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Influence of Medicinal Herb Plantain (*Plantago lanceolata* L.) on Broiler Performance and Plasma Metabolites

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Abstract The aim of this study was to determine the effect of plantain (PL) supplemented diet for a period of 35 days on the growth, feed efficiency and plasma metabolites of broiler. One hundred twenty 1-day old broiler chicks (Cobb-500 strain) were randomly distributed into three treatment groups with four replicate cages having 10 birds in each. A corn-soybean based diet was used as basal diet (control group), which was supplemented with PL (0.5 % of DM basis) for another group (Plantain-diet) the remaining group received commercial ready feed. Although feed intake was similar ($P>0.05$) in all treatment groups the body weight (BW) of PL supplemented group was significantly ($P<0.05$) higher than control group. However, BW between PL and commercial feed supplied groups was statistically ($P>0.05$) similar. Best-feed conversion ratio (FCR) was observed in PL supplemented group. A positive influence of PL on plasma parameters (glucose, total cholesterol, high-density lipoprotein, low density lipoprotein and triglycerides) were found PL supplemented group compared to both control and commercial diet groups. Therefore, further research with PL supplementation is suggested to clarify the level of significance for plasma metabolites.

Key words

broiler, antibiotic growth promoter, plantain, performance, plasma metabolites

Medicinal plants passive voice as feed additives in broiler diet as alternative approach of antibiotic growth promoters (AGPs) considering safety aspect of the products as well as human health. Moreover, the scientific interest to fix up some potential alternative to AGPs is because of their relatedness with similar antibiotics used in human medicine and the possibility that their use may contribute to the pool of antibiotic resistant bacteria that causes antibiotic resistance [4]. In this concept, herbs and herbal products are now used in animal production to obtaining safe food for human consumption because they have no residual effect on human health like antibiotics. Some researchers have been already reported the positive effect of medicinal herbs on broiler performance [9, 10, 23].

Medicinal herb Plantain (*Plantago lanceolata* L.) has some bioactive compounds such as acteoside, aucubin, and catalpol [13, 18], which have anti-oxidative activity [24, 25] and anti-inflammatory effects [15, 16], as well as it is a good source of proteins and mineral [22]. In a mixed pasture, plantain is highly palatable to cattle, sheep [2, 5] and enhanced growth rate of calves, lambs grazing mixed swards containing plantain also reported by Fraser *et al.* [7] and Rumball *et al.* [20]. Phenolic compound present in plantain act as a primary antioxidant and improve blood lipid components [3, 12]. Curcumin, a phenolic compound inhibits lipid per oxidation, scavenges the superoxide anion and hydroxyl radicals [21] and enhances the activities of detoxifying enzymes [19], reduce the concentration of plasma low-density lipoproteins very low-density lipoproteins and liver total cholesterol [14]. Therefore, it was expected that, due to the presence of some bioactive and phenolic components, plantain might influence the growth as well the plasma metabolites of chickens. However, until now, to the best of my knowledge, the effect of plantain herb on broiler chicken has not been reported. Therefore, the present research work was conducted to observe the effect of plantain on performance and plasma metabolites in broiler.

Material and Method

One hundred twenty healthy 1-d-old broiler chicks (Cobb-500) were randomly distributed to 12 cages containing 10 broilers in each, and 4 cages were allocated to each of the 3 treatment groups. The chicks were carefully handled to avoid any pain or injury. A corn-soybean-based feed was used as the basal diet for the control group. After cultivation, during the entire 35 days trial period, fresh plantain plant was harvested

from the land thereafter chopped plantain was mixed with basal diet (0.5 % on DM basis) to supply in another group. Moreover, commercial feed without any supplementation provided in one group. The corn-soybean meal based mash diet was formulated as recommendation of by NRC [17]. Chemical composition of the basal diet, commercial feed and plantain was stated in Table 1.

The cages, in an open-air trial house, were of steel wire construction and had a surface area of 0.91 m^2 (120 cm × 76 cm) per cage. Droppings were allowed to drop on the sawdust that was spread below the cages. Electric light (neon bulbs) illuminated the trial house over 24 h. All birds were reared in identical management conditions. Chicks were given *had libitum* access to diets and water during the trial period. Birds were weighed at first day of the trial and at 7-d intervals up to 36 days. The house was cleaned frequently and the birds were observed for any types of clinical signs. Dead birds were recorded, necropsied, and histopathological exams was also done. At the ages of 9 and 17 d, the birds were vaccinated against infectious bursal disease, and in d 3 and 19, the birds were vaccinated against Newcastle disease, all via eye drop as per recommendation of the manufacturer.

At day 35, five birds from each replicate were randomly selected and blood samples were collected in heparinized syringes from the jugular vein of the bird in 35 days of the experiment. Collected blood samples were immediately poured into test tubes containing fluoride and EDTA. The test tube then where gently shaken so that anticoagulant and fluoride mixed with the blood properly. These tubes were transferred to the laboratory with ice in an icebox. Then blood samples were centrifuged at 5000 rpm for 5 minutes at 2^0 C (Centrifuge 5415R, Eppendorf, Tokyo, Japan). After centrifugation, Plasma was transferred into Eppendorf pipette containing 1 ml in each with the help of micropipette and finally stored at -30^0C until further analysis.

Analysis was done by semi auto biochemical analyzer 3000 evaluation using commercially available reagent kit. All the tests were carried out as early as possible. Concentration of plasma glucose was enzymatically determined by the method of Huggett and Nixon [11]. Commercially available kits (Sigma Diagnostics, Taufkirchen, Germany) were used to analyze the serum for cholesterol, triglyceride and HDL with an auto analyzer. LDL levels were estimated using the Friede wald equation [8]. Values were expressed as mg/dL.

At first, the raw data were organized using computer Microsoft Excel Program and then analyzed using SAS statistical program for one-way analysis of variance (ANOVA) and Duncan's Multiple Range test was done to know the differences among the treatment means at 5 % level of significance [6].

Results and Discussions

Analysis of variance revealed that, there were significant differences in terms of BW, BW gain, feed intake, feed conversion ratio (Table 2) in different treatment groups.

Birds of all groups had a similar live weight during the beginning of and no significant differences were observed during first week of age among the treatment groups. However, at fourth and fifth week of age, significant ($P<0.05$) changes were observed in all treatment groups. Although highest ($P<0.05$) body was recorded in commercial feed supplied group but there was insignificant ($P>0.05$) difference in body weight between PL supplemented and commercial feed supplied group both in 4^{th} and 5^{th} weeks of age of birds. Moreover, at 4^{th} week of age PL showed highest ($P>0.05$) body weight on the other hand at 5^{th} week commercial feed showed highest ($P>0.05$) value in both weeks PL supplied group showed higher ($P<0.05$) weight than control. Similarly, weight gain of broiler was higher ($P<0.05$) in both plantain and commercial feed supplied group than control but there was insignificant ($P>0.05$) difference between plantain and commercial diet fed broiler in terms of weight gain during the 4^{th} week of age. Although during 5^{th} week weight gain of broiler showed insignificant ($P>0.05$) difference in all groups, but numerical difference was observed clearly.

Feed intake was statistically ($P>0.05$) similar in all three treatment groups during 1^{st}, 4^{th} and 5^{th} week of age, although in 4^{th} and 5^{th} week numerically higher feed intake was observed in commercial feed supplied group. In general, feed conversion ratio differed significantly ($P<0.05$) during the end of the trial. The best-feed conversion ratio was found in PL supplemented group and this group showed significant ($P<0.05$) difference with control fed group whereas the difference was statistically ($P>0.05$) similar with commercial feed supplied group.

Lipid profiles and plasma glucose of birds under different treatment groups were shown in Table 3. Although there were no significant differences in plasma glucose concentration among the treatment groups, the numerical differences were very clear. Highest ($P>0.05$) plasma glucose concentration was recorded in PL supplemented diet compared to both control and commercial feed supplied group. Additionally, total cholesterol, triglycerides and LDL-C were significantly ($P>0.05$) lower in treatment group fed PL supplemented diet compared to other groups. Moreover, HDL-C was numerically higher in the birds fed PL supplemented diet compared to commercial feed.

Table 1. Chemical composition of basal diet, commercial diet and plantain.

Chemical Composition	Basal diet	Commercial diet	[#]Plantain
Dry Matter (DM)	87.25	87.00	13.00
Crude Protein (CP)	22.78	23.00	9.31
Crude Fiber (CF)	4.23	4.00	13.25
Ether Extract (EE)	2.68	3.00	3.10
Nitrogen Free Extract (NFE)	48.56	48.61	-
Ash	9.00	8.39	7.39
Calcium (Ca)	0.93	0.90	1.70
Phosphorus (P)	0.75	0.80	0.29
[*]ME (Kcal/Kg DM)	3353.00	3416.00	-
[#]Acteoside (%)	-	-	1.06
Aucubin (%)	-	-	0.65
Catapol (%)	-	-	0.0004

*Calculated using the formula of Wiseman (1987), [#] Reference [1].

Table 2. Effect of plantain on growth, feed intake, and feed conversion of broiler.

Age (week)	Treatment groups		
	Control	Plantain	Commercial diet
Body weight (g)			
Initial	41±0.40	41±0.40	41±0.40
1st	128±0.91	129±2.27	130±1.91
4th	646^{b}±2.39	810^{a}±6.12	811^{a}±6.80
5th	939^{b}±6.88	1136^{a}±18.5	1138^{a}±19.16
Body weight gain (g)			
1st	86±0.75	88±1.93	89±1.77
4th	221^{b}±3.75	250^{a}±2.88	248^{a}±3.58
5th	293^{b}±4.78	326^{ab}±12.47	327^{ab}±12.39
Feed intake (g)			
1st	120±1.75	118±1.70	116±0.28
4th	466±8.55	477±11.54	480±11.44
5th	676±18.72	663±30.45	691±14.67
Feed conversion ratio			
5th	2.31^{a}±0.03	2.03^{b}±0.03	2.12^{b}±0.09

Values of different variables under different program indicates Mean± SE;
[ab,] mean values with dissimilar superscripts are significantly different (P<0.05);
SE, standard error.

Table 3. Effect of plantain on plasma parameters of broiler

Parameters	Treatment groups			Significance
	Control	Plantain	Commercial diet	
Plasma glucose (mg/dL)	159±29	189±13	195±4	8
Total Cholesterol (mg/dL)	107±3	90±2	109±8	3.0
Triglycerides (mg/dL)	66±4	58±3	67±7	1.9
HDL-C (mg/dL)	25±2	25±2	26±1	0.5
LDL-C (mg/dL)	83±9	55±2	81±3	4.4

Values of different variables under different program indicate Mean± SE; SE, standard error.

Conclusions

In conclusion, this study demonstrated that supplementation of PL (0.5 % of DM basis) with basal diet enhanced the growth performance of broiler chicken and produced healthy broiler that possessed higher HDL and lower total cholesterol, triglycerides and LDL. Further investigations are needed to be performed with an increasing amount of plantain in the basal diet, which may provide more accurate findings.

References

1. Al-Mamun M, Hanai Y, Tanaka C, Tamura Y and Sano H. Responses of whole body protein synthesis and degradation to plantain herb in sheep exposed to heat. 2008. International Journal of Biological Science, 3: 349-355.

2. Archer M, 1971. Preliminary studies on the palatability of grasses, legumes and herbs to horses. Veterinary record, 89: 236-240.
3. Brian P, Todd D and Porter. 2001. Resveratrol inhibits human squalene monooxygenase. Nutritional Research. 21:747-753.
4. Chacrabati R, Chowdhury R, Yesmin S, Sano H and Al-Mamun M. 2013. Comparison of broiler performance using Plantain (*Plantago lanceolata* L.), Bio-Sel-E and commercial diet. Bangladesh Journal of Animal Science. 42 (2): 123-130.
5. Clark DA and Harris PS. 1985. Composition of the diet of sheep grazing swards of differing white clover content and spatial distribution. New Zealand Journal of Agricultural Research, 28:233-240.
6. Duncan DB. 1955. Multiple range tests and multiple F test. Biometrics, 11: 1-42.
7. Fraser TJ, Cosgrove GP, Thomas WJ, Stevens DR and Hickey MJ. 1988. Performance of Grasslands Puna chicory. Proceedings of the New Zealand Grassland Association, 49: 193-196.
8. Friedewald, WT, Levy RI and Fredrickson DS. 1972. Estimation of concentration of low-density lipoprotein cholesterol in plasma without use of the ultracentrifuge. Clinical Chemistry, 18, 449-502.
9. Hassan I, Askar A and El-Shourbagy GA. 2004. Influence of some medicinal plants on performance, physiological and meat quality traits of broiler chicks. Egyptian Journal of Poultry Science, 24: 247-266.
10. Huang YF, Ma HL, Wu DF, Zhou JI, Zhou KS and Qi ZY. 1992. Effect of Chinese medicinal herbs additives on the growth of broilers. Journal of Agricultural Systems, 21: 93-96.
11. Huggett AG and Nixon DA. 1957. Enzymatic determination of blood glucose. Biochemical Journal 66:12.
12. Huff MW and Telford DE. 1989. Dietary fish oil increases the conversion of VLDL apoB to LDL apoB. Atherosclerosis 9(1):58-66.
13. Ishiguro K, Yamaki M and Takagi S. 1982. Studies on the iridoid related compounds. I. on the antimicrobial activity of aucubigenin and certain iridoid aglycones. Yaku. Zas. 102:755- 759.
14. Kamal-Eldin A, Frank J, Razdan A, Tengblad S, Basu S and Vessby B. 2000. Effects of dietary phenolic compounds on tocopherol, cholesterol, and fatty acids in rats. Lipids, 35: 427-435.
15. Marchesan M, Paper DH, Hose S and Franz G. 1998. Investigation of the anti-inflammatory activity of liquid extracts of *Plantago lanceolata* L. Phytotherapy Research, 12: S33-S34.
16. Murai M, Tamayama Y and Nishibe S. 1995. Phenylethanoids in the herb of *Plantago lanceolata* and inhibitory effect on arachidonic acid-induced mouse ear edema. Planta Medica, 61:479-480.
17. NRC. 1994. Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.
18. Nishibe S and Murai M. 1995. Bioactive components of Plantago herb. Foods and Food Ingredient Journal, 166: 43-49.
19. Piper JT, Singhal SS, Salameh MS, Torman RT, Awasthi YC and Awasthi S. 1998. Mechanisms of anticarcinogenic properties of curcumin: The effect of curcumin on glutathione linked detoxification enzymes in rat liver. International Journal of Biochemistry and Cell Biology, 30: 445-456.
20. Rumball W, Keogh RG, Lane GE, Miller JE and Claydon RB. 1997. Grasslands Lancelot plantain (*Plantago lanceolata*). New Zealand Journal of Agricultural Research, 40: 373-377.
21. Ruby AJ, Kuttan G, Babu KD, Rajasekharan KN and Kuttan R. 1995. Antitumor and antioxidant activity of natural curcuminoids. Cancer Letters, 94: 79-83.
22. Sano H, Tamura Y and Shiga A. 2002. Metabolism and glucose kinetics in sheep fed plantain and orchard grass and exposed to heat. New Zealand Journal of Agricultural Research, 45:171-177.
23. Sharifi SD, Khorsandi SH, Khadem AA, Salehi A, Moslehi H. 2013. The effect of four medicinal plants on the performance, blood biochemical traits and ileal microflora of broiler chicks. Veterinary archives, 83:69-80.
24. Wang P, Kang J, Zheng R, Yang Z, Lu J, Gao J and Jia Z. 1996. Scavenging effects of phenyl propanoid glycosides from pedicularis on superoxide anion and hydroxyl radical by the spin trapping method (95) 02255-4. Biochemical Pharmacology, 51:687-691.
25. Zhou YC and Zheng RL. 1991. Phenolic compounds and an analog as superoxide anion scavengers and antioxidants. Biochemical Pharmacology. 42:1177-1179.