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Effect of Dietary Supplementation of Organic Acid and Mannan Oligosaccharide on the Plasma Minerals and Carcass Traits of Japanese Quail (*Coturnix coturnix japonica*)

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Abstract: An experiment was conducted to determine the influence of Organic Acid Salts (OAS) and mannan oligosaccharides on carcass traits and plasma minerals of Japanese Quail. Day old chicks of Japanese Quail (n = 280) were randomly assigned into seven dietary treatments replicated four times with 10 chicks per replicate. Control (T_0) birds were given a standard basal diet; T_1 birds were provided with basal diet having antibiotic (Bacitracin methyl disalisylate -BMD) at 0.5 g kg^{-1}; T_2 birds having diet with sodium butyrate at 5 g kg^{-1}; T_3 birds were provided with basal diet having Mannan Oligosaccharide (MOS) at 1 g kg^{-1}; group T_4 birds were fed basal diet with ammonium formate at 1 g kg^{-1}, calcium propionate 1 g kg^{-1} and sodium butyrate 5 g kg^{-1}; T_5 birds having diet with sodium butyrate at 5 g kg^{-1} and MOS at 1 g kg^{-1}; T_6 birds having diet with ammonium formate at 1 g kg^{-1}, calcium propionate at 1 g kg^{-1}, sodium butyrate at 5 g kg^{-1} and MOS at 1 g kg^{-1} of the diet. Statistical analysis revealed that OAS and MOS had no significant ($p>0.05$) effect on carcass traits like dressing %, water holding capacity, pH, thigh %, drumstick %, back %, breast %, neck % and wing %. But carcass composition such as crude protein % and crude fat % were varied significantly among the experimental groups due to dietary treatments. Statistical analysis also confirmed that OAS and MOS had no significant ($p>0.05$) effect on plasma minerals except calcium level which is varied significantly among the experimental groups due to dietary treatments. It could be concluded that organic acid and mannan oligosaccharide can act like probiotic that can increase Ca and Fe in blood plasma and increase meat crude protein % and decrease meat crude fat %.

Key words: Japanese quail, MOS, organic acid, plasma minerals, carcass traits

INTRODUCTION

Public disapproval for the use of antibiotics in the poultry production due to their residual effects in meat, concerns over the emergence of antibiotic resistant (JETACAR, 1999). The problem is however much complicated that just a simple withdrawal of this growth promoter overnight, it will not only affect feed efficiency but also increase mortality, morbidity and carcass quality of animals. Therefore, many parts of the world are experimenting alternative feed additives that may be used to alleviate the problems associated with the withdrawal of antibiotic from feed. In poultry production organic acids have maiuly been used in order to sanitize the feed having problem with bacterial infection (Hinton and Linton, 1985; Berchieri and Barrow, 1996; Thompson and Hinton, 1997). Organic acids in their un-dissociated forms are able to pass through the cell membrane of the bacteria and inside the bacterial cell they dissociate to produce H^+ ions which lower the pH of the cell causing the organism to use of its energy in trying to restore the normal balance, where as $RCOO^-$ anions produced from the acid can disrupt DNA and thus hamper protein synthesis, putting the

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organism under stress so that it is unable to replicate rapidly (Nursey, 1997). Mannan oligosaccharides (MOS) maintain gut health by adsorption of pathogenic bacteria containing type-I fimbrae of different bacterial strains and remove the bacteria from gut (Oyofo *et al*., 1989; Spring *et al*., 2000). The present study was carried out to evaluate the effect of various organic acid salts, viz., formic acid, propionic acid and butyric acid salt, as well as MOS on plasma minerals and carcass characteristics of Japanese quail.

MATERIALS AND METHODS

Experimental Design and Diet

Day old chicks of Japanese quail (n = 280) were randomly distributed into seven experimental groups consisting of four replicates in each. Each replicate had 10 birds. The chicks were individually weighed and allocated to 28 cages of electrically heated battery brooder so that each cage had birds with similar ($p>0.05$) average weight. In control (T_0) birds were supplied with standard basal diet; group T_1 birds were provided with diet having antibiotic Bacitracin Methyl Disalisylate (BMD) at 0.5 g kg^{-1} of diet; group T_2 birds having diet with sodium butyrate at 5 g kg^{-1} diet; group T_3 birds were provided with diet having MOS 1 g kg^{-1} diet; group T_4 birds were fed diet with ammonium formate at 1 g kg^{-1}, calcium propionate 1 g kg^{-1} and sodium butyrate 5 g kg^{-1} of the diet; group T_5 birds having diet with sodium butyrate at 5 g kg^{-1} and MOS at 1 g kg^{-1} of the diet; group T_6 birds having diet with ammonium formate at 1 g kg^{-1}, calcium propionate at 1 g kg^{-1}, sodium butyrate at 5 g kg^{-1} and MOS at 1 g kg^{-1} of the diet. Basal diet was starter (0 to 3 weeks) and finisher (4 to 6 weeks). The diets (Table 1) of the experiment were formulated to meet or exceed the nutrient requirement as per Bureau of Indian Standard (BIS, 1992).

Housing and Management

Chicks were housed in an electrically heated battery brooder which were disinfected thoroughly three days prior to arrival of birds. The day-old chicks were offered electrolyte solution upon arrival. Birds were maintained on a 24 h constant light schedule. Water troughs and feeders were cleaned at regular interval. Feed and water both are provided *ad libitum* to the birds.

Table 1: Composition of basal diets for starter and finisher for quail (by parts)

Items	Starter	Finisher
Maize	45.505	50.00
Deoiled rice bran	2.00	6.00
Soyabean oil	1.00	1.00
Soyabean meal	41.00	33.00
Fish meal	7.60	7.00
Dicalcium phosphate	1.40	1.40
Lime stone powder	1.00	1.00
Trace minerals+	0.045	0.045
Daily mix++	0.025	0.025
Briplex+++	0.025	0.03
Choline chloride (60%)	0.10	0.10
DL-Methionine	0.10	0.10
L-lysine	-	0.10
Common salt	0.20	0.20
Nutrient composition		
ME (kcal/kg) (Calculated)	2800.66	2805.00
CP (%) (Estimated)	26.05	23.95
Lysine (%) (Calculated)	1.616	1.48
Methionine (%) (Calculated)	0.562	0.527

+: Composition of trace minerals, Manganese sulphate 15 g, copper sulphate 2 g, ferrus sulphate 6 g and zinc carbonate 6 g; ++: Composition of DAILYMIX, Vitamin A 82,500 IU, Vitamin B_2 50 mg, Vitamin D_3 12,000 IU, Vitamin K 10 mg, Vitamin B_{12} 15 mcg; +++: Composition of BRIPLEX, Vitamin B_1 8 mg, Vitamin B_2 4 mg, Vitamin B_6 16 mg, Vitamin B_{12} 80 mcg, Niacin 120 mg, Calcium Pantothenate 80 mg, Folic acid 3600 mcg and Vitamin E 80 mg

Dietary Ingredients of Feeds

The dietary ingredients and nutrient composition of the diet were in Table 1. Total protein was analyzed according to AOAC (1995).

Blood Collection

During slaughter blood samples were collected in test tube containing heparin and allowed to stand for few hours to collect plasma. Plasma samples were kept in deep freeze (-20°C) for further analysis.

Mineral Estimation

Plasma Calcium (Ca), copper (Cu), zinc (Zn), manganese (Mn) and iron (Fe) were estimated by atomic absorption spectrophotometry (Perkin Elmer, A Analyst-100), following the method described by Sandel (1950) and modified by Arenza *et al.* (1977). Plasma Phosphorus was determined colorimetrically according to the method of Fiske and Subba Rao (1925).

Slaughtering of Birds

After completion of experimental period, 8 birds from each group i.e., two birds from replicate, were selected randomly and fasted for 12 h to empty their gastrointestinal tract. During this period only water was supplied. Before slaughtering, weight of each bird was taken carefully to calculate dressing percentage. The birds were slaughtered by stunning method (i.e., cutting atlanto-occipital joint) with a sharp knife and were allowed to bleed for 3 min. Then birds were dressed properly for further experiment.

Carcass Traits

Hot carcass was weighted and chilled at 1°C for 48 h. The chilled carcass was separated into different cut up parts like neck, back, wings, breast, thighs and drumsticks and they were weighed properly through electronic weighing balance. Weight of giblets (liver, heart and gizzard) was also recorded. Then different cut up parts were frozen at -20°C for further analysis. Water holding capacity was determined by a modified method as described by Offer and Knight (1988). The pH of the finely minced meat was determined by the method of meat and meat product analysis (Gillespie, 1960) by using digital pH meter (Systronics, model 335).

Carcass Composition

Composite meat samples were taken from left side of frozen cut up parts, grinded and homogenized. Then they were made into sub samples which were assayed for their moisture, crude fat and crude protein content (AOAC, 1995).

Statistical Analysis

The analysis was done by using General Linear Model of SPSS (1997) programme with replicates as experimental units for studying the effect of organic acid on broiler performance and gut health. Levels of significance were calculated by (Duncan, 1995) test whenever any effect was found significant.

RESULTS AND DISCUSSION

Plasma Minerals

Calcium (Ca), Phosphorus (P) and Magnesium (Mg) in Plasma

Ca level increased in ($p<0.05$) T_3 and T_6 group over other groups. Control group (T_0) lower ($p<0.05$) serum calcium level against T_2, T_4 and T_5 groups, respectively (Table 2). Isshiki (1979)

reported increase blood Ca level with supplementation of *Bacillus* or *Lactobacillus* but phosphorus level remained unchanged in white leghorn cockrels. Mannan-oligosaccharide and organic acid salts reduce the load of pathogenic bacteria and increase the population of beneficial bacteria like *Lactobacillus*, *Bacillus* etc. (Thirumeignanam *et al*., 2006). Thus, they indirectly act like probiotcs and thereby increase the plasma Ca level. Plasma Mg as well as plasma P was not affected ($p>0.05$) by dietary supplementation of OAS and MOS. But it was seen that phosphorus in the plasma was higher in T_6 group.

Iron (Fe), Copper (Cu), Zinc (Zn) and Manganese (Mn) in Plasma

Cu, Zn and Mn in the plasma were not affected ($p>0.05$) by different dietary supplementation with OAS and MOS. MOS in the diet improved serum Fe level (3.68 ppm) over other diet. T_1, T_2, T_4, T_5 and T_6 groups had 3.16, 3.31, 3.31, 3.24 and 3.42 ppm iron, respectively (Table 2). Control had lowest Fe (3.07 ppm) level in plasma. In earlier study, Meluzzi *et al*. (1986) observed more blood Fe content in broiler by supplying probiotics. Organic acid salts and mannan-oiligosaccharide indirectly act like probiotic, which may influence plasma iron level of Japanese quail.

Carcass Traits

Values of dressing percentage in different groups indicated that there was no marked variation. Statistical analysis showed insignificant ($p>0.05$) result in dressing percentage of Japanese quail, however numerically T_6 group had the highest dressing percentage followed by T_4, T_5, T_2, T_1, T_3 and T_0, respectively (Table 3). Mujdat *et al*. (1999) also reported that dressing percentage was not affected by ACIDLAC. The present investigation also supports this observation. Statistical analysis confirmed that Water Holding Capacity (WHC) and meat pH did not vary significantly ($p>0.05$) among the experimental groups due to dietary treatments.

Table 2: Effect of organic acid salts and MOS on the mineral parameters of Japanese quail†

	Treatment groups								
Attributes	T_0	T_1	T_2	T_3	T_4	T_5	T_6	SEM	p-value
Calcium (mg dL^{-1})	10.50^{c}	10.58^{bc}	10.61^{bc}	11.18^{a}	10.54^{bc}	10.96^{ab}	11.09^{a}	0.136	0.004
Phosphorus (mg dL^{-1})	5.01	4.90	5.01	5.09	5.17	5.08	5.35	0.130	0.341
Magnesium (mg dL^{-1})	3.09	3.15	3.20	3.19	3.11	3.10	3.29	0.154	0.972
Iron (ppm)	3.08	3.17	3.31	3.69	3.31	3.24	3.42	0.171	0.292
Copper (ppm)	0.30	0.29	0.29	0.32	0.29	0.29	0.32	0.022	0.926
Zinc (ppm)	1.09	1.16	1.24	1.26	1.30	1.27	1.35	0.100	0.597
Manganese (ppm)	0.17	0.17	0.18	0.21	0.20	0.19	0.19	0.016	0.333

†: The birds on test for 42 days, n = 4 replicate per treated group. Values bearing no common superscript in a row differs significantly ($p<0.05$)

Table 3: Effect of organic acid salts and MOS on the carcass traits of Japanese quail†

	Treatment groups								
Attributes	T_0	T_1	T_2	T_3	T_4	T_5	T_6	SEM	p-value
Live weight (g)	185.75	200.75	193.75	194.25	216.25	194.50	193.75	13.128	0.781
pH	6.41	6.39	6.38	6.50	6.37	6.30	6.28	0.045	0.901
WHC	67.13	66.88	65.03	72.73	67.20	66.60	65.60	0.884	0.362
Dressing (%)	61.96	63.62	63.74	63.06	64.99	64.28	65.81	1.337	0.519
Neck (%)	4.00	4.13	3.45	3.24	3.91	4.01	3.33	0.332	0.325
Wing %	6.71	5.68	5.82	6.70	6.23	5.78	5.82	0.444	0.449
Breast (%)	40.95	41.58	42.04	39.91	39.85	38.62	42.22	0.843	0.056
Back (%)	19.14	21.55	20.57	20.44	21.17	21.50	21.40	1.086	0.702
Thigh (%)	14.31	13.91	14.27	14.35	14.23	15.05	13.99	0.517	0.792
Drumstick (%)	9.33	9.42	9.98	9.82	9.60	10.01	10.07	0.384	0.726

†: The birds on test for 42 days, n = 4 replicate per treated group

Table 4: Effect of organic acid salts and MOS on the meat composition of Japanese quail†

	Treatment groups								
Attributes	T_0	T_1	T_2	T_3	T_4	T_5	T_6	SEM	p-value
Moisture (%)	68.66	68.98	68.19	75.47	68.10	68.24	67.47	2.926	0.520
Crude protein (%)	23.54^{bc}	23.21^{c}	24.31^{bc}	23.89^{bc}	25.26^{ab}	25.20^{ab}	26.54^{a}	0.529	0.003
Crude Fat (%)	7.09^{a}	6.77^{ab}	6.30^{c}	5.50^{d}	6.55^{bc}	6.18^{c}	6.29^{c}	0.127	0.000

†: The birds on test for 42 days, n = 4 replicate per treated group. Value bearing at least one common superscript within the same row do not differ significantly ($p>0.05$)

Cut-up Parts

Proportion of neck, wing, back, thigh and drumstick were more or less similar ($p>0.05$) with little difference to dietary treatments with OAS and MOS. However, T_6, T_2 and T_1 yielded better ($p<0.05$) breast per cent than other groups. It was observed that butyrate supplementation in the diet yielded better breast meat (42.03%) in comparison to control (40.94%). Lesson *et al*. (2005) also found better breast meat yield compared to control. The present study also complied with the earlier observation.

Carcass Composition

The average moisture percentage was 68.6, 68.9, 68.1, 75.4, 68.1, 68.2 and 67.4 in T_0, T_1, T_2, T_3, T_4, T_5 and T_6 groups, respectively. There was no significant difference ($p>0.05$) in moisture percentage in the meat of different treatment groups of Japanese quail (Table 4).

The crude protein % in group T_6 had indicated highest ($p<0.01$) value over other groups where T_0, T_2 and T_3 had similar ($p>0.05$) effect. Group T_4 and T_5 had better meat protein ($p<0.01$) than T_0, T_6, T_2 and T_3 groups. Antibiotic group (T_1) had lowest meat protein percentage.

MOS in diet reduced ($p<0.01$) the meat crude fat % over other groups. Group T_5, T_6, T_2 and T_4 had also less crude fat % against control group (T_0). No difference ($p>0.05$) was found in antibiotic and control group. Incorporation of oligosaccharide, diluted the bile salt (Maisonnier *et al*., 2003) and reduced the lipid digestibility, thus admission of MOS in the diet of Japanese quail may results in reduction of crude fat percentage in muscle.

CONCLUSION

It could be concluded that organic acid and mannan oligosaccharide can act like probiotic that can increase Ca and Fe in blood plasma and increase meat crude protein % and decrease meat crude fat %. Finally, it can be summarized that organic acid and mannan oligosaccharide had little effect on carcass quality and plasma minerals in Japanese quail.

REFERENCES

AOAC., 1995. Official Method of the Association of Official Analytical Chemists. Vol. 1. 16th Edn. AOAC International, Arlington, USA.

Arenza, J.S., S.D. Hathi, B. Singh and P.N. Verma, 1977. Status of some microminerals in neonatal buffalo calves and their mothers. Indian J. Dairy Sci., 30: 255.

Berchieri, A. Jr. and P.A. Barrow, 1996. Reduction in incidence of experimental fowl typhoid by incorporation of a commercial formic acid preparation (Bio-Add™) into poultry feed. Poult. Sci., 75: 339-341.

BIS (Bureau of Indian Standard), 1992. Nutrient requirements for poultry, IS: 13574.

Duncan, D.B., 1995. Multiple range and F-test. Biometrics, 11: 1-42.

Fiske, C.H. and Y.S. Subba Rao, 1925. Determination of inorganic phosphorus in blood. J. Biol. Chem., 66: 375.

Gillespie, E.L., 1960. Methods of Analysis. The Science of Meat and Meat Product. Freeman, W.H. and Company, London, pp: 234.

Hinton, M. and A.H. Linton, 1985. Control of *Salmonella* infections in broiler chicken by the acid treatment of their feed. Vet. Rec., 123: 416-421.

Isshiki, 1979. Effect of *Lactobacilli* in the diet on the concentration of nitrogenous compounds and minerals in the blood of chickens. Jap. Poult. Sci., 16: 254-258.

JETACAR (The Joint Expert Advisory Committee on Antibiotic Resistance), 1999. The use of antibiotic in food producing animal: Antibiotic resistance bacteria in animal and human. (Commonwealth Department of health and aged care; Commonwealth Department of Agriculture, Fishery and Forestry. Auslunfo, GPO Box, 84, Canberra, Act 2901, Australia).

Lesson, S., H. Namkung, M. Autongiovanni and E.H. Lee, 2005. Effect of butyric acid on the performance and carcass yield of Broiler chickens. Poult. Sci., 84: 1418-1422.

Maisonnier, S., J. Gomez, A. Bree, C. Berri, E. Baeza and B. Carre, 2003. Effects of microflora status, dietary bile salts and guar gum on lipid digestibility, intestinal bile salts and histomorphology in broiler chickens. Poult. Sci., 82: 805-814.

Meluzzi, A., A. Franchini and G. Giordani, 1986. Lactic acid bacteria and Bifido bacteria in the chest of broiler chicken. Avicoltura, 55: 54-56.

Mujdat, A.L.P., N. Kocabagli, R. Kahraman and K. Bostan, 1999. Effects of dietary supplementation with organic acids and zinc bacitracin on ileal microflora, pH and performance in broilers. Tr. J. Vet. Anim. Sci., 23: 451-455.

Nursey, I., 1997. Control of *Salmonella*. Kraftfutter, 10: 415-422.

Offer, G. and P. Knight, 1988. The Structural Basis of Water Holding in Meat. Part 2. Development in Meat Science, Lawrie, R. (Ed.). Elsevier Applied Science, London, 4: 63-173.

Oyofo, B.A., R.E. Drolesky, J.O. Norman, H.H. Mollenhauer, R.L. Ziprin, D.E. Corrier and J.R. Deloach, 1989. Inhibition by mannose of *in vitro* colonization of chicken small intestine by *Salmonella typhimurium*. Poult. Sci., 68: 1351-1356.

Sandel, E.E., 1950. Colorimetric Determination of Trace of Metals. Intersciences Publishers, Inc., New York.

Spring, P., C. Wenk, K.A. Dawson and K.E. Newman, 2000. Effect of mannan oligosaccharide on different caecal parameters and on caecal concentration of entire bacteria in challenged broiler chicks. Poult. Sci., 79: 205-211.

SPSS, 1997. Base Application Guide 7.5 © SPSS, USA.

Thirumeignanam, D., R.K. Swain, S.P. Mohanty and P.K. Pati, 2006. Effect of dietary supplementation of organic acids on performance of broiler chicken. Indian J. Anim. Nutr., 23: 34-40.

Thompson, J.L. and M. Hinton, 1997. Antibacterial activity of formic and propionic acids in the diet of hens on Salmonella in the crop. Br. Poult. Sci., 38: 59-65.