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Short Communication

Effect of calcium, phosphorus premix with synergistic herbs supplementation in improving overall performance, carcass quality and tibial mineralization in broiler chickens

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ABSTRACT

Objective: Efficacy of AV/CSP/29 premix (Ca, P supplement with Vit. A & D3 along with synergistic herbs) (*M/S Ayurvet Ltd.*) was evaluated in commercial broiler chicks.

Materials and methods: A total of 144 day-old chicks were randomly divided into three groups. Group T_0 (n=48) control group, supplemented with basal diet without any additional source of calcium (Ca) and phosphorus (P). Group T_1 (n=48) was administered with AV/CSP/29 premix at 500 gm/ton of feed and Group T_2 birds (n=48) were supplemented with Brand A at 500 gm/ton of feed for 0 to 42 days. Parameters *viz.*, growth, performance, serum biochemical and carcass quality traits were evaluated.

Results: More gain in body weight was observed in the AV/CSP/29 premix supplemented group (T_1) birds as compared to other groups. Similarly, FCR was improved in the AV/CSP/29 premix supplemented group (T_1) birds. Blood Ca and P concentrations were comparatively improved in AV/CSP/29 premix supplemented birds. Parameters *viz.*, carcass yield, dressing percentage, tibial mineralization, water holding capacity and extract release volume were also found to be better in AV/CSP/29 premix supplemented group (T_1) birds.

Conclusion: The results from the current study suggest that feeding of AV/CSP/29 premix to broiler chickens may have a beneficial effect on bone quality and in improving overall performance.

KEYWORDS

Carcass quality, Growth, Tibial mineralization

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INTRODUCTION

Metabolic and structural function of Ca and P in bone and eggshell formation is essential in poultry production (Pelicia et al., 2009). Calcium also plays significant role in metabolism, blood clotting, enzyme activation, neuromuscular function, muscle contraction, cell adhesion, and intracellular signaling (Weglarz and Angel, 2013). Poor mineralization has been associated with increased risk of fractures (Blake and Fogelman, 2002). Bone breakage and associated infections contribute to mortality, low productivity, and carcass condemnations (Rath et al., 2004). Inadequate level of Phosphorus results in loss of skeletal integrity and loss of appetite. This results in subnormal growth in young birds and weight loss in older birds (Narcy et al., 2009; Venalainen et al., 2006). Overall deficiency or excess of Ca and P interferes with homeostasis of each other, results in depressed growth rate and bone mineralization (Shafey et al., 1990; Hurwitz et al., 1995). Vitamin D is involved in various physiological processes, including the absorption of calcium and phosphorus, bone mineralization and mobilization (Sanotra et al., 2002; Garcia et al., 2013). Similarly deficiency of vitamin A seriously affect growth rate, feed utilization, development of bone, movements, vision, reproduction, resistance against diseases, and mortality in poultry birds (Bhuiyan et al., 2004). Many herbs *viz*., *Moringa oleifera, Lepidium sativum* are rich source of calcium and have role in calcium and phosphorus utilization (Olson and Carlquist, 2001; Juma, 2007). Therefore the present study was undertaken to evaluate efficacy of supplementation of AV/CSP/29 premix (Ca, P supplement with Vit. A & D3 along with synergistic herbs) in improving g performance, carcass quality and tibial mineralization.

MATERIALS AND METHODS

The trial was conducted at the College of Veterinary Sciences and Animal Husbandry, Bidar, Karnataka, India. The trial duration was 6 weeks with identical management conditions for all the groups. A total of 144 day-old commercial broiler chicks were divided into 3 groups having 48 birds comprising of 3 replicates of 16 birds in each group. Group T_0 birds were fed with standard basal diet (commercial feed) without any supplementation and Group T_1 birds were supplemented with AV/CSP/29 premix at 500 gm/ton of feed (M/S Ayurvet Ltd.). AV/CSP/29 premix is acalcium, phosphorus supplement with Vitamin A & D3 along with synergistic herbs *viz*., *Cisssus quadrangularis, Lepidium sativum, Uraria picta, Zingiber officinale* etc. Group T_2 birds were supplemented with Brand A dosed at 500 mg/ton of feed from 0-42 days. To check the efficacy of product supplementation the parameters viz. body weight, body weight gain, feed intake, FCR, health status, carcass quality traits, and biochemical parameters were studied. The results were analyzed statistically (Snedecor and Cochran, 1991).

RESULTS

Body weight (gm)

At the beginning of the trial there was no significant difference in body weight of birds in all the groups. The mean initial body weight in Group T_0, Group T_1 and Group T_2 was 45.3 gm, 45.4 gm and 45.6 gm, respectively (**Table 1**). Second week after supplementation the body weight (gm) was significantly ($P<0.05$) more in AV/CSP/29 premix supplemented Group T_1 birds (460.2) as compared to Group T2 (441.4) and Group T_0 (430.1) birds. At the end of 6th week the mean body weight was non-significantly more in AV/CSP/29 premix supplemented Group T_1 birds (2203.4) as compared to Brand A supplemented Group T_2 birds (2137.5) but was significantly ($P<0.05$) more than control Group T_0 birds (2089.3). The mean weekly body weight gain did not vary significantly among all the groups on 6th week. At 6th week, the mean weekly body weight gain was higher in AV/CSP/29 premix supplemented Group T_1 (436 gm) followed by Group T_2 (414.6 gm) and Group T_0 (402.5 gm) (**Table 1**).

Feed consumption (gm) and Feed conversion ratio (FCR)

Cumulative feed consumption and feed conversion ratio did not vary significantly among different groups during the entire experimental period. The cumulative feed consumption was highest in the AV/CSP/29 premix supplemented Group T_1 (3944.1 gm) in comparison to Group T_2 (3868.9 gm) and Group T_0 (3802.5 gm), but AV/CSP/29 premix supplemented Group T_1 had the best cumulative FCR *i.e.*, 1.79 as compared to the other groups (T_0 -1.82, T_1 -1.81) (**Table 2**).

Biochemical parameters

There was no significant difference in Biochemical parameters in all groups. However, there is considerable increase in serum calcium and phosphorous concentration in AV/CSP/29 premix supplemented Group T_1 (8.23 mg/dL and 4.58 mg/dL, respectively) followed by Group T_2 (8.15 mg/dL and 4.28 mg/dL, respectively) and Group T_0 (8.12 mg/dL and 4.41 mg/dL, respectively) (**Table 3**). Similarly, Total protein (g/dL) and Albumin (gm/dL) concentration was also better in AV/CSP/29 premix supplemented Group T_1

Table 1. Mean weekly body weight and body weight gain (BWG) in broiler flocks

Age (Weeks)	Group T_0		Group T_1		Group T_2	
	Body weight (gm)	BWG (gm)	Body weight (gm)	BWG (gm)	Body weight (gm)	BWG (gm)
0	45.3[a] ± 0.43	-	45.4[a] ± 0.51	-	45.6[a] ± 0.44	-
1	173.3[a] ± 2.12	128.1[a] ± 2.04	180.2[a] ± 1.91	135.7[b] ± 1.77	178.6[a] ± 2.02	132.3[ab] ± 1.62
2	430.1 [a]± 5.13	256.8[a] ± 4.02	460.2[b] ± 5.31	278.9[b] ± 3.98	441.4[ab] ± 5.29	268.8[b] ± 3.55
3	789.9[a] ± 9.31	359.1[a] ± 5.84	840.1[b] ± 9.04	372.9[b] ± 4.56	809.9[a] ± 10.09	367.7[ab] ± 4.75
4	1217.7 [a]± 14.94	431.7[a] ± 15.41	1287.9[b] ± 15.13	447.6[a] ±13.73	1265.6[b] ± 18.07	454.9[b] ±12.02
5	1688.2[a] ± 25.27	471.6[a] ± 19.39	1767.0[b] ± 31.22	479.5[a] ±15.64	1724.7[b] ±29.09	460.3[a] ±17.20
6	2089.3[a] ± 33.47	402.5[a] ± 21.34	2203.4[b] ± 39.58	436.0[a] ± 22.85	2137.5[b] ±36.02	414.6[a] ±20.97

Means within different superscript varied significantly (P<0.05)

Table 2. Cumulative Feed Consumption (gm) and Cumulative Feed Consumption Ratio of experimental broilers

Age (Weeks)	Group T_0		Group T_1		Group T_2	
	Cumulative Feed Consumption (gm)	Cumulative Feed Consumption Ratio	Cumulative Feed Consumption	Cumulative Feed Consumption Ratio	Cumulative Feed Consumption	Cumulative Feed Consumption Ratio
1	161.2	0.93	167.6	0.93	164.3	0.92
2	481.7	1.12	520.0	1.13	494.4	1.12
3	1098.0	1.39	1134.1	1.35	1117.7	1.38
4	1866.9	1.56	1944.7	1.51	1949.0	1.54
5	2937.5	1.74	3039.2	1.72	3001.0	1.74
6	3802.5	1.82	3944.1	1.79	3868.9	1.81

Table 3. Blood biochemical parameters of broiler flocks

Groups	Calcium (mg/dL)	Phosphorus (mg/dL)	Total protein (g/dL)	Albumin (g/dL)	Alkaline phosphatase (U/L)
T_0	8.12±0.16	4.41±0.11	3.23±0.18	1.58±0.09	156.72±5.12
T_1	8.23±0.11	4.58±0.10	3.64±0.12	1.65±0.13	152.92±3.97
T_2	8.15±0.15	4.28±0.09	3.52±0.12	1.42± 0.10	149.68±4.22

Table 4. Serum immunoglobulin on 3rd and 5th week

Groups	Serum Immunoglobulin (g/dL)	
	Week 3	Week 5
T_0	0.78[a]±0.08	0.92[a]±0.06
T_1	1.05[b]±0.09	1.20[b]±0.10
T_2	1.09[b]± 0.08	1.19[b]± 0.07

Means within different superscript varied significantly (P<0.05)

(3.64 and 1.65, respectively) followed by Group T_2 (3.52 and 1.42, respectively) and Group T_0 (3.23 and 1.58, respectively). Serum alkaline phosphatase activity remained unaltered (**Table 3**).

Serum immunoglobulin

Serum immunoglobulin concentration was significantly (P<0.05) higher in both treatment groups as compared to control group on 3rd and 5th week. At 5th week serum immunoglobulin concentration in AV/CSP/29 premix supplemented Group T_1 (1.20 g/dL) and Brand A supplemented Group T_2 (1.19 g/dL) was significantly (P<0.05) higher in comparison to control Group T_0 (0.92 g/dL) (**Table 4**).

Pathology

Of the 48 birds in each group, there was only one mortality in the Group T_0 in the 2nd week. Post-mortem examination revealed that the death was due to unspecified causes.

Carcass Quality

Highest carcass yield and dressing percentage was noticed in AV/CSP/29 premix supplemented Group T_1 (1590.6 gm and 72.2%, respectively) followed by Brand A supplemented Group T_2 (1474 gm and 69%, respectively) and unsupplemented control; Group T_0 (1460 gm and

Table 5. Carcass quality traits of experimental broilers

Group	Carcass yield (gm)	Dressing %	Pectoral muscle weight (gm)	Muscle pH		ERV (mL/100 gm)	Sensory evaluation (max. 10)
				Before rigor mortis	After rigor mortis		
T_0	1460.8±30.67	65.1±1.54	484.5±6.96	6.61±0.20	5.92±0.19	7.0	25.62±0.55
T_1	1590.6±34.59	72.2±1.47	577.0±8.02	6.62±0.13	5.82±0.15	8.7	32.61±0.73
T_2	1474.4±37.34	69.0±1.44	519.5±7.78	6.65±0.24	5.89±0.27	8.0	29.56±0.38

Table 6. Effect of supplementation on Tibial mineralization in broilers

Traits	Treatment Groups		
	T_0	T_1	T_2
Weight (gm)	10.81±0.44	14.29±0.27	12.92±0.59
Length (mm	85.67±1.45	101.52±1.31	91.73±1.30
Width (mm)	13.48±0.13	16.26±0.20	14.88±0.17

65.1%, respectively). Pectoral muscle weight (g) was also maximum in AV/CSP/29 premix supplemented Group T_1 (577 gm) followed by Group T_2 (519.5 gm) and Group T_0 (484.5 gm). Muscle pH values varied none significantly in all groups (**Table 5**). In AV/CSP/29 premix supplemented Group T_1, Extract release volume (ERV) (32.61 mL/100 gm) was found to be better than other Groups i.e. from Group T_2 (29.56 mL/100 gm) and control Group T_0 (25.62 mL/100 gm). Meat quality of chicken is stressed by consumers which refer to the sensory attributes of chicken product. The overall score for sensory quality of chicken product from AV/CSP/29 premix supplemented Group T_1 (8.7) was better than Brand B supplemented Group T_2 (8) and control Group T_0 (7) (**Table 5**).

Tibial mineralization

Characteristic relationship existed between growth performance and the development of the tibia. After AV/CSP/29 premix supplementation to Group T1, there is characteristic increase in tibial weight, length and width (14.29 gm, 101.52 mm and 16.26 mm, respectively) (**Table 6**) as compared to Brand A supplemented Group T_2 (12.92 gm, 91.73 mm, 14.88 mm, respectively) and control Group T_0 (10.81 gm, 85.67 mm, 13.48 mm, respectively).

Economics

The economic benefit analysis revealed that cost of production (Rs./kg) of broilers with AV/CSP/29 premix supplementation was economical (65.41) in comparison to cost of production of broilers supplemented with Brand A (66.17) and control group (67.18).

DISCUSSION

Nutrition has a vital role in broiler production. Deficiency of calcium cause skeletal abnormalities, and phosphorus plays a critical role in cellular metabolism, as a part of the energy currency of the cell, in cellular regulatory mechanism, and in bone (85% of P is in bone) (Musilova et al., 2014). Supplementation of calcium and phosphorus has substantial effects on weight gain (Bintvihok and Kositcharoenkul, 2006) that's why after AV/CSP/29 premix (Ca, P supplement with Vitamin A & D3 along with synergistic herbs) supplementation to Group T1 birds showed increase in body weight and body weight gain. 70% of the total cost of production is because of feed cost (Waller, 2007), increase in weight gain after AV/CSP/29 premix supplementation will helps to reduce the production cost. Feed conversion ratio (FCR) is measure of how well a bird converts feed intake into live weight. AV/CSP/29 premix ingredient herb *Zingiber officinale* has role in improvement of FCR (Herawati, 2006; Herawati, 2010). The ways for exploring methodologies for enhancing bioavailability of minerals especially calcium and phosphorus is a strategy to reduce the poultry feed cost. Serum calcium and phosphorous concentration increased on AV/CSP/29 premix supplementation. AV/CSP/29 premix ingredient herbs *viz.*, *Cissus quadrangularis*, *Lepidium sativum* and *Uraria picta* (Singh et al., 2011; Mohamed et al., 2013; Saxena et al., 2014) have synergistic effect on calcium and phosphorus utilization. Blood plasma proteins have significance role in homeostasis maintenance (Filipović et al., 2007). An improvement in total protein (g/dL) concentration in AV/CSP/29 premix supplemented Group T1 birds might act as the source of amino acids for synthesis of tissue proteins, and lead to better performance. Serum Alkaline phosphates (ALP) levels have been used as diagnostic indicators in bone and liver disease (Iyngkaran et al., 1995). Unaltered serum alkaline phosphates activity in the treatment groups indicates that none of the herbal products under study had any detrimental side effects on hepatic functions in broilers. Serum immunoglobulin levels are routinely determined in clinical practice to check the Humoral immune status (Gonzalez-Quintela et al., 2008). Serum immunoglobulin concentration increased on 3rd and 5th week after AV/CSP/29 premix supplementation to Group T_1, might be because of its constituent Vitamin A. Researchers showed that after Vitamin A supplementation significant increase in Immunoglobulin (Moghaddam and Emadi, 2014). High carcass yield,

dressing percentage and improved tibial mineralization was observed in AV/CSP/29 premix supplemented Group T_1. This improvement may be attributed to the synergistic calcium and phosphorus absorption enhancing ability of the AV/CSP/29 premix ingredient herbs *viz*., *Cissus quadrangularis*, *Lepidium sativum* and *Uraria picta* (Jaiswal et al., 2004). Meat of good organoleptic quality with a relatively low bacterial count releases large volumes of extract, whereas meat of poor organoleptic quality with larger numbers of bacteria releases progressively less extract. Extract release volume (ERV) was more in meat from AV/CSP/29 premix supplemented Group T_1 birds. Extract release volume decreases with progress of spoilage (Jay and Hollingshed, 1990). The high ERV value of Group T_1 meat depicts that after AV/CSP/29 premix supplementation, the organoleptic quality of meat is enhanced. Sensory quality of meat was increased in AV/CSP/29 premix supplemented Group T_1. Sensory attributes of foods are often used to evaluate food eating quality and serve as references during the selection of foods (Chumngoen and Tan, 2015). Thus, in this way AV/CSP/29 premix supplementation enhance the consumer preference.

CONCLUSION

Incorporation of AV/CSP/29 premix in broiler feed improved the growth and overall performance of broilers, making broiler rearing comparatively more profitable. Tibial mineralization improved after AV/CSP/29 premix supplementation. AV/CSP/29 premix supplementation led to better humoral immunity and no adverse effect on other serum biochemical parameters.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest with any other people or organizations in any financial or personal relationship.

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