



Original Research

Effect of Dietary Supplementation of Aloe vera and *Lactobacillus acidophilus* on Growth Performance, Nutrient Utilization and Carcass Characteristics Of Broiler Birds

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Abstract

A study was conducted to evaluate the effect of Aloe vera and *Lactobacillus acidophilus* on performance of broiler birds. Two hundred one day old broiler chicks were randomly distributed into five treatment groups: 1) basal diet without any supplementation (control); 2) basal diet with BMD @0.5g/kg of feed (AB); 3) basal diet with 0.5% Aloe vera powder (AV); 4) basal diet with *Lactobacillus acidophilus* (LAB) and 5) basal diet with 0.5% Aloe vera plus *Lactobacillus* (ALVAB). Final body weight was tended to be higher ($P=0.08$) in treatment groups than control. Improved feed conversion efficiency ($P<0.05$) observed in all AV, LAB and ALVAB groups compared to the control. Significant differences ($P>0.05$) were not observed on the digestibilities of nutrients among the treatments. Carcass characteristics showed no significant difference between the treatment groups. It is concluded that aloe vera (0.5%) and *Lactobacillus acidophilus* can be used as an alternative to antibiotic growth promoters to improve performance of broiler.

Key words: Aloe vera, Broiler Birds, Carcass Traits, *Lactobacillus acidophilus*, Nutrient Utilization, Performance

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Introduction

Antibiotic feed additive as growth promoters have long been supplemented to poultry feed to improve the general performance and prevent some specific intestinal pathology (Hassan *et al.*, 2010). However, due to emergence of microbial resistance to antibiotics the European Commission (EC) decided to ban, the



marketing and use of antibiotics as growth promoters in feed since 2006. Such situation has compelled the researcher to use alternatives to antibiotic growth promoter like organic acids, enzymes, probiotics, prebiotic, herbs, essential oil and immunostimulants as feed additives in poultry (Jackson *et al.*, 2004). Among the alternatives phytobiotics and probiotics have the potential to improve the production performance of poultry.

Probiotics are live microbial feed supplements which beneficially affect the host animal by improving its intestinal microbial balance, feed conversion efficiency, weight gain and reduce mortality or a live microbial feed that is beneficial to health (Patterson and Burkholder, 2003). Aloe vera (*Aloe barbadensis*) is a well-known medicinal herb used for commercial and therapeutic properties in many parts of the world. Aloe vera gel contains compounds like accemannan with proven antibacterial, antiviral, antifungal, antioxidant, anti-inflammatory, anti-diabetic, immunomodulatory, and wound healing properties (Boudreau and Beland, 2006). Studies have reported that there is increase *Lactobacillus* count by supplementing diets with Aloe vera due to its prebiotic properties (Erdogan *et al.*, 2010). Very few studies have been conducted to explore the symbiotic properties of Aloe vera and *Lactobacillus spp.* in broiler birds. Therefore, this experiment was conducted to evaluate the effect of aloe vera and *Lactobacillus acidophilus* as alternative to antibiotic growth promoters on performance, nutrient utilization and carcass traits in broiler birds.

Materials and Methods

Location and Climate

This experiment was conducted at Instructional Livestock Farm Complex, Department of Animal Nutrition, College of Veterinary Sciences & Animal Husbandry, Selesih, Aizawl, Mizoram. Permission for using the animals for the experiment was duly taken from Institutional Animal Ethics committee (IAEC) constituted as per CPCSEA rules laid down by Government of India.

Experimental Birds, Experiment Design & Diet

Two hundred one day old broiler chicks were randomly distributed into five treatments groups with five replicates (n=5) per group. Each replicate contained 8 chicks. Five dietary groups consisted of- 1) basal diet as per BIS standard, 2007 without any supplementation (control); 2) basal diet with BMD (Bacitracin methylene disalicylate) 0.5g/kg of feed (AB); 3) basal diet with 0.5% aloe vera powder (ALV); 4) basal diet with *Lactobacillus acidophilus* (LAB) and 5) basal diet with 0.5% aloe vera powder plus *Lactobacillus acidophilus* (ALVLB). The chicks were reared group wise under the similar management condition and health care. The birds were vaccinated against Ranikhet and infectious bursal disease at the 7th and 14th day respectively. Three types of standard broiler diets have been prepared i.e. broiler pre-starter (1-7 days of age), broiler starter (8-21 days of age) and broiler finisher (22-42 days of age) as per BIS (2007) specification (Table 1). The natural pure Aloe vera powder was purchased from local market. Premix of

Aloe vera powder and culture of *L. acidophilus* were added to basal diet and mixed thoroughly to obtain different treatment diets.

Table 1: Ingredient and nutrient composition of diets fed to experimental broiler chicken at different period

Ingredients Composition(kg/100g feed as fed)	Pre-starter	Starter	Finisher
Maize	59.14	61	64.8
Soyabean meal	33.6	30.71	26.2
Fish Meal	3.8	4.3	3.5
Rice bran oil	0	0.8	2.21
Dicalcium phosphate	1.24	0.9	0.9
Sodium Chloride	0.3	0.3	0.3
Limestone powder	1.12	1.25	1.21
Methionine	0.27	0.27	0.27
Lysine	0.22	0.11	0.12
Threonine	0.045	0.045	0.045
Cocciostat	0.05	0.05	0.05
Toxin binder	0.05	0.05	0.05
Trace mineral mixture	0.05	0.05	0.05
Vitamin premix	0.015	0.015	0.015
Choline chloride	0.05	0.05	0.05
Antioxidant	0.01	0.01	0.01
Total	100	100	100
Dry matter (%)	89.55	90.81	92.02
Nutrient Composition (DM basis)			
Crude protein (%)	23.05	22.02	20.38
Crude fibre (%)	2.86	3.52	3.92
Ether extract (%)	3.1	3.5	3.48
Total ash (%)	5.9	7.09	6.48
Nitrogen free extract (%)	65.06	63.93	65.8
Calcium (%)	1.3	1.62	1.29
Phosphorous (%)	0.86	0.96	0.99
ME (Kcal/kg)*	3062.22	3116.4	3184.5

* Calculated value

Preparation of *Lactobacillus acidophilus* Culture

The probiotic product (*Lactobacillus acidophilus*) was procured from National Dairy Research Institute, Karnal, India. From the stock culture, a loop full of *Lactobacillus acidophilus* was transferred aseptically to glycerol solution for maintaining the micro-organism culture by incubating for 24 hrs at 37°C. The bacterial culture was kept in deep freeze. Bacterial colony was grown in MRS agar and was suspended in PBS solution and concentration was checked by following McFarland standards. Minimum concentration of *Lactobacillus acidophilus* was maintained at 10⁶CFU/ g of feed.

Measurement of Performance Traits

Body weight of all the broiler chicken was measured at day 1 and subsequently at weekly interval. Feed intake per bird was calculated subtracting the residual feed from the amount of feed offered. Average daily feed intake (ADFI) & feed conversion ratio (FCR) was calculated accordingly. Mortality was recorded daily and PM examination was done to find out the exact cause of death. European production efficiency index (EPEI) was calculated with the following formula-

$$EPEI = \frac{LW(Kg) \times LA(\%)}{SA(days) \times FCR(kg)} \times 100$$

Where, LW (kg) = Live weight at the end of the rearing period, LA (%) = Livability (number of birds alive at the end of the rearing period relative to the number of chicks placed), SA (days) = Slaughter age of chicks, FCR (kg) = Cumulative feed intake (kg) / total weight gain (kg).

Measurement of Digestibility of Nutrients

Apparent digestibility of dry matter and other nutrients was measured at the end of feeding trail i.e. at d 42. Five chickens of each group was randomly selected and housed in individual pen. The faecal sample in each pen was collected daily over a period of three days. Feed and faecal samples were processed for chemical analysis.

Measurement of Carcass Traits

At the end of the experiment representative birds from each group were selected and then slaughtered. Live weights, plucked weight and dressed weights have been taken for each of the birds. Organs- liver, lungs, heart, kidneys, etc., were removed and weighed individually.

Sensory Evaluation

Cuts obtained from the breast region from carcasses of broiler birds of different groups were cooked under the same temperature and pressure and subjected to sensory evaluation on an 8 point hedonic scale for various sensory attributes of appearance and colour, flavor, texture, juiciness and overall acceptability.

Chemical Analysis of Feed and Faeces

Feed and faeces were processed and analyzed for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), total ash (TA) and nitrogen free extract (NFE) as per procedure of AOAC (2000). Calcium and phosphorous content by following the procedure of Talapatra *et al.* (1940) and AOAC (2000) respectively.

Statistical Analysis

The data was analyzed by one way analysis of variance (ANOVA) using SPSS (1997) by following completely randomized design. The test was employed for identifying the significant differences amongst the different treatments. Probability values less than 0.05 is considered to be statistically significant and the values $P \leq 0.1$ was declared as trend.

Results and Discussion

Feed Intake, Average Daily Gain and Feed Efficiency

Final body weight was not significantly differed ($P > 0.05$) among the treatments (Table 2). However, Body weight was tended to be higher ($P = 0.08$) in AB, ALV, LAB, ALVLB supplemented groups compared to control group. The findings are similar with Mountzouris *et al.* (2007) who also found that average daily weight gain of chickens fed probiotics was significantly increased during the first 3 weeks but not during the 4–6th weeks of growth.

Table 2: Effect of aloe vera and probiotic (*L. acidophilus*) supplementation on average daily gain (ADG; g/h), average daily feed intake (ADFI; g/d) and Feed conversion ratio (FCR; g gain/g feed intake) and EPEI in broiler chicken (1-42 days of age)

Attributes	Treatments						P VALUE
	Control	AB	ALV	LAB	ALVLB	SEM	
Initial wt	43.68	41.68	43.85	45.63	43.09	0.45	0.078 ^{NS}
Final wt	1814.1	1894.1	1894.7	1899.8	1888.9	11.5	0.080 ^{NS}
ADG(g/d)							
d 1-14	18.18±0.42 ^{ab}	17.61±0.43 ^{ab}	17.11±0.18 ^a	16.97±0.37 ^a	18.69±0.22 ^b	1.24	<0.01
d 15-28	38.75±2.21	41.78±0.34	42.45±0.32	42.19±0.55	41.72±0.22	0.47	0.126
d29-42	69.52±2.29	72.92±2.27	72.64±1.30	73.27±1.23	71.42±2.04	0.82	0.63 ^{NS}
d 1-42	42.15±0.39	44.10±0.74	44.06±0.39	44.14±0.44	43.95±0.67	0.27	0.08 ^{NS}
ADFI(g/d)							
d 1-14	22.50±0.45 ^{ab}	22.28±0.18 ^{ab}	21.87±0.09 ^a	22.84±.08 ^{bc}	23.31±.06 ^c	0.136	0.003 [*]
d 15-28	74.29±0.52	73.66±0.12	73.73±0.10	74.15±0.11	74.18±.07	0.48	0.310 ^{NS}
d 29-42	138.27±0.39	137.90±0.12	137.66±0.06	137.43±0.19	137.58±0.08	0.1	0.078 ^{NS}
d 1-42	78.35±.40	77.94±0.05	77.75±0.05	78.14±0.08	78.35±0.04	0.27	0.145 ^{NS}
FCR							
d 1-14	1.23±0.03	1.26±0.03	1.28±0.01	1.35±0.03	1.24±0.01	0.015	0.065
d 15-28	1.93±0.06 ^b	1.76±0.01 ^{ab}	1.73±0.01 ^a	1.75±0.02 ^a	1.77±0.009 ^{ab}	0.02	0.03 [*]
d 29-42	2.00±0.07	1.89±0.05	1.89±0.03	1.87±0.03	1.93±0.05	0.02	0.521 ^{NS}
d 1-42	1.86±0.01 ^b	1.76±0.02 ^a	1.76±0.01 ^a	1.77±0.01 ^a	1.78±0.02 ^a	0.02	0.033 [*]
EPEI							
day 1-42	225.72	241.39	238.15	241.14	235	3.57	0.66 ^{NS}

NS=Non significant, ^{abc}means with different superscript in the same row differ significantly; AB=Antibiotic; ALV=Aloe vera; LAB=L. acidophilus; ALVLB=Aloe vera & L. acidophilus; d=Day; EPEI= European Production Efficiency Index.

In our present study, comparatively higher body weight was observed in LAB group at day 42. This could be due to alteration of intestinal microbial status, suppression of pathogenic microbial growth and enhancement of digestion and utilization of nutrients in broiler supplemented with probiotic (Yeo *et al.*, 1997). Better growth rate in ALV supplemented group may be due to presence of acemannan- a mannose polymer having antibacterial, antiviral, antifungal, antioxidant, anti-inflammatory and immunomodulatory, properties (Boudreau and Beland, 2006). The average daily gain (g/h/d) during the overall experimental trail d (1-42) was not affected ($p>0.05$) by the dietary treatment provided to AB, ALV, LAB and ALVLB groups compared to control group. ADG was tended to be higher ($P=0.08$) in AB, ALV, LAB, ALVLB supplemented group as compared to control. The similar observation was reported by Sinurat *et al.* (2002) who reported that aloe gel and its extract did not influence body weight gain and feed consumption of broiler significantly. In contrast, Mmereole (2011) who observed significantly higher ($P<0.05$) body weight was observed in the birds fed diet containing aloe vera than the birds fed control diet. In our study it was also observed that LAB supplementation tended to increase ($P=0.08$) the ADG and final body weight of the broiler birds. This finding is in agreement with the other studies (Kalavathy *et al.*, 2003; Song *et al.*, 2014). Song *et al.* (2014) reported significant increase in body weight gain in broiler fed with *Lactobacilli* and *Bifidobacteria spp.*

The average daily feed intake (g/h/d) during the overall experimental trial (d 1-42) was 78.35, 77.94, 77.75, 78.14, and 78.35 for Control, AB, ALV, LAB and ALVLB groups respectively. Feed intake during the entire experimental period (1-42 d) was similar ($P=0.145$) among the treatments (Table 3). However, the average daily feed intake (g/h/d) (ADFI) was significantly reduced ($P<0.003$) in ALV group when compared to Control, AB, ALVLB group from 1-14 d of age. This finding is in congruency with Yousefi and Karkoodi (2007) who also reported that feed consumption was not affected by the dietary probiotic supplementation. Eevuri and Putturu (2013) who reported that turmeric, tulsi, amla and *aloe vera* preparations increased the body weight gain feed efficiency and decreased the feed intake.

Table 3: Apparent digestibility of nutrients (per cent) in experimental birds during the digestion trial

Digestibility Coefficient (%)	Treatments						P Value
	Control	AB	ALV	LAB	ALVLB	SEM	
DM	81.83	83.69	83.85	84.65	84.19	0.35	0.103 ^{NS}
CP	83.94	84.93	85.45	86.31	85.84	0.29	0.090 ^{NS}
EE	81.3	82.65	81.65	83.67	83.58	1.07	0.092 ^{NS}
CF	56.88	56.73	54.12	62.44	60.55	0.5	0.485 ^{NS}
NFE	83.25 ^a	85.76 ^b	85.75 ^b	86.67 ^b	86.62 ^b	0.38	0.016 [*]

NS=Non significant; SEM: Standard error of means. AB=Antibiotic; ALV= Aloe vera; LAB=L. acidophilus; ALVLB=Aloe vera & L. acidophilus

On contrary to our findings, Olupona *et al.* (2010) and Amini and Vali (2016) reported increased feed intake in groups which were treated by aloe vera gel dissolved in water (15, 20, 25 and 30 cm³/dm³) as body weight gain. Zhang *et al.* (2014) reported an increased feed intake in chicken fed multi strain probiotics compared with that control group fed basal diet.

The FCR during the overall experimental period (d 1-42) was 1.86, 1.76, 1.76, 1.77 and 1.78 for control, AB, ALV, LAB and ALVLB groups respectively with significant difference ($P < 0.05$) among the treatment groups. An improved FCR was observed in ALV and LAB compared to control. The present observation was similar to Mountzouris *et al.* (2010) who reported improved FCR without significant difference in feed intake by in probiotic supplemented broiler birds. Namagirilakshmi (2005) also reported that supplementation of aloe vera, probiotic and turmeric in chicken diet showed better feed efficiency. AB, ALV, LAB and ALVLB supplemented group was comparatively improved FCR but non-significant ($P > 0.05$) as compared to control group during overall period (d 1-42).

European Production Efficiency Index (EPEI) of AB, ALV, LAB and ALVLB supplemented group was comparatively higher but non-significant ($P > 0.05$) as compared to control group during overall period (d 1-42). It is a tool for measuring the production performance in broiler birds. The factors involved in the EPEI are BWG, FCR and viability is considered universal measures for evaluating broiler performance. Comparatively better EPEI in LAB group could be due to fact that probiotics have a good impact on the poultry performance (Mountzouris *et al.*, 2007), improve microbial balance, synthesize vitamins (Fuller, 1989), decrease pH and release bacteriocins (Rolfe, 2000), improve feed consumption in layers and broilers (Nahashon *et al.*, 1994).

Nutrient Utilization

The digestibility of dry matter (DM) and other nutrient such as crude protein (CP), crude fibre (CF), ether extract (EE) were not significantly different ($p > 0.05$) among the treatment groups except NFE (Table 4). The digestibility of nitrogen free extracts (NFE) which was significantly higher ($P < 0.05$) in AB, ALV, LAB and ALVLB group when compared to Control. However, digestibility of CP was tended to be higher ($P = 0.09$) in all the dietary treatment as compared to control. The better digestibility of nutrients due to LAB supplementation could be due to established fact that probiotics alter pH of gastrointestinal tracts and microbial status to favor an increased activity of the intestinal enzymes and digestibility of nutrients (Dirck, 1989). However, Li *et al.* (2008) reported that supplementation of commercial probiotic (AgiPro A100) in broiler diet increased digestibility of dry matter (DM) by 12.4% at day 42. Tariq *et al.* (2015) noted that apparent total tract digestibility of DM, CP and EE was significantly higher ($P < 0.05$) in Aloe vera and clove supplemented group in comparison to control group. Zhang *et al.* (2014) also observed that the apparent ileal digestibility (AID) of essential amino acids was improved in birds fed a maize-soybean-based diet

supplemented with a low dose (1 to 2×10^2 cfu/g) of a multi-strain commercial probiotic (Probian) containing *L. acidophilus*, *B. subtilis* and *C. butyricum*.

Carcass Characteristics

Carcass characteristics were not affected by the dietary treatments (Table 4). The dressing percentage of ALV was numerically higher compared to other treatment groups however no significant difference was observed amongst all the groups. The present observation is not in agreement with Durrani *et al.* (2006) who reported the significantly higher dressing percentage in the group receiving 10ml /l aqueous extract of aloe gel (10% w/v) but other parameters like abdominal fat, liver, heart and gizzard weight were not affected. The relative weight of different cut parts (as % of slaughter body weight) have been presented in the Table 4.

Table 4: Effect of aloe vera and probiotic (*L. acidophilus*) supplementation on carcass characteristic (as percentage of slaughter body weight) of the experimental birds

Attributes	Treatments						P value
	Control	AB	ALV	LAB	ALVLB	SEM	
Slaughter b. wt	1796.7	1915	1900	1910	1926.7	35.2	0.82 ^{NS}
Eviscerated carcass wt	1204.3	1303.33	1323.3	1305	1306.7	31.58	0.82 ^{NS}
Dressing%	66.86	67.94	69.68	68.34	67.69	0.66	0.807 ^{NS}
Relative parts(as % slaughter body weight)							
Breast %	20.73	20.02	25.47	23.75	22.81	0.75	0.112 ^{NS}
Back %	13.09	14.96	13.15	15.71	13.89	0.56	0.566 ^{NS}
Thigh%	10.66	8.75	10.91	10.84	10.02	0.33	0.218 ^{NS}
Drumstick %	10.58 ^{bc}	9.25 ^a	10.01 ^{ab}	11.25 ^c	9.33 ^a	0.24	0.011 [*]
Wings%	7.79	7.5	6.75	7.86	7.8	0.25	0.68 ^{NS}
Neck %	4.14	3.39	3.01	3.21	3.79	0.18	0.32 ^{NS}
Liver %	1.76	1.65	1.72	2.16	1.53	0.1	0.41 ^{NS}
Gizzard %	2.4	1.83	2.15	2.12	2.33	0.08	0.17 ^{NS}
Heart %	0.46	0.51	0.7	0.88	0.6	0.06	0.23 ^{NS}
Giblet %	4.64	4	4.58	5.17	4.47	0.15	0.20 ^{NS}
Abdominal fat %	1.24	1.41	1.39	1.34	1.37	0.02	0.35 ^{NS}
Bursa %	0.05	0.046	0.066	0.053	0.056	0.002	0.23 ^{NS}

NS=Non significant; SEM: Standard error of means. AB=Antibiotic; ALV= Aloe vera; LAB=L. acidophilus; ALVLB=Aloe vera & L. acidophilus

On statistical analysis it was observed that there was significant difference ($P > 0.05$) in drumstick and LAB have highest percent among the different treatment groups. The present observation is in agreement with Hossain *et al.* (2012) who found addition of probiotics increased breast meat absolute and relative weight. Tariq *et al.* (2015) observed that giblet weight, other cut up parts and composition of breast, thigh and drumstick of Japanese quails supplemented with aloe vera were significantly differed from control group.

Sensory Evaluation

Effect of aloe vera and probiotic supplementation on organoleptic test changes in broiler chickens is presented in Table 5. On statistical analysis it was revealed that there was no significant difference ($p>0.05$) among the various experimental groups of birds when organoleptic test was done by using eight point Hedonic scale tests. Our findings are similar with Lodii *et al.* (2000) who found that neither probiotic nor antibiotic affected sensory characteristic (intensity of flavor, tenderness, juiciness and overall acceptability of breast and leg meat of broiler birds. Puvaca *et al.* (2013) reported the beneficial effect of phytobiotic compounds on meat quality and safety, which might be due to presence of antimicrobial and antioxidants properties in these compounds. Mahajan *et al.* (2000) reported that the scores for the sensory attributes i.e. appearance, texture, juiciness and acceptability of meat parts were significantly ($P<0.01$) improved in the probiotic (Lacto-sac) fed group.

Table 5: Effect of aloe vera and probiotic (*L. acidophilus*) supplementation on organoleptic test changes in broiler chicken

Attributes	Treatments						P value
	Control	AB	ALV	LAB	ALVLB	SEM	
Appearance & Colour	7.33	7.33	7	7.25	7.5	0.1	0.651 ^{NS}
Flavour	6.83	7.16	6.96	7.16	7.11	0.1	0.851 ^{NS}
Texture	6.83	7.16	6.83	6.91	7	0.56	0.852 ^{NS}
Juiciness	6.5	6.66	6.33	6.91	6.75	0.17	0.866 ^{NS}
Overall acceptability	6.83	6.76	6.63	6.85	6.91	0.07	0.811 ^{NS}

NS=Non significant; AB=Antibiotic, ALV= Aloe vera; LAB=L. acidophilus; ALVLB=Aloe vera & L. acidophilus

Economics of Production

The return over feed cost (ROFC) (Rs/ bird) realized under different feed supplemented groups were found to be 208.74, 220.57, 209.65, 219.6, 202.46 for Control, AB, ALV, LAB and ALVLB respectively. ROFC (Rs/ kg live bird) was Rs 113.42, Rs 115.24, Rs109.08, Rs113.98 and Rs105.6 for Control, AB, ALV, LAB and ALVLB respectively.

Conclusion

Considering the overall performance of broiler birds in terms of body weight gain and conversion efficiency, it can be concluded that, aloe vera and *Lactobacillus acidophilus* can be used as alternative to antibiotic growth promoters to improve performance in commercial broiler birds.

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References

1. Amini, AG and Vali, N. 2016. Effect of using Aloe vera and Protexin probiotic on performance, carcass characteristic and some blood biochemical in Japanese quail. *Journal of Zoology*, 5(2):39-44.
2. AOAC. 2000. Official methods of analysis, Association of Official Analytical Chemists, 18th Ed. Gaithersburg, Maryland, USA.
3. BIS. 2007. Poultry Feeds Specification, 5th rev. edn. New Delhi, IS 1374.
4. Boudreau, MD and Beland, FA. 2006. An evaluation of the biological and toxicological properties of *Aloe barbadensis* (Miller), Aloe vera. *Journal of Environmental Science Health Conference*, 24:103–154.
5. Dierck, NA.1989. Biotechnology aids to improve feed and feed digestion: Enzymes and fermentation. *Archaeology of Animal Nutrition Berland*,39:241-261
6. Durrani, FR, Mohammad, I, Sultan, A, Suhail, SM, Chand, N and Durrani, Z. 2006.Effect of different levels of feed added turmeric (*Curcuma longa*) on the performance of broiler chicks. *Journal of Agricultural and Biological Science*, 1: 9-11.
7. Erdoğan, Z, Erdoğan, S, Aslantaş, Ö and Çelik, S. 2010. Effects of dietary supplementation of synbiotics and phytobiotics on performance, caecal coliform population and some oxidant/antioxidant parameters of broilers. *Journal of Animal Physiology and Animal Nutrition*, 94: 40–48.
8. Eevuri, TR and Putturu, R. 2013. Use of certain herbal preparation in broiler feeds. *Veterinary World*. 6(3): 172-179.
9. Fuller, R. 1989. Probiotics in man and animals. *Journal of Applied Bacteriology*, 66(5): 365–378.
10. Hassan, M, Kjos, M, Nes, I, Diep, D and Lotfipour, F. 2010. Natural antimicrobial peptides from bacteria: characteristics and potential applications to fight against antibiotic resistance. *Journal of Applied Microbiology*, 113(4):723–736.
11. Hossain, ME, Kim, GM, Lee, SK and Yang, CJ. 2012. Growth performance, meat yield, oxidative stability, and fatty acid composition of meat from broilers fed diets supplemented with a medicinal plant and probiotics. *Asian Australasian Journal of Animal Science*, 25:1159.
12. Jackson, ME, Geronian, K, Knox, A, McNab, J and McCartney, E. 2004. A dose-response study with the feed enzyme β -mannanase in broilers provided with corn-soybean meal based diets in the absence of antibiotic growth promoters. *Poultry Science*, 83:1992-1996.
13. Kalavathy, R, Abdullah, N, Jalaludin, S and Ho, YW.2003. Effects of *Lactobacillus* cultures on growth performance, abdominal fat deposition, serum lipids and weight of organs of broiler chickens. *British Journal of Poultry Science*, 44(1): 139–144.
14. Li, LL, Hou, ZP, Li, TJ, Wu, GY, Huang, RL, Tang, ZR, Yang, CB, Gong, J, Yu, H and Kong, XF. 2008. Effects of dietary probiotic supplementation on ileal digestibility of nutrients and growth performance in 1- to 42-day-old broilers. *Journal of Science and Food Agriculture*, 88(1):35–42.
15. Loddi, MM, Gonzalez, E, Takita, TS, Mendes, AA, Roca, RO and Roca, R. 2000.Effect of the use of probiotic and antibiotic on the performance, yield and carcass quality of broilers. *Revolutionary BrazilianZootechnolgy*, 29:1124-1131.
16. Mahajan, P, Sahoo, J and Panda, PC. 2000. Effect of probiotic (Lacto-Sacc) feeding, packaging methods and seasons on the microbial and organoleptic qualities of chicken meat balls during refrigerated storage. *Journal of Food Science Technology Mysore*, 37: 67-71.
17. Mountzouris, KC, Tsirtsikos, P, Kalamara, E, Nitsch, S, Schatzmayr, G and Fegeros, K. 2007. Evaluation of the efficacy of a probiotic containing *Lactobacillus*, *Bifidobacterium*, *Enterococcus* and *Pediococcus* strains in promoting broiler performance and modulating cecalmicroflora composition and metabolic activities. *Poultry Science*, 86(2): 309–317.
18. Mountzouris, K, Tsirtsikos, P, Palamidi, I, Arvaniti, A, Mohnl, M, Schatzmayr, G and Fegeros, K. 2010. Effects of probiotic inclusion levels in broiler nutrition on growth performance, nutrient digestibility, plasma immunoglobulins, and cecalmicroflora composition. *Poultry Science*, 89(1): 58–67.

19. Mmereol, FUC. 2011. Evaluation of the Dietary Inclusion of Aloe vera as an Alternative to Antibiotic Growth Promoter in Broiler Production. *Pakistan Journal of Nutrition*, 10:1–5.
20. Moorthy, M, Mehala, C, Saravanan, S and Edwin, SC. 2009. Aloe vera in White Leghorn Layer Diet. *International Journal of Poultry Science*, 8: 706-709.
21. Nahashon, SN, Nakne, HS, Mirosh, LW. 1994. Production variables and nutrient retention in single comb white leghorn laying pullets fed diets supplemented with direct-fedmicrobials. *Poultry Science*, 73: 1699–1711.
22. Olupona, JA, Omotoso, OR, Adeyeye, AA, Kolawole, OD, Airemionkhale, AP and Adejinmi, OO. 2010. Effect of aloe vera juice application through drinking water on performance, carcass characteristics, and hematology and organoleptics properties in broilers. Proceedings of 98th Annual Meeting of Poultry Science Association, 88:42-43.
23. Patterson, JA and Burkholder, KM. 2003. Application of prebiotics and probiotics in poultry production. *Poultry Science*, 82, 627–631.
24. Puvaca, N, Stanacev, V, Glamocic, D, Levic, J, Peric, L, Stanacev, V and Mili, D. 2013. Beneficial effect of phytoadditives in broilers nutrition. *World's Poultry Science Journal*, 69:27-34.
25. Rolfe, RD. 2000. The role of probiotic cultures in the control of gastrointestinal health. *Journal of Nutrient*, 130:3965–4025.
26. Sinurat, AP, Purwadaria, T, Togatorop, MH, Pasaribu, T, Bintang, IAK, Sitompul, S and Rosida, J. 2002. Responses of broilers to Aloe vera forms and levels of bioactive on performances of broilers. *Journal of Ilmu Ternak Dan Veterinary*, 7:69-75.
27. Song, J, Xiao, YL, Ke, LF, Jiao, CH, Hu, QY, Diao, B, Shi, X and Zou, T. 2014. Effect of a probiotic mixture on intestinal microflora, morphology, and barrier integrity of broilers subjected to heat stress. *Poultry Science*, 93(3):581-588.
28. Talapatra, SK, Ray, SC and Sen, KC. 1940. Estimation of phosphorous, chlorine, calcium, magnesium, sodium and potassium in food-stuffs. *Journal of Veterinary Science and Animal Husbandry*, 10: 243-246.
29. Tariq, H, Rao, PV, Raghuvanshi, RS, Mondal, BC and Singh, SK. 2015. Effect of Aloe vera and clove powder supplementation on carcass characteristics, composition and serum enzymes of Japanese quails. *Veterinary World*, 8(5): 664-668.
30. Namagirilakshmi, S. 2005. Turmeric (*curcuma longa*) as nutraceutical to improve broiler performance. *M.V.Sc.*, thesis submitted to Tamil Nadu Veterinary University, Chennai, India.
31. Yeo, J and Kim, K. 1997. Effect of feeding diets containing an antibiotic, a probiotic, or yucca extract on growth and intestinal urease activity in broiler chicks. *Poultry Science*, 76: 381-385.
32. Yousefi M and Karkoodi K. 2007. Effect of probiotic Thepax® and *Saccharomyces cerevisiae* supplementation on performance and egg quality of laying hens. *International Journal of Poultry Science*, 6(1): 52–54.
33. Zhang, J, Yang, C, Cao, G, Zeng, X and Liu, J. 2014. *Bacillus amyloliquefaciens* and its application as a probiotic. *Chinese Journal of Animal Nutrition*, 26(4):863–867.