IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 3 Ver. I (March 2018), PP 54-58
www.iosrjournals.org

Effect of dietary supplementation of increasing levels of organic acid mixture on performance and carcass characteristics of broiler chickens

Abdelrahim A.Mohamed[1††], Abdelbasit B. Habib[2], Ahmed M. E. Eltrefi[3], Egbal S.Abu shulukh[3], Abubaker A. Abubaker[2], Haytham H. Abdelwahid[4], Eiman O. Basheer[5], Sulafa M. Hassouna[6]

[1]*Department of Animal Nutrition, College of Animal Production, University of Bahri, Sudan*
[2]*Department of Poultry production, College of Animal Production, University of Bahri, Sudan*
[3]*Department of Meat production, College of Animal Production, University of Bahri, Sudan*
[4]*Department of Animal Breeding and Genetics, College of Animal Production, University of Bahri, Sudan*
[5]*International Food Research Center, Shambat, Sudan.*
[6]*Animal Production in Dry land Department, Environment, Natural Resources and Desertification Research Institute, National Research Center, Khartoum, Sudan*

Abstract: *The aim of the present study was to evaluate the effect of different levels of organic mixture on growth performance, carcass characteristics and meat quality of broiler chickens fed. For this purpose, three hundred, unsexed, one-day old, Ross 308 broiler chicks with 40 g average initial weight were used. After one week adaptation period, chicks were divided randomly to receive one of the four dietary treatments being, basal diet (A) or basal diet supplemented with organic acid mixture, Citrinal, at a level of 0.05% (B); 0.1% (C) and 0.2% (D). The results showed that feed intake/g, body weight/g, body weight gain/g/d, feed conversion ratio and meat chemical and physical characteristics were not affected at any level of supplementation. Dressed carcass weight/g was significantly higher (P<0.05) in those groups received diet supplemented with organic acid mixtures at a level of 0.05%, 0.1% and 0.2% compared to those received control diet. Moreover, dressing% was higher (P<0.05) in the group received 0.2% supplemented organic acid mixtures compared to those received the control diet; however, there were no significant differences among the groups fed the organic acid mixtures supplemented diets. It was concluded that supplementing broiler diet with organic mixture up to 0.2% slightly improved the carcass quality but meat quality did not affected.*

Keywords: *Broiler diet, organic acid mixture, citrinal, meat quality, growth performance*

Date of Submission: 25 -02-2018 Date of acceptance: 10-03-2018

I. Introduction

Obtaining proper growth rate and feed conversion efficiency and maintaining optimal animal health are the key aim of poultry production for the food chain. To achieve such goals, various feed additives have been suggested by animal nutritionists. Antibiotics has been used in broiler diets as growth promoter for decades, however, it were prohibited to use in animal feed in the European Union because of concern residues in animal products and potential appearance of antibiotics resistant bacteria (Xu et al., 2018). Therefore, identification and development of alternatives to in-feed antibiotics is a high priority (Long et al., 2018). Organic acid (AO) is one of the most potent alternative feed additives in poultry nutrition. These compounds have been recently tested in laying hens (Jahanian and Golshadi, 2015; Kazempour and Jahanian, 2017), big (Long et al., 2018) and broilers (Dehghani-Tafti and Jahanian, 2016) and the result shown that OA can improve poultry productivity.

Organic acids are used in feeds for their various beneficial effects on gut function and microflora, feed preservation from microbial invasion, inhibition of pathogenic bacteria, enhancing mineral absorption, accelerating recovery from cage fatigue, and improvement of nutrient digestibility (Abdel-Azeem et al., 2000; Dibner and Buttin, 2002; Jahanian and Golshadi, 2015). As a result, these beneficial effects will enhance the growth performance and profitability of poultry production. Several previous studies have indicated that butyric acids improve the growth rate and feed conversion ratio in broiler chickens (Antongiovanni et al., 2007; Abdel-Fattah et al., 2008; Jahanian, 2011). Other study by (Chowdhury et al., 2009) showed that dietary supplementation of citric acid at the level of 5 g/kg had positive effects on growth, feed intake, feed efficiency, carcass yield, bone ash, and immune status of broiler chickens. Moreover, (Rafacz-Livingston et al., 2005) in their study with crossbred and commercial broiler chickens observed that citric acid improved phytate phosphorus utilization in both breeds. . (Asano et al., 1994) reported that gluconic acid could reduce pathogenic enteric bacteria and subsequently improved nutrient digestibility.

In addition to general mode of action, butyric acid is considered as the prime enterocytes' energy source and it is necessary for the optimum development of intestinal epithelium and gut-associated lymphoid tissues (Friedman and Bar-Shira, 2005). In this regard, (Jahanian, 2011) observed that while dietary supplementation of butyric acid glycerides at the level of 2 g/kg improved weight gain and feed efficiency, the greatest villi height was obtained with the level of 3 g/kg. Similarly, (Leeson et al., 2005) reported the positive impacts of butyric acid on production performance and carcass efficiency of broiler chickens. In contrast, OA supplementation of poultry diets had no marked impact on performance and/ or feed efficacy in some research studies (Biggs and Parsons, 2008; Mahdavi and Torki, 2009). Most of the previous studies have evaluated a single OA as a dietary supplement. To the best of our knowledge, few studies have been conducted to evaluate the effect of mixture of different OA and their effect on big (Long et al., 2018) and broilers (Hassan et al., 2010). Therefore, the present study aimed to evaluate the effect of increasing levels of commercial OA mixture, Citrinal (Citric acid, Fumaric acid, D-L Malic acid, and Lactic acids, with Orthophosphoric acid), on growth performance, carcass characteristics and meat quality of broiler chickens fed balanced diet.

II. Materials and Methods

Study location

The present experiment was conducted at training and research farm, poultry unit, College of Animal Production, University of Bahri, Khartoum North, during the period of 11th April 2016 to 16th May 2016 in a closed system .The temperature was gradually reduced during the six weeks of entire experimental period from 37 to 24˚C.

Experimental birds housing,management and diets

Three hundred, unsexed, one-day old, Ross 308 broiler chicks with 40 g average initial weight were obtained from local commercial company (Inmaa for poultry Production Company, Omdurman- Sudan). Upon arrival, the chicks were received multi-vitamins AD3E+coliston 0.2ml/1L in the drinking water for three days. Chicks were vaccinated against Newcastle disease at the first day (spraying) and repeated at 21days of age (drinking water). Also vaccinated against Gambaro disease at 12 days of age and repeated at 19 days old. Soluble multi-vitamins were offered to the chicks before and after three days of the vaccination to guard against stress.

The experimental chicks were kept in an open experimental wire mesh pen constructed on the concrete floor (1.5 m^2) inside the poultry house. Each pen was supplied with cleaned and disinfected nipples line for drinking water and 2 feeders (5Kg). The feeders and water lines heights were adjusted, according to the progressive growth of the chicks.

The chicks were fed 100 g/ bird/ day a pre-starter diet (pellets) in the first week (Table 1), then after, 1.25 kg /bird starter and finisher (mash) diet was offered for the rest of the experimental period (Table 2). Feed and water were made available *ad libitum*. Starting from the second week, chicks were randomly divided into four groups and assigned to one of the experimental diets being: A, basal diet (control) or basal diet supplemented with OA mixture, Citrinal, at a level of 0.05% (B); 0.1% /(C) and 0.2% (D). The basal diet was formulated to be iso-nitrogenous (22.5% CP) and iso-caloric (3100 Kcal/Kg) to meet the nutrient requirements of broiler according to (NRC, 1994). Diets were formulated from local ingredients except for the imported super concentrate.

III. Data Collection

Growth performance and Carcass measurements

Growth performance parameters (feed intake/g/bird, average weight gain/g/bird/day, body weight/g/bird and feed conversion ratio) for all groups were recorded weekly throughout the experimental period. Mortality was observed and recorded daily. At the end of a 6th week, the experimental birds were fasted overnight and slaughtered by severing the jugular vein. After complete bleeding the slaughtered birds were scalded in hot water mixed with salt, hand-plucked and washed. The head was removed close to skull, Eviscerated to remove the internal organs. All the cut parts including the internal organs were separated and weighed accordingly.

Hot carcass weight was recorded and the dressed carcasses were weighed and the dressing percentage was obtained by expressing the dressed carcass weight as a percentage of live body weighed. Breast, back, wings, drum stick, high and neck percentages were recorded as percentage of dressed carcass. Internal organs including liver, gizzard and heart were weighed and recorded individually; weights of parts were expressed as percentage of respective slaughter body weight.

Chemical and physical analysis of breast muscle

A proximately 100 g of breast muscle from 5 replicates in each group was stored in freezer (-20 ºC) pending evaluation of chemical and physical characteristics of the meat. After thawing, the crude protein, fat, ash and moisture contents were determined according to the procedure described by (AOAC, 1989). Water holding capacity (WHC) of breast muscles was determined in duplicate according to the centrifugal method described by (Kim et al., 2016). The WHC (%) was estimated by calculating the percentage breast weight before and after centrifugation. For pH determination, 3 g samples of breasts muscles were homogenized with 27 mL of distilled water using a homogenizer at 6,000 rpm for 30 sec. The pH value of chicken breasts was determined in triplicate using an electronic pH meter (HI 99163, Hanna Instruments Inc., Woonsocket, RI, USA).

Statistical Analysis

Data were analyzed by one- way analysis of variance as completely randomized block design using the PROC MIXED of SAS (SAS, 2003). Means were separated by Duncan's Multiple Range Test (Steel and Torrie, 1980) at $P<0.05$.

IV. Results and discussion

The effects of dietary treatments on growth performance of broiler chickens are shown in (Table 3). In the present study, no significant differences were detected either on feed intake, body weight, weight gain or feed conversion ration among the dietary treatments. Different Organic acid supplementation in broiler diets is usually associated with improved growth performance (Antongiovanni et al., 2007; Abdel-Fattah et al., 2008; Panda et al., 2009; Taherpour et al., 2009; Jahanian, 2011). On the other hand, according to (Biggs and Parsons, 2008; Talebi et al., 2010), addition of various organic acids into the broiler diets had no beneficial effect on performance variables. The lack of response in the present study and the contradictory results could be attributed to difference in phosphorous contents (Dehghani-Tafti and Jahanian, 2016). The differences between in the individual experimental birds between and within the groups could be another factor since the standard errors of growth performance parameters are relatively high (Table 3).

The effect of dietary supplementation of different levels of organic acids mixture on carcass characteristics and none-carcass components are presented in (Table 4). Dressed carcass weight/g was significantly increased ($P<0.05$) in the groups fed diet supplemented with organic acids mixture compared to the group received control diet. Moreover, feeding diet supplemented with 0.2 % organic acid mixture increased ($P<0.5$) dressing percentage compared to the control diet. The results are in line (Islam et al., 2008) and (Sultan et al., 2015) who reported that organic acids have positive effects on dressing percentages. Feeding organic acids mixture supplemented diets decreased ($P<0.05$) the breast, drumstick, thigh and wings weight percentages relative to live body weight compared to the control diet.

In the present study, Liver and gizzard percentages, relative to the live weight, were significantly decreased ($P<0.05$) when the broilers fed different levels of diets supplemented with organic acid mixtures compared to the control diet; however, the heart weight percentage was not affected. the reducing effect of organic acids on gizzard weight could be attributed in part to the partial hydrolysis and destruction of cell wall components of feed ingredients, whereby reduce the grinding action of gizzard and its relative weight (Leeson et al., 2005; Jahanian and Golshadi, 2015). On the other hand, the antibacterial effect of organic acid is believed to take mainly place in the upper part of the digestive tracts like crop and gizzard (Canibe et al., 2001). Therefore, decrease in gizzard weight could be explained in part by the decrease in microbial populations of upper parts by dietary organic acid supplementation (Dehghani-Tafti and Jahanian, 2016).

The effects of increasing levels of organic acid mixtures on physio-chemical properties of breast muscle are presented in (table 5). Group mean values of moisture, Protein and fat contents of breast meat samples ranged from 68.84-68.99 %, 23.74-24.24 % and 5.27-5.47% respectively, which is in accordance with previous studies (Belitz et al., 2008; Durek et al., 2014). The values measured for moisture, crude protein, fat and ash showed that the dietary treatments did not have a substantial influence on meat composition(Kopecký et al., 2012) studied the effect of organic acid supplements on performance of broilers and found higher abdominal fat contents in corresponding meat samples. In contrast, (Denli et al., 2003) observed that organic acid dietary regimens had no effect on the carcass yield, abdominal fat pad and abdominal fat percentage in broilers. Similarly, (Islam et al., 2008) found that supplementations with citric acid and acetic acid, as well as their combination, had no effect on carcass characteristics in broilers.

The group pH values determined ranged from 5.23 to 5.37, which is in accordance to previously determined values for fresh meat (Durek et al., 2014). Supplementation of the broiler diets with organic acids seemed to have a contrary effect on meat pH, as it became slightly more alkaline with increasing concentrations of organic acids. Organic acids exert their antimicrobial effects in the feed prior to consumption and/or upon ingestion in the crop, stomach and intestine (Cherrington et al., 1991). This may inhibit intestinal colonization

by pathogens, and thereby alleviate carcass contaminations during slaughter (van Immerseel et al., 2006) but does not seem to directly correlate with meat pH.

V. Conclusion

In the present study, broiler feed was supplemented with different levels of organic acid mixture, Citrinal, to evaluate, the effect of these treatments on growth performance, carcass characteristics and meat composition. The results of the present study indicated that broiler diets supplemented with organic acid mixture up to 0.2% slightly improved the carcass parameters, however, growth performance and meat quality was not affected.

Acknowledgement

Authors would like to thank the staff of Poultry Unit, Training and Research Farm, College of Animal production, University of Bahri for taking care of the birds during the entire experimental period.

References

[1] Abdel-Azeem, F., El-Hommosany, Y.M., Nematallah, Ali, G.M., 2000. Effect of citric acid in diets with different starch and fiber levels on productive performance and some physiological traits of growing rabbits. Egyptian Journal of Rabbit Science 10, 121-145.
[2] Abdel-Fattah, S.A., El-Sanhoury, M.H., El-Mednay, N.M., Abdel-Azeem, F., 2008. Thyroid Activity, Some Blood Constituents, Organs Morphology and Performance of Broiler Chicks Fed Supplemental Organic Acids. International Journal of Poultry Science 7, 215-222.
[3] Antongiovanni, M., Buccioni, A., Petacchi, F., Leeson, S., Minieri, S., Martini, A., Cecchi, R., 2007. Butyric acid glycerides in the diet of broiler chickens: effects on gut histology and carcass composition. Italian Journal of Animal Science 6, 19-25.
[4] AOAC, 1989. Official Methods of Analysis, 14th edition, Association of Official Analytical Chemists, Arlington, Va, USA.
[5] Asano, T., Yuasa, K., Kunugita, K., Teraji, T., Mitsuoka, T., 1994. Effects of Gluconic Acid on Human Faecal Bacteria. Microbial Ecology in Health and Disease 7, 247-256.
[6] Belitz, H.D., Grosch, W., Schieberle, P., 2008. Lehrbuch der Lebensmittelchemie Springer - Verlag, Berlin, Germany.
[7] Biggs, P., Parsons, C.M., 2008. The Effects of Several Organic Acids on Growth Performance, Nutrient Digestibilities, and Cecal Microbial Populations in Young Chicks. Poultry Science 87, 2581-2589.
[8] Canibe, N., Engberg, R.M., Jensen, B.B., 2001. An overview of the effect of organic acids on gut flora and gut health, Proc. of the Workshop: Alternatives to Feed Antibiotics and Coccidiostats in Pigs and Poultry (AFAC), Norfa network, October 13-16, Oslo, Norway.
[9] Cherrington, C.A., Chopra, I., Hinton, M., 1991. Acid treatment of feed for the control of Salmonella infections in poultry. Veterinary Annual 31, 90-95.
[10] Chowdhury, R., Islam, K.M.S., Khan, M.J., Karim, M.R., Haque, M.N., Khatun, M., Pesti, G.M., 2009. Effect of citric acid, avilamycin, and their combination on the performance, tibia ash, and immune status of broilers. Poultry Science 88, 1616-1622.
[11] Dehghani-Tafti, N., Jahanian, R., 2016. Effect of supplemental organic acids on performance, carcass characteristics, and serum biochemical metabolites in broilers fed diets containing different crude protein levels. Animal Feed Science and Technology 211, 109-116.
[12] Denli, M., Okan, F., Çelik, K., 2003. Effect of dietary probiotic, organic acid and antibiotic supplementation to diets on broiler performance and carcass yield. Pakistan Journal of Nutrition 2, 89-91.
[13] Dibner, J.J., Buttin, P., 2002. Use of Organic Acids as a Model to Study the Impact of Gut Microflora on Nutrition and Metabolism1. The Journal of Applied Poultry Research 11, 453-463.
[14] Durek, J., Ghadiri Khozroughi, A., Fröhling, A., Schlüter, O., Knorr, F., Mader, A., Goodarzi Boroojeni, F., Zentek, J., Knorr, D., Bolling, J.S., 2014. Effects of thermally treated broiler feed with different organic acid levels on resulting meat composition and parameters related to meat quality. Innovative Food Science & Emerging Technologies 26, 397-405.
[15] Friedman, A., Bar-Shira, E., 2005. Effects of nutrition on development of immune competence in chicken's gut-associated lymphoid system, World's Poultry Science Association (WPSA), Beekbergen, pp. 247-255.
[16] Hassan, H.M.A., Mohamed, M.A., Youssef, A.W., Hassan, E.R., 2010. Effect of Using Organic Acids to Substitute Antibiotic Growth Promoters on Performance and Intestinal Microflora of Broilers. Asian-Australas J Anim Sci 23, 1348-1353.
[17] Islam, M.Z., Khandaker, Z.H., Chowdhury, S.D., Islam, K.M.S., 2008. Effect of citric acid and acetic acid on the performance of broilers. Journal of Banglariuan Agricultural University 6, 315–320.
[18] Jahanian, R., 2011. Effect of varying levels of butyric acid glycerides on performance, 338 immune responses and jejunal epithelium morphology of broiler chicks, ^{18}th European Symposium on Poultry Nutrition, Çeşme, Izmir, Turkey, pp. 213–215.
[19] Jahanian, R., Golshadi, M., 2015. Effect of dietary supplementation of butyric acid glycerides on performance, immunological responses, ileal microflora, and nutrient digestibility in laying hens fed different basal diets. Livestock Science 178, 228-236.
[20] Kazempour, F., Jahanian, R., 2017. Effects of different organic acids on performance, ileal microflora, and phosphorus utilization in laying hens fed diet deficient in non-phytate phosphorus. Animal Feed Science and Technology 223, 110-118.
[21] Kim, H., Yan, F., Hu, J., Cheng, H., Kim, Y., 2016. Effects of probiotics feeding on meat quality of chicken breast during postmortem storage. Poultry science 95, 1457-1464.
[22] Kopecký, J., Hrnčár, C., Weis, J., 2012. Effect of organic acids supplement on performance of broiler chickens. Animal Sciences and Biotechnologies 45, 51-54.
[23] Leeson, S., Namkung, H., Antongiovanni, M., Lee, E.H., 2005. Effect of butyric acid on the performance and carcass yield of broiler chickens. Poultry Science 84, 1418-1422.
[24] Long, S.F., Xu, Y.T., Pan, L., Wang, Q.Q., Wang, C.L., Wu, J.Y., Wu, Y.Y., Han, Y.M., Yun, C.H., Piao, X.S., 2018. Mixed organic acids as antibiotic substitutes improve performance, serum immunity, intestinal morphology and microbiota for weaned piglets. Animal Feed Science and Technology 235, 23-32.
[25] Mahdavi, R., Torki, M., 2009. Study on usage period of dietary protected butyric acid on performance, carcass characteristics, serum metabolite levels and humoral immune response of broiler chickens. Journal of Animal and Veterinary Advances 8, 1702-1709.
[26] NRC, 1994. Nutrient requirements of poultry, Ninth Revised Edition. National Academy Press, Washington D.C.

[27] Panda, A.K., Rama Rao, S.V., Raju, M.V.L.N., Shyam Sunder, G., 2009. Effect of butyric acid on performance, gastrointestinal tract health and carcass characteristics in broiler chickens. Asian-Australian Journal of Animal Science 22, 1026–1031.
[28] Rafacz-Livingston, K.A., Martinez-Amezcua, C., Parsons, C.M., Baker, D.H., Snow, J., 2005. Citric acid improves phytate phosphorus utilization in crossbred and commercial broiler chicks. Poultry Science 84, 1370-1375.
[29] SAS, 2003. User's Guide: Statistics. 9.1 ed. Cary, NC.: SAS Institute Inc.
[30] Steel, R.G., Torrie, J.H., 1980. Principles and Procedures of Statistics: Abiometric Approach. McGraw-Hill Book, New York.
[31] Sultan, A., Ullah, T., Khan, S., Khan, R.U., 2015. Effect of organic acid supplementation on the performance and ileal microflora of broiler during finishing period. Pakistan Journal of Zoology 47, 635-639.
[32] Taherpour, K., Moravej, H., Shivazad, M., Adibmoradi, M., Yakhchali, B., 2009. Effects of dietary probiotic, prebiotic and butyric acid glycerides on performance and serum composition in broiler chickens. African Journal of Biotechnology 8, 2329–2334.
[33] Talebi, E., A, Zaeri, M., Abolfathi, 2010. Influence of three different organic acids on broiler performance. Asian Journal of Poultry Science 4, 7-11.
[34] van Immerseel, F., Russell, J.B., Flyhe, M.D., Gantois, I., Timbermont, L., Pasmans, F., Haesebrouck, F., Ducatelle, R., 2006. The use of organic acids to combat Salmonella in poultry: A mechanistic explanation of the efficiency. Avian Pathology 35, 182-188.
[35] Xu, Y.T., Liu, L., Long, S.F., Pan, L., Piao, X.S., 2018. Effect of organic acids and essential oils on performance, intestinal health and digestive enzyme activities of weaned pigs. Animal Feed Science and Technology 235, 110-119.

Abdelrahim A.Mohamed"Effect of dietary supplementation of increasing levels of organic acid mixture on performance and carcass characteristics of broiler chickens"IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.3 (2018): PP 54-58