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Effect of Dietary Supplementation of *Aloe vera* Leaves on Growth Performance and Immunity of Fayoumi Chicks

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Abstract: A total of 1800 Fayoumi chicks, 28 day-old of age, were used in this study to determine the effects of two levels of *Aloe vera* leaves on performance and immune parameters. Basal Fayoumi's diet supplementation with 0, 1.0 or 2.0% *Aloe vera* leaves was investigated. The chicks were randomly divided into 9 separate floor pens each comprising 200 chicks and three pens (replicates) per treatment group in a completely randomized design. At the end of study, birds fed diets supplemented with 1.0 or 2.0% *Aloe vera* leaves had greater body weight gain, better feed intake and feed efficiency than those fed diets without *Aloe vera* leaves. Low mortality was recorded in treatment groups. The geometric means HI titres of birds fed on diets containing *Aloe vera* leaves were higher than those fed on control. *Aloe vera* leaves included in the Fayoumi's diet upto 1.0 or 2.0% did not have any deleterious effects on their performance and immunity.

Key words: Proximate analysis, body weight gain, feed intake, immunity

INTRODUCTION

Aloe vera is a tropical or sub-tropical plant with turgid lance-shaped green leaves with jagged edges and sharp points (Qiao *et al.*, 2013). The plant is a member of the lily family (*Liliaceae*), not the cactus family as many would believe from the rosette-like arrangement of the long spiked leaves on the central stem (Chow *et al.*, 2005).

Aloe vera is one of the most well-known herbal medicines with various properties such as healing, anti-inflammatory, anti-oxidative, anti-diabetic and immunomodulatory effects as well as antibacterial, antifungal and antiparasitic properties (Waihenya *et al.*, 2002; Boudreau and Beland, 2006). Various edible herbs have studied for their growth promoting abilities in broiler chicks (Cross *et al.*, 2007; Ansari *et al.*, 2012; Ansari *et al.*, 2013). A previous study that examined two concentrations (5 and 10%) of *Aloe vera* leaves in cockerels diets reported that supplementation of low level (5.0%) of *Aloe vera* leaves improved body weights and feed efficiency of birds (Odo *et al.*, 2010). Mmereole (2011) tested only 1% of *Aloe vera* leaves in the basal diet of broiler and found that body weight gain were significantly higher in the birds fed diets containing *Aloe vera* supplement than the birds fed control diet. Mehala and Moorthy (2008) reported that *Aloe vera* (0.1 and 0.2%) fed groups showed significantly ($p < 0.05$) higher titre values against Newcastle disease in broiler chickens at six weeks of age.

The present study was designed to investigate the effects of using *Aloe vera* leaves on the Fayoumi chick's performance and immunity.

MATERIALS AND METHODS

Collection and preparation of test samples: *Aloe vera* leaves were obtained from the Government Poultry Farm, Multan, Pakistan. Samples were identified and authenticated at the Botany Division, Institute of Pure and Applied Biology, Bahauddin Zakariya University, Multan, Pakistan. Sample collection was conducted during the months of March and April 2013. The leaves were thoroughly washed with tap water and allowed to dry in an air-circulating oven at 50°C followed by 105°C until there were no further changes in weight at these two temperatures. The powder of each sample was sieved through 300 µm mesh and stored in an air-tight cellophane bag as stock sample in a refrigerator till further analysis. Samples of *Aloe vera* leaves were analyzed for proximate composition following procedures as described by AOAC (2011) at feed testing laboratory of Poultry Research Institute, Rawalpindi, Pakistan. All analyses and determinations were done in triplicate.

Experimental birds and management: Eighteen hundred 28 day-old chicks of Fayoumi were randomly divided into 9 separate floor pens each comprising 200 chicks and three pens (replicates) per treatment in a completely randomized design. Each pen contained one tube type feeder and one bell-type automatic water fountain. Birds were provided with *ad libitum* access to feed and water.

Experimental diets: A basal diet was formulated to meet or exceed National Research Council (1994)

recommendation for essential amino acids. Composition and calculated nutrient content of basal diet is given in Table 1. Leaves were weighed on electronic scale and then chopped into pieces and blended in electric blender with some water. This infusion was mixed in feed. The green leaves of *Aloe vera* were added on top of the basal diet. Diets were supplemented with 0 (control), 1.0 and 2.0% *Aloe vera*.

Parameters measured: Feed consumption was determined and pen body weights were obtained at weekly interval. Birds were checked twice daily, weight of dead birds was used to adjust for feed consumption. Feed conversion ratio was also determined. Antibody response against Newcastle disease virus was determined by hemagglutination inhibition (HI) test (Thayer and Beard, 1998) at the Poultry Disease Diagnostic Laboratory, Poultry Research Institute, Rawalpindi, Pakistan. Blood samples from each of 10 birds of each group were collected on 10, 20 and 30 days of post-vaccination. Serum was separated and processed for HI test.

Statistical analysis: All data were analyzed using the SPSS version 16 (SPSS, Cary, NC, USA) statistical analysis program and means compared using Duncan's multiple range test at $p < 0.05$ (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Proximate analysis of *Aloe vera* leaves: The results on proximate analysis of *Aloe vera* leaves are shown in Table 2. The main characteristic of *Aloe* leaf was their high water content. Approximately 96.80% moisture contents were observed. Previous investigations (McKeown, 1983; Ahmed and Fatma, 2013) indicated 90-98% moisture in *Aloe vera* leaf. Two studies on compositional features of *Aloe vera* tissues were found as 6.86-15.4% crude protein (Femenia *et al.*, 1999; Ahmed and Fatma, 2013). The result of present study was found within range (6.90±0.06%) as mentioned in above studies. On dry matter basis, crude fat represented a minor fraction in present analysis (2.85±0.05%) and value was close to finding of Ahmed and Fatma (2013). *Aloe vera* leaves are rich source of fibre, as these represented greater than 70% proportion (75.60%) in this trial. These results were found within range of values observed as 60.34-72.17% by Femenia *et al.* (1999). Ash contents determined in present study (14.65±0.03) were close to values (16.88±0.04%) reported by Ahmed and Fatma (2013).

Fayoumi chick's performance: The results showed that birds fed diets supplemented with 1.0 or 2.0% *Aloe vera* leaves had greater ($p < 0.05$) body weight gain than those fed diets with control (Table 3). There was no ($p >$

Table 1: Composition (g/kg) and calculated nutrient content of basal diet

Item	Composition
Corn	520.0
Rice	100.0
Rice polish	63.4
Soyabean meal	130.0
Canola meal	40.0
Corn gluten meal (60%)	50.0
Fish meal	40.0
Lime stone	30.0
DCP	20.0
NaCl	3.0
Premix*	3.0
DL-Methionine	0.6
Total	1000.0
ME Kcal/kg	2800
CP, (%)	16.5
CF, (%)	4.90
EE, (%)	3.50
Ca, (%)	4.20
Available P, (%)	0.55
Lysine, (%)	0.85
Methionine, (%)	0.40

*Supplied/kg of diet:

vit. A, 12000 IU	vit. D ₃ , 2200 IU
vit. E, 10 mg	vit. K ₃ , 2 mg
vit. B ₁ , 1 mg	vit. B ₂ , 5 mg
vit. B ₆ , 1.5 mg	vit. B ₁₂ , 0.01 mg
Nicotinic acid, 30 mg	Folic acid, 1 mg
Pantothenic acid, 10 mg	Biotin, 0.05 mg
Choline chloride, 500 mg	Copper, 10 mg
Iron, 30 mg	Manganese, 60 mg
Zinc, 50 mg	Iodine, 1 mg
Selenium, 0.1 mg	Cobalt, 0.1 mg

Table 2: Chemical Composition of *Aloe vera* leaves

Items	Composition (%)
Moisture	96.80±0.45
Crude protein	6.90±0.06
Crude fat	2.85±0.05
Crude fibre	75.60±0.26
Total Ash	14.65±0.03

0.05) difference between body weight gain when birds fed diets of 1.0 or 2.0% *Aloe vera* leaves. The data showed that *Aloe vera* groups have the highest ($p < 0.05$) level of feed intake compared to the control group. Feed efficiency (weight gain/feed intake) was influenced by the treatments used, improving the feed efficiency compared with the diets of control (Table 3). Significantly ($p < 0.05$) higher mortality (12%) was found in control group as compared to treatment groups (3 to 5%).

These results are agreed with findings of Mehala and Moorthy (2008) and Mmereole (2011), who observed that at 1% dietary inclusion of *Aloe vera* leaf meal in broiler diets, there was significant difference in body weight gains of birds fed *Aloe vera* feed supplemented as compared to control. However, Odo *et al.* (2010) reported that the higher weight gain in birds fed 5% level of inclusion of *Aloe vera* than those fed 10% and explained that *Aloe vera* in large quantity exerts a powerful purgative effect but in smaller quantity, it appear to aid absorption of food from the gut. Moreover, Danhoff and McAnally (1988) also reported that *Aloe vera* accelerated

the growth of new cells, thereby resulting to increased body weight. Durrani *et al.* (2008) reported that the higher body weight gain and improved feed conversion ratio values of the broilers given 10 mL of aqueous extract of aloe gel per liter of drinking water could be due to better performance of the broilers and the diversified antimicrobial activities of aloe gel. Actually, polysaccharides contained in *Aloe vera* (particularly acemannan) have effects similar to those of prebiotics; that is, they increase the number of *Lactobacillus* colonies and reduce gram-negative bacteria (Darabighane *et al.*, 2012). Previous studies show that acemannan added to the broiler diet decreased the number of intestinal *E. coli* colonies (Lin *et al.*, 2005). In fact, short-chain fatty acids, as the final product of *Lactobacillus* fermentation, can lower intestinal pH and make the environment unfavourable for gram-negative bacteria.

High feed intake was recorded in birds fed diets supplemented with *Aloe vera* leaves and this leads to increased body weight gain in treatment groups as compared to control. Darabighane *et al.* (2012) reported increased feed intake in groups which were treated by 2% *Aloe vera* gel solved in water as body weight gain. In addition, *Aloe vera* groups showed higher feed conversion ratio than the control group, but they showed no significant difference from each other. Similarly, the present study shows increased feed intake in the 1 or 2% *Aloe vera* leaves groups with raised level of body weight gain. Increased feed intake in *Aloe vera* groups can be attributed to change in feed taste and stimulated appetite since, as reported by Windisch *et al.* (2008), phytochemical substances (as additives to birds' feed) can improve taste of diet. Furthermore, Wenk (2002) argued that herbs can stimulate appetite and endogenous secretions which, in turn, improve performance.

In the present study, low mortality occurred in treatment groups. Odo *et al.* (2010) reported there was no mortality in all the treatment (*Aloe vera*) groups. The absence of morbidity in treatment groups could be as a result of the antibiotic action of *Aloe vera* (Wendell, 1993) that fights infections. Hundred per cent livability was observed with inclusion of *Aloe vera* and *Curcuma longa* and their combination in broiler diets (Mehala and Moorthy, 2008).

Immunity: The geometric means HI titres of birds fed on diets containing *Aloe vera* leaves were higher on all sampling days than those fed on control (Table 4). Similar findings were obtained by Valle-paraso *et al.* (2005), who found that significant increase in Newcastle Disease Vaccine antibody titre in broilers treated with 2% *Aloe vera* compared to control group. In addition, it has been shown that adding acemannan to Newcastle vaccine significantly increases antibody titre on the 21st day after vaccination (Chinnah *et al.*, 1992). Darabighane *et al.* (2012) reported that the 2.5% *Aloe vera* gel group

Table 3: Effect of supplementation of *Aloe vera* leaves in diet on weight gain, feed intake, feed conversion and mortality in Fayoumi chicks

Treatment	<i>Aloe vera</i> leaves (%)		
	0	1.0	2.0
Weight gain (g)	230.6±3.20 ^a	261.0±3.13 ^a	263.3±3.10 ^a
Feed intake (g/bird)	1140±6.50 ^b	1272±06.70 ^a	1275±7.05 ^a
Feed: gain ratio	4.94±0.36 ^a	4.87±0.30 ^a	4.84±0.42 ^b
Mortality (%)	12.0±0.29 ^a	5.0±0.15 ^b	3.0±0.10 ^b

^{a,b}Means with different letters in rows are different (p<0.05)

Table 4: Effect of *Aloe vera* leaves on the Production Antibody Titers against Newcastle Virus

<i>Aloe vera</i> leaves (%)	Geometric means HI titers		
	Day 7	Day 14	Day 30
0	32.89±1.43	61.74±0.65	65.37±0.76
1.0	52.11±02.01	96.34±1.39	143.27±0.46
2.0	51.94±02.00	91.93±1.10	141.10±0.37

resulted in significantly higher levels of humoral and cellular immunity, as well as relatively greater weight of lymphoid organs, which suggested that *Aloe vera* gel could be a proper replacement for the virginiamycin antibiotic.

Enhanced humoral immunity can be attributed to polysaccharides (acemannan) contained in *Aloe vera* gel. Polysaccharides can increase cytokines and antibodies and enhance the performance of natural killers and B- and T-lymphocytes (Chinnah *et al.*, 1992; Nie and Zhang, 1999). In general, polysaccharides can affect the humoral immune response and cellular immunity (Lien and Gao, 1990). The effects of acemannan on immunity system have been studied in several researches. As a polymer formed by mannose, acemannan can attach to mannose receptors in macrophages which tend to bind with carbohydrate structures containing mannose (Lee, 1988; Lee *et al.*, 2001). Such bonds activate microphages and release growth factors such as Granulocyte Macrophage-Colony Stimulating Factor (GM-CSF) that controls the growth and divisions of cells which act as myeloid precursor. In addition, acemannan contained in *Aloe vera* can release cytokines such as IL-1, IL-6, IL-12 and TNF- α (Tumour Necrosis Factor) from macrophages (Ramamoorthy *et al.*, 1996; Zhang and Tizard, 1996). This can stimulate the growth of B lymphocytes and increase the number of T lymphocytes.

Conclusion: This study showed *Aloe vera* leaves can be included in the diets of Fayoumi chicks up to 2.0% without any deleterious effects on their performance. Furthermore, *Aloe vera* leaves also enhanced the immunity level in birds.

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