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Effect of Aloe Vera (*Aloe barbadensis*) Supplementation on Production Indices, Mortality and Cost of Production of Broiler Chicken

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ABSTRACT

The present study investigated the effect of dietary supplementation of three physical forms of aloe vera *viz*. powder, gel and juice on the energy efficiency (EE), protein efficiency (PE), performance index (PI), production number (PN), mortality pattern and cost of production of broiler chicken. Two hundred and forty day old unsexed broiler chicks (Cobb 400) were distributed in four groups with four replicates, each consisting of fifteen chicks on a completely randomized design. The treatments included the control (T_1- basal diet as per BIS 2007) and three groups with basal diet mixed with aloe vera powder @ 0.5% in feed (T_2), gel @ 2% in feed (T_3) and fresh aloe vera juice @ 2% in drinking water (T_4), respectively. The results revealed that PE and EE were significantly ($p<0.05$) different during last week among T_2 and T_3 groups as compared to control group. Values of PI and PN showed non-significant results among treatment groups. Mortality recorded was within standard limits which showed that there was no detrimental effect of aloe vera supplementation on health and performance of broilers. The cost of production calculated at the end of experiment revealed that net profit on drawn weight (₹/kg) was 3.96 (powder form), 7.39 (gel form) and 8.77 (juice form) as compared to control group (basal diet only). Thus, aloe vera can act as an efficient, effective and economical herbal feed additive in broiler industry.

Keywords: Aloe vera, broilers, cost of production, mortality, production indices

Poultry production in India has undergone a paradigm shift, growing at around 8-10% annually (Chatterjee and Rajkumar, 2015). But for ensuring more net return, to minimize high expenditure and maintaining better health, continuous research is always in progress to add newer feed supplements and feed additives in poultry industry by knowing their efficacy. Antibiotic Growth Promoters (AGPs) are the agents added in feed to enhance the feed conversion ratio (FCR) and body growth in poultry (Izat *et al*., 1990; Dibner and Buttin, 2002; Miles *et al*., 2006). However, constant application leads to residual effects in poultry products and bacterial resistance to drugs in human body causes threats to human health (Botsoglou and Fletouris 2001; Alcicek *et al*., 2004; Owens *et al*., 2008). On the other hand use of non-antibiotic growth promoters (NAGPs) is commonly regarded as favourable alternative to AGP in poultry production. Many studies have been carried out on feed additives including herbs, as alternatives to antibiotics, with direct or indirect effects on intestinal microflora in poultry (Taylor, 2001).

Aloe vera has a great medicinal potential, having more than 70 biologically active compounds (Ezeibekwe *et al*., 2009). It is a succulent, stem less herb found widely in India, China and many Egyptian countries. Many studies have shown antibacterial, antiseptic, anti-inflammatory and immune-modulator effects of aloe vera (Gautam *et al*., 2004; Madan *et al*., 2008; Moorthy *et al*., 2009). Studies have also shown anti-oxidant and anti-cancerous properties in aloe vera (El-Shemy *et al*., 2010; Nwaoguikpe *et al*., 2010). Apart from the above, anti-mutagenic effects and anti-hypersensitivity effects of aloe vera have also been reported by some researchers (Snezana, S. 2007). Aloe vera in different forms *viz.* powder, gel and extract (aqueous and ethanolic) was used by researchers in various animal and lab animals' feed. But the use of aloe vera in

broiler feed and its efficacy in terms of production indices, cost of production and mortality pattern on broiler birds is scanty in literature. Keeping in view the facts stated above, the present study was planned to observe the effect of supplementation of aloe vera on energy efficiency, protein efficiency, performance index, production number of broiler chicken. The mortality and cost of production which are keys to broiler industry were also calculated under different treatments.

MATERIALS AND METHODS

Location of study

The present research work was conducted for 42 days at the Poultry shed of the Department of Livestock Production Management, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar with prior approval by the Institutional Animal Ethics Committee (Reference number- VPHE/IAEC/88-108).

Experimental design

Two hundred and forty day old commercial broiler chicks (Cobb-400 strain) were randomly distributed into four treatment groups [T1: Control (Standard Broiler Ration) – As per BIS (2007); T2: Control + aloe vera powder in feed @ 0.5 %; T3: Control + aloe vera gel in feed @ 2 %; T4: Control + fresh aloe vera juice in drinking water @ 2 %] and each treatment group was further divided into four replicates of fifteen chicks each.

Preparation of different forms of aloe vera

Aloe vera leaves were purchased from medicinal, aromatic and underutilized plants section, department of Plant Breeding, College of Agriculture, CCS HAU, Hisar. All three physical forms of aloe vera needed for the entire experiment were prepared by processing fresh aloe vera leaves. The aloe vera powder was prepared by cutting thorny margins as well as portion containing yellow sap from fresh aloe vera leaves. The leaves were washed under tap water followed by distilled water. The surface of leaves was treated with 0.1% mercuric chloride ($HgCl_2$) solution mainly to avoid fungal contamination during drying. The leaves were cut down into fine pieces with the help of knife so as to facilitate sun drying after spreading on clean polythene sheets for 3 days provided optimum sunlight is available. Oven drying at 60°C for 24 hours was performed, when required. Dried leaves are then grinded to make fine powder. Finally, powder was stored in air tight container.

The aloe vera leaves were washed under tap water followed by distilled water after cutting the thorny margins as well as portion containing yellow sap from fresh leaves. The thick green coloured skin portion was peeled off. The gel was scoop out with a spoon. The gel portion was placed in sterilized, clean glass jar.

After cutting thorny margins as well as portion containing yellow sap from fresh aloe vera leaves, washing of the leaves under tap water followed by distilled water was performed. Leaves were cut down with the help of knife for processing in juicer. Then, Straining was performed with the help of fine sieve 2-3 times followed by straining through muslin cloth to obtain fine extract which was uniformly dissolved in drinking water on daily routine basis.

Experimental procedure

The chicks were routinely vaccinated and reared under strict hygienic conditions maintaining all standard managemental practices including brooding, lighting, litter management, cleaning of feeders and drinkers etc. Before formulation of broiler rations (pre-starter, starter and finisher), all feed ingredients and experimental diets were analyzed for proximate composition as per AOAC (2005), ingredient and chemical composition are presented in table 1.

Observations recorded

Body weight and feed consumption

The birds belonging to all the experimental groups were closely observed for body weight gain throughout the experiment i.e. 42 days. Chicks were weighed individually at the start of experiment and later on at weekly interval to calculate gain in body weight. Body weight of individual bird of each group was taken in the morning using digital single pan balance.

Table 1: Ingredient (kg/100 kg feed) and chemical composition (% DM) of experimental broiler diets

Name of Ingredients	Quantity		
	Pre- starter (0-1 week)	**Starter (2-3 weeks)**	**Finisher (4-6 weeks)**
Maize	55	55.5	60
Soyabean meal	20	17	15
Ground nut cake	12.5	13.5	10
Fish meal	8	8	8
*Mineral mixture	2	2	2
Vegetable oil	2.5	4	5
****Feed additives (g/100kg of ration)**	**0-1 week**	**2-3 weeks**	**4-6 weeks**
Spectromix (g)	10	10	10
Spectro BE (g)	20	20	20
Cocciwin(g)	50	50	50
Choline chloride(g)	50	50	50
Lysine(g)	50	50	50
DL - methionine (g)	80	80	80
Chemical composition	**Pre- starter**	**Starter**	**Finisher**
Moisture %	10.52	10.84	10.88
Crude protein %	23.03	22.04	20.08
Crude fibre %	3.64	3.61	3.32
Ether extract %	6.98	8.38	8.98
Total ash %	6.30	6.18	5.86
Nitrogen free extract %	49.53	48.97	50.88
Metabolizable energy (Kcal/Kg)	2952	3056	3163

*Mineral mixture (salt free): Ca (32%), P (6%), Mn (0.27%), Zn (0.26%), Iodine (0.01%), Fe (1000 ppm), Cu (100 ppm), and Co (50 ppm).

**Spectromix Powder: Each gm contained Vitamin A-82,500 IU, Vit. B2-50 mg, Vit. D3-12,000 IU, and Vit. K-10mg, Spectro BE Powder: Each gm contained Vit.B1-8 mg, Vit.B6-16 mg, Vit.B12-80 mg, Niacin- 120mg, Vit. E-160 mg, Lysine hydrochloride-10 mg, DL-methionine- 10 mg, Calcium pentothenate -80mg, and Calcium – 260mg., Cocciwin: Dinitro- O –Toluamide, Lysine: Contained 98 per cent lysine, DL- methionine: Contained 98 per cent methionine, Choline chloride: Contain 60 percent choline.

Group wise weekly record of the feed offered and feed weigh back were maintained during the experimental period of six weeks. The data were compiled and summarized for statistical analysis.

Performance and nutrient utilization parameters were recorded as per standard protocol viz. FCR, PI (Bird, 1995), PE (Karman *et al.,* 2008) and PN (Euribrid, 1991).

Mortality rate

The birds were reared with special care to observe any sign of stress and regular observations were made to record the occurrence of mortality in experimental birds to estimate the rate of mortality in percentage relative to different treatments. The dead birds were sent to the Department of Pathology, College of Veterinary Sciences, LUVAS, Hisar for post-mortem examination to know the cause of mortality.

Cost of production

Relative cost of production was calculated at the end of sixth week. The cost of production included the cost of chick survived and the cost of feed consumed among the treatments to know which form of dietary supplementation was more profitable.

Statistical analysis

Data obtained were subjected to statistical analysis as per Snedecor and Cochran (1994) using Completely Randomized Design (CRD). All the data were subjected to ANOVA using the General Linear Models procedure of SAS software (SAS Institute, 2003). The mean differences among different treatments were separated by Duncan's multiple range tests. Consequently, a level of ($p<0.05$) was used as the criterion for statistical significance (Duncan, 1955).

RESULTS AND DISCUSSION

Performance Index (PI)

The weekly PI of birds fed diets supplemented with aloe vera is presented in Table 2. The mean PI values of birds at all ages remained non-significantly different in all the treatment groups ($p<0.05$), but indicate that treatment groups were better than control group. The mean PI values of birds recorded during 1, 2, 3, 4, 5 and 6 week of experiment ranged from 80.27 (T_1) to 97.96 (T_2), 69.90 (T_2) to 86.94 (T_4), 130.64 (T_2) to 148.16 (T_4), 194.60 (T_2) to 213.53 (T_1), 252.56 (T_2) to 293.83 (T_4) and 214.26 (T_1) to 259.32 (T_2), respectively.

Table 2: Effect of aloe vera on performance index of broilers

Week	Treatments			
	T_1	T_2	T_3	T_4
1	80.27 ± 7.33	97.96 ± 18.23	89.66 ± 10.82	83.46 ± 5.22
2	70.28 ± 8.23	69.90 ± 4.68	84.94 ± 12.03	86.94 ± 6.97
3	139.56 ± 8.72	130.64 ± 3.52	138.56 ± 8.20	148.16 ± 7.71
4	213.53 ± 8.60	194.60 ± 6.60	195.97 ± 9.69	206.71 ± 8.53
5	275.99 ± 16.67	252.56 ± 18.98	265.59 ± 18.56	293.83 ± 15.41
6	214.26 ± 5.90	259.32 ± 18.80	258.16 ± 14.92	221.56 ± 17.38

Values are means ±standard errors.

Protein efficiency (PE)

The treatment means of PE showing significance of aloe vera supplementation have been presented in Table 3. The mean PE values of birds at six week period remained significantly better ($p<0.05$) in T_2 (2.29) and T_3 (2.22) groups as compared to T_1 (1.93). The different level of PE at different age intervals attributes to pre-starter (CP= 23.03 %), starter (CP= 22.04 %) and finisher ration (CP= 20.08 %) fed at 0-1, 2-3 and 4-6 weeks of age, respectively. The improved protein efficiency in aloe vera powder and gel treated groups as compared to control group may be attributed to efficient nutrient utilization, better gut morphology due to antibacterial, immuno-modulatory and anti-oxidant properties of aloe vera (Madan *et al*., 2008; Moorthy *et al*., 2009).

Table 3: Effect of aloe vera on protein efficiency of broilers

Week	Treatments			
	T_1	T_2	T_3	T_4
1	4.34 ± 0.26	5.45 ± 1.10	4.70 ± 0.29	4.40 ± 0.33
2	1.89 ± 0.13	1.89 ± 0.07	2.10 ± 0.15	2.13 ± 0.08
3	2.05 ± 0.07	1.99 ± 0.02	2.08 ± 0.08	2.15 ± 0.04
4	2.43 ± 0.04	2.33 ± 0.06	2.38 ± 0.04	2.41 ± 0.05
5	2.32 ± 0.06	2.40 ± 0.09	2.35 ± 0.04	2.51 ± 0.05
6	1.93^{b} ± 0.05	2.29^{a} ± 0.09	2.22^{a} ± 0.09	2.07^{ab} ± 0.09

Values are means ±standard errors.

Means bearing different superscripts, differ significantly ($p<0.05$) row wise.

Energy efficiency (EE)

The treatment means of EE showing significance of aloe vera supplementation have been shown in Table 4. The mean EE values of birds at six week period remained significantly better ($p<0.05$) in T_2 (14.37) and T_3 (13.90) groups as compared to T_1 (12.08). The different level of EE at different age intervals attributes to pre-starter (ME= 2952 Kcal/Kg), starter (ME= 3056 Kcal/Kg) and finisher

ration (ME= 3163 Kcal/Kg) fed at 0-1, 2-3 and 4-6 weeks of age, respectively. There is likelihood that improved metabolism has beneficial impact on weight gain in aloe vera treated groups as compared to control group. Gomez *et al*. (1998) 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.

Table 4: Effect of aloe vera on energy efficiency of broilers

Week	Treatments			
	T_1	T_2	T_3	T_4
1	33.27 ± 2.05	41.82 ± 8.50	36.05 ± 2.26	33.78 ± 2.57
2	13.42 ± 0.94	13.44 ± 0.53	14.91 ± 1.08	15.16 ± 0.63
3	14.56 ± 0.53	14.13 ± 0.19	14.81 ± 0.57	15.28 ± 0.36
4	15.18 ± 0.27	14.60 ± 0.43	14.90 ± 0.25	15.05 ± 0.33
5	14.53 ± 0.43	15.04 ± 0.59	14.72 ± 0.29	15.72 ± 0.33
6	12.08^{b} ± 0.32	14.37^{a} ± 0.57	13.90^{a} ± 0.59	12.95^{ab} ± 0.60

Values are means ±standard errors.
Means bearing different superscripts, differ significantly ($p<0.05$) row wise.

Table 5: Effect of aloe vera on production number of broilers

Week	Treatments			
	T_1	T_2	T_3	T_4
1	116.06 ± 10.44	140.47 ± 26.57	128.10 ± 15.46	119.23 ± 7.46
2	99.09 ± 12.61	98.40 ± 7.68	119.90 ± 18.19	124.21 ± 9.95
3	196.04 ± 12.79	183.41 ± 4.89	198.44 ± 14.52	211.66 ± 11.01
4	300.41 ± 16.00	273.78 ± 13.33	275.03 ± 12.86	295.30 ± 12.19
5	388.30 ± 27.33	354.26 ± 25.38	372.22 ± 22.43	419.75 ± 22.02
6	301.37 ± 12.95	352.40 ± 29.28	356.18 ± 20.04	316.52 ± 24.83

Values are means ±standard errors.

Production Number (PN)

The weekly PN of birds fed diets supplemented with aloe vera is presented in Table 5. The values of production number under different treatments were found to be statistically similar, but indicate that treatment groups were better than control group.

Mortality

The experimental chicks were observed carefully for abnormal behaviour and mortality if any and post mortem examination was performed in dead chicks. Percent mortality recorded has been presented in Table 6. Throughout the experimental period 8 birds died out of a total of 240 birds. Mortality recorded in T_1, T_2, T_3 and T_4 was 3, 2, 2 and 1 respectively. The post-mortem findings revealed that the main cause of death was pneumonia and ascites which were due to adverse effects of season prevailing during the experimental period. Eevuri and Putturu (2013) found that aloe vera supplementation in broilers decreased the mortality rates as compared to control group. The reduced mortality rate in present experiment may be due to anti-bacterial, anti-oxidant, immune-modulatory, anti-viral and anti-inflammatory properties of aloe vera which have attributed to better immunity in supplemented groups.

Cost of production

The cost of production of broilers, considering the cost of chicks and feed consumed up to six weeks of age, reared under different treatments is presented in Table 7. At the start of experiment there were sixty birds in each treatment group. The cost of chicks was calculated on the basis of birds survived at the end of experiment under each treatment. The initial cost of one-day-old broiler chicks was ₹ 32.00 per chick. This cost raised to the tune of ₹ 33.68 (T_1), 33.10 (T_2), 33.10 (T_3) and 32.54 (T_4) respectively. Feed cost was calculated to be ₹ 29.82 per kg of feed. Aloe vera was purchased @ of ₹ 5/Kg. The total cost of production of birds up to six weeks of age, based upon the cost of chicks, cost of feed consumption as well as cost of aloe vera consumed up to this age, was found to be ₹ 176.29 (T_1), 170.44 (T_2), 170.55 (T_3) and 168.28 (T_4). The cost per kilogram of live weight and drawn weight ranged from ₹ 77.09 (T_3) to 80.48 (T_1) and ₹ 112.75 (T_4) to 121.52 (T_1), respectively.

Table 6: Effect of aloe vera on mortality of broilers

Treatments	Age in weeks						Total Mortality	Mortality Percentage
	I	II	III	IV	V	VI		
T_1 (Control)	1	—	—	—	1	1	3	5.00
T_2 (aloe vera powder in feed @ 0.5 %)	1	—	—	—	—	1	2	3.33
T_3 (aloe vera gel in feed @ 2 %)	1	—	—	1	—	—	2	3.33
T_4 (Fresh aloe vera juice in drinking water @ 2 %)	—	—	—	—	—	1	1	1.66
Total	3	0	0	1	1	3	8	3.33

Table 7: Cost of production of broilers under different treatments at the end of experiment

S. No.	Particulars	Treatments			
		T_1	T_2	T_3	T_4
1	Live body weight at 6th week of age (g)	2190.34	2165.07	2212.38	2168.32
2	Drawn percentage	66.23	66.96	67.54	68.83
3	Total feed consumption up to 6th week of age (g)	4782.60	4438.00	4581.60	4468.30
4	Feed cost (₹) per kilogram feed	29.82	29.82	29.82	29.82
5	Total feed cost (₹)	142.617	132.341	136.623	133.244
6	Chick cost (₹)	33.68	33.10	33.10	32.54
7	Cost of aloe vera (₹)	0	5.00	0.83	2.50
8	Total cost of production up to six week (₹)	176.297	170.441	170.553	168.284
9	Cost of Production/Kg of live body weight	80.488	78.723	77.090	77.610
10	Cost of Production/Kg of drawn weight	121.528	117.567	114.139	112.756
11	Net Savings (₹)/Kg of Drawn weight	0	3.96	7.39	8.77

The effect of supplementation of aloe vera depicted that the cost of production of live weight (₹ /kg) at six weeks of age was reduced as much as ₹ 1.76 (T_2), 3.39(T_3) and 2.87 (T_4) as compared to T_1 (control). The corresponding figures of reduction in cost of production of drawn weight (₹ /kg) were ₹ 3.96 (T_2), 7.39 (T_3) and 8.77 (T_4) as compared to T_1 (control).

Aloe vera treated groups were found to be beneficial in terms of net profit. Net savings/Kg of drawn weight was highest in aloe vera supplemented in the form of juice followed by gel and powder forms, respectively. Cost of production of birds given aloe vera supplemented diet was lower than those of control group birds due to better performance and feed efficiency. Similar to these results cost of production was lower in aloe vera treated groups as compared to control group (Moorthy *et al*., 2009; Eevuri and Putturu 2013). This study has showed that the supplementation of broilers diet with aloe vera may offer benefits to the poultry industry by reducing the cost of production of live weight as well as drawn weight.

CONCLUSION

The present study revealed that aloe vera supplementation significantly improved the EE and PE of broilers. So, it can be concluded that these values (PI, EE, PE, PN, mortality and cost of production) although calculated indirectly but were in accordance with the facts that aloe vera supplementation improves feed utilization, facilitate better nutrient absorption, strengthen the immune system of broiler chicken and also reduces the cost of production.

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