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SB Adangale
Assistant Professor, Department of Animal Husbandry and Dairy Science, College of Agriculture, Pune, Maharashtra, India

PH Padvi
M. Sc. Student, Department of Animal Husbandry and Dairy Science, College of Agriculture, Dhule, Maharashtra, India

PD Mali
Ph.D. Scholar, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AT Lokhande
Assistant Professor, Department of Animal Husbandry and Dairy Science, College of Agriculture, Nandurbar, Maharashtra, India

Corresponding Author:
SB Adangale
Assistant Professor, Department of Animal Husbandry and Dairy Science, College of Agriculture, Pune, Maharashtra, India

Effect of *Aloe vera* (*Aloe barbadensis*) supplementation on growth performance and serum biochemical parameters in broilers

SB Adangale, PH Padvi, PD Mali and AT Lokhande

Abstract
A study was conducted on 160 day-old broiler chicks to evaluate the effect of *Aloe vera* powder on growth performance and serum biochemical parameters. The experiment lasted for 42 days in which broiler chicks were randomly divided into four treatment groups, each group having four replications consisting of ten birds each. The chicks fed with basal diet in control group (T_0), while chicks in treatment group T_1, T_2 and T_3 were fed basal diet with *Aloe vera* powder @ 0.5, 1.0 and 1.5%, respectively. At the end of study, birds fed diets supplemented with 1.0% *Aloe vera* powder had greater body weight gain, better feed intake and feed efficiency than those fed diets without *Aloe vera* powder. The serum cholesterol, triglycerides and LDL levels decreased as the level of *Aloe vera* powder increased in the diet of broiler chicken. It was concluded from this study that 1.0% *Aloe vera* powder feed supplemented has a beneficial impact on the growth performance of broilers chicks and serum biochemical parameters.

Keywords: *Aloe vera*, broiler, growth and blood biochemical parameters

Introduction
Poultry productions act as a source of income to the farmers and also supply good quality proteins through egg and meat. The success of poultry production depends primarily on the quality of the bird employed, comfortable environment and provision for nutritious feed, the last being most expensive of all other inputs deserves, so it benefiting attention (Panda, 2002) [17]. Besides a liberal supply of well-balanced feed, its effective utilization by bird is equally important. Thus the major objective of poultry farming is to increase the profit margin in poultry business by improving feed efficiency and growth rate.
Recent trend in broiler production is to offer diets containing feed additives to improve feed efficiency and obtain maximum returns in shortest possible time. Various types of feed additives (antibiotics, enzymes, hormones, prebiotics, probiotics, herbal products, etc.) are used as growth stimulants in poultry production. Phytogenics are derived from herbs, spices or aromatic plants and have shown antimicrobial, antifungal, antiviral, antioxidant or sedative properties. A complex mixture of bioactive compounds present in them is known for their appetizing effects, since they increase the palatability of the feed and stimulate endogenous digestive enzymes. Moreover, phytogenics have a pronounced impact on the gut microflora. Many studies have been carried out on using additives including herbs, as alternatives to antibiotics, with direct or indirect effects on intestinal microflora in poultry products (Taylor, 2001) [22]. Several studies have shown antimicrobial properties of herb extracts (Cowan, 1999 and Hammer *et al.*, 1999) [3, 8] which can improve intestinal microflora population and enhance health in bird's digestive system through reduction in number of disease making bacteria (Mitsch *et al.*, 2004) [12]. In addition, modified harmful microbial population in intestines will change intestinal morphology. Intestinal health is of great importance in poultry for improved performance and reduced feed conversion ratio (Montagne *et al.*, 2003) [13].
*Aloe vari*es one of such plants, having a great medicinal potential (Ezeibekwe *et al.*, 2009) [6]. *Aloe vari*es a succulent, stem fewer herbs found widely in India, China and many Egyptian countries, having more than 70 biologically active compounds. Many studies have shown antibacterial, antiseptic, anti-inflammatory and immune-modulator effects of *Aloe vera* (Moorthy *et al.*, 2009; and Madan *et al.*, 2008) [14, 10]. Many studies have also shown antioxidant and anti-cancerous properties of *Aloe vera* (El-Shemy *et al.*, 2010) [5]. Apart from the above, anti-mutagenic effects and anti-hypersensitivity effects of *Aloe vera* have also been

reported by some researchers (Snezana *et al.,* 2007 and Strickland, 1993) [20, 21].

Material and Methods

Total 160 day old (Vencobb-400) chicks were randomly and equally distributed into four treatment groups T_0, T_1, T_2 and T_3 with 40 numbers of chicks in each group. The chicks fed with basal diet in control group (T_0), while chicks in treatment group T_1, T_2 and T_3 were fed basal diet with *Aloe vera* powder @ 0.5, 1.0 and 1.5%, respectively and reared under deep litter system. For the experiment, a pre-starter (0-1 week), starter (2-3 weeks) and finisher (4-6 weeks) feed were used during experimental period of 6 weeks. Feeding and watering was done in identical feeders and waterers specified for the deep litter. The birds under all treatment groups had *ad-libitum* access to feed and fresh, clean and cool drinking water throughout the experimental period. The average live body weight, body weight gain, feed intake and feed conversion ratio were measured on weekly basis. At the end of experiment, nine birds were randomly selected from each experimental group blood samples are collected for serum biochemical parameters analysis. The data were analyzed using General Linear Model procedure of statistical package for social sciences (SPSS) 15th version and comparison of means tested using Duncan's multiple range test (1955) [4] and significance was considered at (p<0.05)

Results and Discussion

Composition of experimental ration

The proximate composition of experimental broiler starter and finisher rations are presented in Table 1. It was observed that experimental broiler rations contained adequate nutrients for growth as per BIS (2007) [2]. The crude protein and calculated metabolizable energy (ME) of the starter diet was 23 percent and 2863.81 Kcal/kg, respectively. The crude protein and calculated metabolizable energy (ME) of the finisher diet was 20 percent and 2939.75 Kcal/kg, respectively.

Growth performance

The weekly live body weight gain of chicks indicated no significant difference on various treatment groups during the first two weeks of the experiment. There is significant (p<0.05) difference among the treatments from third weeks onwards. The weekly body weight gain for control, T_1, T_2 and T_3group at 3rd week of age were 284.15±6.14, 288.10±5.32, 318.08±5.21and 325.03±4.44g, respectively. The higher weight gain was observed in treatment T_3 (325.03) followed by T_2 (318.08), T_1 (288.10) and control (284.15) g, respectively. During the fourth higher body weight gain was observed in treatment T_3 as compared to other treatments. However, treatmentT_1, T_2 and T_3 were at par with each other. In the fifth weeks of experimental period the maximum weekly body weight gain in treatment T_2 (448.15) and minimum in treatment T_3 (395.08) was reported. In the sixth week, significantly (p<0.05 %) higher body weight gain in the T_2 (558.83 g) group was recorded. However, the treatments T0, T1and T3 were at par to each other. There is likelihood that improved metabolism has beneficial impact on weight gain in *Aloe vera* treated groups as compared to control group.

Improvement in the body weight gain of the broiler birds in present study may be due to phenolic compounds found in the sap of *Aloe vera* plant and also due to biochemical catalysts, such as amylase and lipase which can aid digestion by breaking down fats and sugars. Gomez *et al*. (1998) [7] concluded that improvement in live body weight in broiler may be due to antibacterial related to flavonoids in *Aloe barbadensis* that led to maintaining normal intestine microflora by competitive exclusion and antagonism, altering metabolism and increased liver and muscle glycogen contents. Kumar *et al*. (2005) [9] also obtained similar results when they compared the body weights and weight gains of birds fed on diets containing *Aloe vera* feed supplement and those fed on diets containing antibiotic growth promoters. These results appear to confirm the observations made by Mehala and Moorthy (2008) [11] who observed that 1% dietary supplementation of *Aloe vera* leaf meal had significant (**p**<0.05) higher body weights and body weight gains as compared to control diet.

Feed Intake

Weekly feed intake

The weekly feed intake of experimental broiler chicks was recorded at weekly interval throughout the experimental period of 6 weeks (Table 3). The overall average feed intake of the birds at six week for treatment T_0, T_1, T_2 and T_3 was 902.60±27.71, 905.10±10.21, 913.13±22.05 and 915.40±22.12 g, respectively. However, the difference was non-significant of the weekly feed intake in all the treatment groups for the entire experimental period. During six week weekly feed intake of the birds during experimental period was higher in treatment T_3 (915.40) followed by treatment T_2, T_1 and T_0 group.

Improved feed intake in the present investigation may be attributed to the facts that improved digestion of feed by simulation of digestive enzyme, as phytogenic feed additives are reported to improve performance by enhancing the activity of digestive enzymes (Recoquillay, F. 2006) [18].

Mehala and Moorthy (2008) [11] found that no significant difference among the treatment groups due to dietary inclusion of *Aloe vera* and cucumber longa and its combination on feed efficiency. Silalahi *et al*. (2009) [19] reported non- significant effect of dried and fresh *Aloe vera* barbadens gels on feed intake. Increased feed intake in the 1.5% *Aloe vera* powdered groups can be attributed to changes in feed taste and stimulation of appetite since, as reported by Windisch *et al*; (2008) [23], phytogenic substances (as additives to birds' feed) can improve taste of diet.

Feed conversion ratio

The mean weekly feed conversion ratio and their standard error at different weeks of age are presented in Table 4. All treatments were non-significant during upto second week's period. Statistically the significant (p<0.05 %) was observed in FCR from third to six weeks onward. The overall feed conversion ratio at six week for treatment T_0, T_1, T_2 and T_3 were 1.81±0.02, 1.78±0.02, 1.69±0.02 and 1.75±0.02, respectively. Statistically better FCR was recorded in T_2 (1.69) treatment as compared to other treatments.

Better growth performance and favorable feed conversion ratio (FCR) with the group T3 may be attributed to the anti-bacterial and anti-oxidant properties of *Aloe vera* reported by Arunkumar and Muthuselvam (2009) [1].

Olupona *et al.* (2010) [16] supplemented broiler drinking water with *Aloe vera* and reported an improvement in FCR was observed for broilers treated with *Aloe vera* compared to the control group, but the difference was not significant.

Blood serum biochemical profile

The average serum lipid profile values (mg/dl) in different groups are presented in Table 5. The average serum total triglyceride at the end of experimental period for T_0, T_1, T_2 and T_3 were 100.42±2.18, 99.06±2.13, 98.81±1.72and 96.81±1.15 (mg/dl), respectively. The difference was non-significant. Indicating that, triglyceride was unaffected by the dietary treatments of *Aloe vera*. The serum cholesterol for treatment T_0, T_1, T_2 and T_3 were 147.96±2.00, 135.15±2.93, 126.01±2.00 and 124.61±1.60 (mg/dl), respectively. It was revealed that the average serum cholesterol value of group $T_0$was significantly (p<0.05) higher than other treatment. However, treatment T_2 and T_3 were at par to each other. As the level of *Aloe vera* increases in diet it significantly reduces the serum cholesterol. The values of high density lipoprotein (HDL) was higher in treatment T_3 (67.81 mg/dL) followed by $T_{2,}$ $_{T1}$and$T_{0.}$ The serum HDL concentration was significantly (p<0.05) higher in treatment $T_{3.}$ However, treatment $T_{0,}$ T_1 and $T_{2,}$ were at par to each other. The average serum low density lipoprotein (LDL) cholesterol at the end of experimental period for treatment T_0, T_1, T_2 and T_3 were 29.38±1.80, 23.65±1.22, 20.99±0.98and 19.06±1.82(mg/dl), respectively. Thus, there was significant decrease in low density lipoprotein values with the increasing level of *Aloe vera*. Statistically treatment T_0 (control) had significantly (p<0.05 %) higher LDL than *Aloe vera* treated group. However treatment T_1, T_2 and T_3were at par to each other.

Taraneh J.F.K (2016) [24] showed that broilers receiving *Aloe vera* gel and garlic powder had lower blood glucose, uric acid, total cholesterol, High-density lipoprotein (HDL), Low-density lipoprotein (LDL) and Triglycerides concentrations compared to control group. However, higher total protein concentrations were observed with supplementation of *Aloe vera* gel and garlic powder than control group. Mehala and Moorthy (2008) [11] reported non-significant difference in total serum protein, serum albumin, serum globulin, albumin globulin ratio, glucose, cholesterol and triglyceride value in broilers supplemented with *Aloe vera* in feed. Namagirilakshami (2005) [15] who stated that supplementation of turmeric in broiler chicken diet at 0.25, 0.50, 0.75 and 1.00 percent levels had no significant effect on blood glucose, total cholesterol, HDL, LDL and triglycerides between treatment groups and control.

Table 1: Percent proximate chemical composition of experimental ration (on DM basis)

Nutrients	Broiler ration	
	Starter	Finisher
Crude protein	23.0	20.0
Crude fibre	4.60	3.78
Ether extract	4.80	4.3
Total ash	7.20	6.85
Nitrogen free extract	60.40	65.15
Acid insoluble ash	1.25	1.44
ME (Kcal/kg)	2863.81	2939.75

Table 2: Effect of different levels of *Aloe vera* powder feeding on weekly body weight gain of broilers

Weeks	Treatments				CD @ 5%
	T0	T1	T2	T3	
First	150.43±1.36	153.00±1.32	154.00±1.34	154.58±1.43	NS
Second	213.90±4.12	213.08±3.61	215.05±3.34	215.13±3.54	NS
Third	284.15±6.14^{a}	288.10±5.32^{a}	318.08±5.21^{b}	325.03±4.44^{b}	14.84
Fourth	395.80±8.53^{a}	420.33±9.43^{b}	423.28±8.69^{b}	441.63±7.54^{b}	23.95
Five	412.08±8.72^{ab}	443.63±14.81^{bc}	448.15±12.32^{c}	395.08±9.44^{a}	32.35
Six	488.78±16.43^{a}	465.10±16.27^{a}	558.83±12.91^{b}	500.33±15.96^{a}	43.19

Values bearing different superscripts in columns differ significantly (p<0.05)

Table 3: Effect of different levels of *Aloe vera* powder feeding on weekly feed intake of broilers

Weeks	Treatments				CD @ 5%
	T0	T1	T2	T3	
First	174.00±1.80	174.33±1.82	175.03±1.80	175.03±2.54	NS
Second	376.25±3.61	377.05±3.59	376.08±3.14	377.18±3.63	NS
Third	600.10 ±3.52	609.03±4.21	619.15±4.28	620.50±9.91	NS
Fourth	795.93±7.56	798.00±6.46	790.00±9.54	811.83±7.63	NS
Five	769.08±20.79	762.83±11.81	798.00±13.35	779.13±17.01	NS
Six	902.60±27.71	905.10±10.21	913.13±22.05	915.40±22.12	NS

Table 4: Effect of different levels of *Aloe vera* powder feeding on weekly feed conversion ratio of broilers

Weeks	Treatments				CD @ 5%
	T0	T1	T2	T3	
First	1.15±0.02	1.14±0.02	1.13±0.02	1.13±0.02	NS
Second	1.79±0.04	1.79±0.04	1.77±0.03	1.77±0.04	NS
Third	2.15±0.05^{b}	2.15±0.05^{b}	1.97±0.04^{a}	1.92±0.04^{a}	0.12
Fourth	2.05±0.06^{b}	1.94±0.05^{ab}	1.89±0.04^{a}	1.86±0.03^{a}	0.13
Five	1.86±0.06^{ab}	1.71±0.06^{a}	1.78±0.07^{ab}	1.97±0.07^{b}	0.18
Six	1.84±0.09^{ab}	1.95±0.08^{b}	1.63±0.05^{a}	1.83±0.08^{ab}	0.21
Overall	1.81±0.02^{c}	1.78±0.02^{bc}	1.69±0.02^{a}	1.75±0.02^{ab}	0.05

Values bearing different superscripts in columns differ significantly (p<0.05)

Table 5: Effect of different levels of *Aloe vera* powder feeding on blood parameter of broilers

Treatments	Parameters			
	Triglyceride (mg/dL)	Cholesterol (mg/dL)	HDL (mg/dL)	LDL (mg/dL)
T0	100.42±2.18	147.96±2.00 [c]	60.32±0.79 [a]	29.38±1.80 [b]
T1	99.06±2.13	135.15±2.93 [b]	61.05±0.72 [a]	23.65±1.22 [a]
T2	98.81±1.72	126.01±2.00 [a]	62.80±1.84[a]	20.99±0.98 [a]
T3	96.81±1.15	124.61±1.60[a]	67.81±1.93[b]	19.06±1.82 [a]
Mean±SE	98.77±1.79	133.43±2.13	62.99±1.32	23.27±1.45
CD @5%	NS	6.45	4.24	4.42

Values bearing different superscripts in columns differ significantly (p<0.05)

Conclusions

It can be concluded from our study that supplementation of *Aloe vera* powder @ 1.0% level in the feed of broiler birds enhances the body weight gain, better FCR and significantly reduces blood serum i. e. cholesterol, HDL and LDL level.

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