1.5%) of salts of organic acids in the diets of layers and as the inclusion level of salts of organic acids increased in the diets of layers, the per cent hen day egg production was increased as compared to control (T_1) group. This improvement in per cent hen day egg production might be due to increased digestibility and retention of nutrients by supplementation of salts of organic acids in the diets of layers. The results are in close agreement with Nollet *et al.* (2004) [17] who found a positive effect of sodium butyrate on laying performance that might be confounded by variations in gut flora and environmental conditions (Mahdevi *et al.*, 2005) [15].

Effect on economics of production at farm

Rahman *et al.* (2008) [20] studied the efficiency of organic acid mixture supplementation as growth promoters in laying hens at age between 67 and 74 weeks. Birds in the control (T_1) group were fed basal diet whereas birds in other treatment groups were fed basal diet supplemented with 260 ppm (T_2), 520 ppm (T_3), 720 ppm (T_4) of organic acid mixture (fumaric acid and salts of butyric, propionic and lactic acids) and found that the highest economical efficiency (46.52%) was obtained by T_3 group when compared with the control. Economical efficiency was also higher (41.37%) in T_4 group when compared with the control group. However, T_2 group exhibited a decrease of economical efficiency of production by about (2.99%) when compared with control. Soltan *et al.* (2008) [25] supplemented the control group 1 with 260 ppm (group 2), 520 ppm (group 3) and 720 ppm (group 4) of organic acids mixture in laying hens and revealed that the highest economical efficiency (23.66%) was obtained by group 4 when compared with the control group. However, lower level of organic acids mixture (group 2 and group 3) exhibited a decrease of economical efficiency of production by about 4.71 and 17.47%, respectively. Dahiya (2015) also found that feed cost value per dozen egg production and kg egg mass production was lower at 0.5% level (T_2 and T_5) of salts of organic acids as compared to all other treatment groups. There was maximum profit of Rs. 1.74 and 1.57 per dozen egg production in T_2 (0.5% sodium-butyrate) and T_5 (0.5% calcium-propionate), respectively, in comparison to control (T_1) group. When feeding cost was calculated in terms of per kg egg mass production, it was found that there was a reduction in cost per kg egg mass production for Rs. 0.52 and 0.99 in dietary treatments T_2 (0.5% sodium-butyrate) and T_5 (0.5% calcium-propionate), respectively, in comparison to control (T_1) group. Addition of salts of organic acids increased the cost per kg feed, but the beneficial effects of salts of organic acids as increased hen day egg production, improved egg mass production and improved feed conversion ratio leads to decreased feed cost value per dozen egg and per kg egg mass production at 0.5% level of inclusion.

Conclusion

The poultry sector in India is one of the fastest growing and less susceptible to natural uncertainties. In the words of Dr. M.S. Swami Nathan, "The achievements and growth in poultry are comparable to the advances made in the wheat production" which has led nation to the path of red revolution. Layers are special types of birds for egg production due to their high feed utilization capacity but under present farm practices in India they are always under stress. Most of researchers noticed supplementation of salts of organic acids had no effect on average feed consumption and body weight gain in layers. Supplementation of salts of organic acids in the diet of layers significantly (P<0.05) improved production performance (Per cent hen day egg production and egg mass production) and FCR (kg feed per dozen egg and kg feed per kg egg mass). It can be concluded that dietary supplementation of salts of organic acids at 0.5% level economize the layers' performance without affecting egg quality traits. From economical point of view, egg production was more profitable at 0.5% level of sodium-butyrate and 0.5% level of calcium-propionate which reduced the feed cost per dozen eggs and per kg egg mass production without affecting the egg quality as reported by Dahiya (2015) on study in White Leghorn.

Reference

1. Adil S, Banday T, Bhat GA, Mir MS, Rehman M. Effect of dietary supplementation of organic acids on performance, intestinal histomorphology and serum biochemistry of broiler chicken. Vet. Med. Intl. 2010, 7.
2. Attia YA, El-Hamid AE, Ellakany F, Bovera F, Al-Harthi MA, Ghazaly SA. Growing and laying performance of Japanese quails fed diet supplemented with different concentrations of acetic acid. Ital. J Anim. Sci. 2013; 12:2.
3. BIS. Requirement for chicken feeds. IS: 1374-2007, Manak Bhawan, 9 Bahadurshah Zafar Marg, New Delhi-110001, 2007.
4. Boling-Frankenbach SD, Snow JL, Parsons CM, Baker DH. The effects of citric acid on the calcium and phosphorus requirements of chicks fed corn soybean meal diets. Poult. Sci. 2001; 80:783-788.
5. Bonos E, Christaki E, Florou-Paneri P. Effects of dietary mannan-oligosaccharides and calcium formate on performance and egg quality of Japanese quails. JF. Sci., Eng. 2011, 289-296.
6. Dhawale A. Better eggshell quality with a gut acidifier. Poult. Intl. 2005; 44:18-21.
7. EFSA. Scientific opinion on the safety and efficacy of propionic acid, sodium propionate, calcium propionate and ammonium propionate for all animal species. EFSA Journal. 2011; 9(12):2446.
8. Grashorn MA, Gruzauskas R, Dauksiene A, Jarule V, Alencikiene G, Slausgalvis V. Influence of organic acids on quality and sensory attributes of chicken eggs. Arch. Geflügelk. 2012; 77:29-34.
9. Gunal M, Yayli G, Kaya O, Karahan N, Sulk O. The effects of antibiotic growth promoter, probiotic and organic acid supplementation on performance, intestinal microflora and tissue of broilers. Intl. J Poult. Sci. 2006; 5:149-155.
10. Huyghebaert G, Ducatelle R, Van Immerseel F. An update on alternatives to antimicrobial growth promoters for broilers. The vet. J. 2011; 187:182-188.
11. ICMR. Indian Council of Medical Research, Department of health research, ministry of health & family welfare, 2012.
12. International Poultry and Livestock Expo. Banglore international exhibition centre (BIEC), Banglore, India, 2015. http://www.iplexpo.com. 03/06/2015.
13. Kadim IT, Al-Marzooqi W, Mahgoub O, Al-Jabri A, Al-Waheebi SK. Effect of acetic acid supplementation on egg quality characteristics of commercial laying hen during hot season. Intl. J Poult. Sci. 2008; 7:1015-1021.
14. Kaya H, Kaya A, Gul M, Celebi S. Effect of zeolite and organic acids mixture supplementation in the layers' diet on performance, egg quality traits and some blood parameters. J Anim. vet. Adv. 2013; 12(6):782-787.
15. Mahdavi AH, Rahmani HR, Pourreza J. Effect of probiotic supplements on egg qualiity and laying hen's performance. Int. J Poult. Sci. 2005; 4:488-492.
16. Moharrery A, Mahzonieh M. Effect of malic acid on visceral characteristics and coliform counts in small intestine in the broiler and layers chickens. Int. J Poult. Sci. 2005; 4(10):761-764.
17. Nollet L, Janssens G, Arnouts S. The use of sodium butyrate (Admix butyrate C) in layer nutrition. Nutri-Ad Int. NV, 2004. www.inve.com/ 01/11/2014.
18. Ozek k, Wellmann KT, Ertekin B, Tarum B. Effect of dietary herbal essential oil mixture and organic acid preparation on laying traits, gastrointestinal tract characteristics, blood parameters and immune response of laying hens in a hot summer season. J Anim. vet. Adv. 2011; 20:575-586.
19. Park KW, Rhee AR, Um JS, Paik IK. Effect of dietary available phosphorus and organic acids on the performance and egg quality of laying hens. J Appl. Poult. Res. 2009; 18:598-604.
20. Rahman MS, Howlider MAR, Mahiuddin M, Rahman MM. Effect of supplementation of organic acid on laying performance, body fat and egg quality of hens. Bang. J Anim. Sci. 2008; 37(2):74-81.
21. Samik KP, Gobinda H, Manas KM, Gautam S. Effect of organic acid salt on the performance and gut health of broiler chicken. J Poult. Sci. 2007; 44:389-395.
22. Sari Mustafa, Onol G, Daskiran M, Cengiz O. Egg production and calcium-phosphorus utilization of laying hens fed diets supplemented with phytase alone or in combination with organic acid. Int. J Poult. Sci. 2012; 11(3):181-189.
23. Schwarzer D, Zhang Z, Zheng W, Cole PA. Negative regulation of a protein tyrosine phosphatase by tyrosine phosphorylation. J Am. Chem. Soc. 2006; 128:4192-4193.
24. Sengor E, Yardimci M, Cetingul S, Bayra I, Sahin H, Dogan I. Effects of short chain fatty acid (SCFA) supplementation on performance and egg characteristics of old breeder hens. South African J Anim. Sci. 2007; 37:158-163.
25. Soltan MA. Effect of organic acid supplementation on egg production, egg quality and some blood serum parameters in laying hens. Intl. J Poult. Sci. 2008; 7:613-621.
26. Swiatkiewicz S, Koreleski J, Arczewska A. Laying performance and egg shell quality in laying hens fed diets supplemented with prebiotics and organic acids. Czech J Anim. Sci. 2010; 55(7):294-306.
27. Van Immerseel F, Russel JB, Flythe MD, Gantois I, Timbermont L, Pasmans F *et al*. The use of organic acids to combat salmonella in poultry: a mechanism explanation of the efficacy. Avian pathology, 2006; 35:182-188.
28. Wang JP, Yoo JS, Lee JH, Zhou TX, Jang HD, Kim HJ *et al*. Effects of phenyl lactic acid on production performance, egg quality parameters and blood characteristics in laying hens. J Appl. Poult. Res. 2009; 18:203-209.
29. Wolfenden AD, Vicente JL, Higgins JP, Andreatti RL, Filho SE, Higgins B *et al*. Effect of Organic Acids and Probiotics on Salmonella enteritidis Infection in Broiler Chickens. Int. J Poult. Sci. 2007; 6:403-405.
30. Yesilbag D, Colpan I. Effects of organic acid supplemented diets on growth performance, egg production, quality and on serum parameters in laying

hens. Revue Med. Vet. 2006; 157:280-284.
31. Youssef AW, El-Daly EF, Abd El-Azeem NA, El-Monairy MM. Effect of sodium formate on laying hen performance, gastrointestinal tract pH and some blood components under heat stress conditions. Asian J Poult. Sci. 2013; 7:17-26.
32. Youssef AW, Hassan HMA, Ali HM, Mohamed MA. Effect of supplementation of probiotics, probiotics and organic acid on layer performance and egg quality. Asian J Poult. Sci. 2013; 7(2):65-74.