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Effect of lemongrass (*Cymbopogon citratus*) and *Aloe vera* (*Aloe barbadensis*) as feed additives on performance traits and microbial analysis of Cobb strain chicks

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Abstract

The study was aimed to investigate the impact of lemongrass and *Aloe vera* on broiler growth performance and microbial analysis under normal and heat stress conditions. Total 300 chicks were randomly distributed in different groups of control and treatment (C₁, C₂, T₁, T₂ and T₃) with 3 replicates of each containing 20 chicks. The chicks were acclimatized for 3 days and then induced heat stress from day 4th to the end of the experimental period. Different performance trait parameters were recorded and calculated on weekly interval during experimental period. For microbial analysis, 1 g ileal content was collected from the slaughtered birds and were blended with 9ml of sterilized physiological saline solution. Selective media (Mac Conkey agar) was used for microbial culture and microbial content were analysed on the interval of 3, 28 and 42 days. It was found that the body weight, feed intake and body weight gain showed an increasing trend with the advancement of age. Significantly higher ($p < 0.05$) body weight, feed intake and body weight gain were recorded in the supplemented groups. Significantly lower ($p < 0.05$) Feed Conversion Ratio were recorded in supplemented groups. Between the control groups, lower values of body weight, feed intake and body weight gain were recorded in C₂ group but higher FCR was recorded in C₂ group. An increasing trend was observed in the microbial load of ileum with the advancement of age in C₁ and C₂ groups. When comparing the microbial analysis among different experimental groups, higher values were recorded in C₂ groups followed by C₁ than those of treatment groups on day 28 and 42. Among supplemented groups, lower count observed in T₃.

Keywords: *Aloe vera*, Cobb strain chick, lemon grass, microbial analysis, performance traits

Introduction

Poultry industry plays a significant role in the Indian economy. There is a great demand of chicken meat, as many households prefer chicken meat over other meats like mutton, beef and pork. Cobb strain chicks are regarded as the world's most efficient broiler breed because of lowest cost of live weight produced, superior performance on lower cost feed rations, most feed efficient and excellent growth rate. Recent ban on the use of antibiotic growth promoters has drawn the concerns of rease Commonly known herbs are *Aloe vera*, fenugreek, ashwagandha, moringaoleifera, cinnamon, tulsi, garlic, pepper etc. can be used as natural feed additives and an alternative to antibiotics for poultry^[1].

Lemongrass (*Cymbopogon citratus*) is the feed additive used to enhance the growth and increase the performance in poultry. This grass contains flavonoids, phenolic compounds, terpenoids^[2] and essential oils which may be responsible for its different biological activities such as growth promoter, antibacterial, antidiarrheal, antifungal and antioxidants^[3]. *Aloe vera* (*Aloe barbadensis*) as an additive to broiler chicken feed, has great potentials for improving growth performance, carcass characteristics, haemato-biochemical parameters, intestinal health, immune system response and cost of production.

Chickens being endothermic animals, can maintain a core body temperature up to 41°C through latent and sensible thermal losses. Therefore, when they are exposed to thermal challenges, they are unable to maintain a balance between the heat generation and heat removal from the body, which results in increased core body temperature, leading to

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mortality. The study was aimed to analyze the impact of lemongrass and *Aloe vera* on broiler growth performance and microbial analysis under normal and heat stress conditions.

Materials and Methods

Location of work of experiment: The study was conducted in the Division of Veterinary Physiology and Biochemistry, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology Jammu, R.S. Pura, J&K.

Experimental birds under study and housing: A total of 300 one day old Cobb strain chicks were obtained from Venky's Private Limited, Satwari, Jammu. The experimental outset was started in the month of mid-April and ended in the month of May in their growth phase for a period of 42 days. The birds were reared under standard managemental practices. The rearing of birds was done in starter phase (day 1 to day 14) and grower phase (day 15 to day 42). The chicks were kept on deep litter system with floor area @ 0.5 sq ft per chicks with light intensity of 20 lux and duration of 24 hours of light. The birds were individually weighed before being randomly assigned to 15 pens with 20 birds per pen. The experimental birds were bedded on clean wood shavings and rice hulls with a depth of 8 cm. Chicks were randomly distributed in different groups of control and treatment (C₁, C₂, T₁, T₂ and T₃) with 3 replicates of each containing 20 chicks.

Dietary regime: Diets were formulated according to the NRC recommendations (1994). The composition of diets is shown in Table 1.

Table 1: Composition of the ration

Ingredients	Starter ration (%)	Finisher ration (%)
Maize	60.88	67.5
Soybean meal	30.37	24.5
MBM	5	5
Salt	0.25	0.25
Refined oil	2.7	2.2
Sodium bicarbonate	0.01	0.01
Methionine	0.13	0.09
LSP	0.59	0.29
Vitamin supplement	0.05	0.05
Trace mineral mixture	0.1	0.1

Grouping of the experimental birds: A total of 300 Cobb strain chicks were randomly distributed in five different groups of control (C₁ & C₂) and treatment (T₁, T₂ & T₃) with 3 replicates of each containing 20 chicks

- **Control group (C₁):** Birds falling in this group were given the basal diet and were kept under normal temperature
- **Control group (C₂):** Birds falling in this group were given the basal diet and were kept under heat stress condition.
- **Treatment 1(T₁):** Birds in this group were supplemented with lemongrass @ 15 mg/kg under heat stress condition.
- **Treatment 2(T₂):** Birds in this group were supplemented with *Aloe vera* @ 1.5 mg/kg under heat stress condition.

- **Treatment 3(T₃):** Birds in this group were supplemented with the combination of lemongrass and *Aloe vera* @ 15 mg/kg and 1.5 mg/kg under heat stress condition.

Application of heat stress: The chicks were acclimatized for 3 days after arrival. Heat stress was induced in C₂, T₁, T₂ and T₃ groups from day 4th to the end of the experimental period. Temperature was increased by using tarpaulin sheets and room heaters from 28 °C (4th day) to 48 °C on day 17, then maintained at 48 °C up to 42 days of trial period.

Performance traits: The following recordings and calculations were done on weekly interval during experimental period for recording of performance traits.

Body Weight: All the broilers of each replicate group were weighed individually at the start of experiment and then at weekly intervals up to 42 days of age with the help of monopan balance and expressed in grams (g).

Feed Intake: Feed consumption of experimentally birds under each treatment group was calculated on replicate basis at weekly interval for 6 weeks. For the purpose daily feed offered to different groups were calculated and weighed and their amount was deducted from total feed offer to calculate the net feed intake.

Body weight gain: All the broilers of each replicate group were weighed individually at the start of experiment and then at weekly intervals up to 42 days of age with the help of monopan balance and expressed in grams (g). Body weight gain was then calculated as difference between final body weight gain and initial body weight.

Feed Conversion Ratio (FCR): Feed conversion ratio for a particular period was calculated from feed and take body weight gain of that period by following formulae:

$$\text{Feed conversion ratio} = \frac{\text{Feed consumed}}{\text{Weight gain}}$$

Microbial analysis: Ileal content (1g) was collected from the slaughtered birds and were blended with 9ml of sterilized physiological saline solution. Selective media (Mac Conkey agar) was used for microbial culture and microbial content were analyzed on the interval of 3, 28 and 42 days. *E. coli* colonies were estimated.

Statistical analysis: For all the observed data in the present experiment, the standard statistical procedures have been followed [4]. The data were presented as Mean $\pm$ standard Error. The significant differences of values for different parameters studied were assessed by two-way analysis of variance. The data were analyzed under polynomial contrast and Duncans post hoc multiple comparison at the significance of 0.05 level.

Results

Performance Traits

Body weight

The body weight of control and treatment groups during growth period are presented in Table 2. With the

advancement of age, the body weight showed an increasing trend in all the experimental groups of broilers. When comparing the body weight among different groups, values were significantly higher ($p<0.05$) in T₁, T₂ and T₃ groups than C₁ and C₂ groups from day 7 to day 42. Between three treatments groups (T₁, T₂ and T₃), no significant difference was observed during experimental period except day 14 and 28, were T₂ and T₃ values were significantly higher ($p<0.05$) than T₁ group. Significantly higher ($p<0.05$) body weights were observed in C₁ group as compared to C₂ group from day 28 of experiment.

Feed Intake

The feed intake of Cobb strain broiler chicken of experimental groups during growth period are illustrated in Table 2. With the advancement of age, feed intake increased in all the experimental groups. When comparing feed intake among different groups, significantly higher ($p<0.05$) values were recorded in all supplemented groups on 35 to 42 days of experiment when compared with C₁ and C₂ groups. Between C₁ and C₂ significantly higher ($p<0.05$) feed intake recorded in C₁ from day 28 of experiment. Significant variation was observed between supplemented groups; higher values were recorded in T₃ group, followed by T₂ than those of T₁ at the end of experimental period i.e. on day

35 and day 42 of trail period.

Body Weight Gain

The body weight gain of Cobb strain broiler chicken of experimental groups during their growth period are presented in Table 2. With the advancement of age, the body weight gain was increased experimental groups of broiler chicks (C₁, C₂, T₁, T₂ and T₃). When comparing the body weight gain among different experimental groups. Significantly higher ($p<0.05$) values were recorded in supplemented groups when compared to control groups (C₁ and C₂). Between C₁ (normal control) and C₂ (heat stressed) group, significantly higher ($p<0.05$) body weight gain were recorded in C₁ from day 21 to 35 of trail period.

Feed Conversion Ratio

The Feed Conversion Ratio (FCR) of Cobb strain broiler chicken of experimental groups during growth period is illustrated in Table 2. Significantly higher ($p<0.05$) FCR were observed in C₁ on day 14 followed by C₂ as compared to supplemented groups; whereas, significantly higher ($p<0.05$) FCR were recorded in C₂ group as compared to other experimental groups from day 21 to 42. Among supplemented groups, significantly lower ($p<0.05$) FCR was found in group T₃ from day 28 onwards.

Table 2: Effect of lemongrass and *Aloe vera* supplementation on performance traits (Mean $\pm$ SE) in Cobb strain broilers under normal and heat stress conditions

Days of experiment	01	07	14	21	28	35	42
Groups	Body weight (g)						
C ₁	32.19 $\pm$ 1.14	124.14 $\pm$ 3.36	240.13 $\pm$ 10.85	667.17 $\pm$ 22.07	1098.15 $\pm$ 36.2	1039.27 $\pm$ 2.60	1087.08 $\pm$ 11.95
C ₂	34.15 $\pm$ 1.13	121.10 $\pm$ 2.40	243.25 $\pm$ 8.12	645.14 $\pm$ 21.51	907.20 $\pm$ 30.24	680.20 $\pm$ 7.60	1070.07 $\pm$ 15.67
T ₁	35.20 $\pm$ 1.17	146.23 $\pm$ 4.88	391.17 $\pm$ 13.06	772.18 $\pm$ 25.76	1128.15 $\pm$ 32.65	1294.18 $\pm$ 3.16	1483.11 $\pm$ 11.74
T ₂	36.00 $\pm$ 1.09	149.18 $\pm$ 4.96	444.23 $\pm$ 14.81	761.46 $\pm$ 25.50	1225.11 $\pm$ 31.77	1302.20 $\pm$ 4.40	1501.09 $\pm$ 10.03
T ₃	39.11 $\pm$ 1.10	156.20 $\pm$ 5.20	472.24 $\pm$ 15.14	792.21 $\pm$ 26.40	1286.18 $\pm$ 32.54	1344.17 $\pm$ 8.82	1557.18 $\pm$ 14.93
Feed intake (g)							
C ₁	-	157.12 $\pm$ 5.21	475.17 $\pm$ 11.63	849.21 $\pm$ 7.44	1775.07 $\pm$ 36.29	1810.24 $\pm$ 21.55	1965.15 $\pm$ 11.41
C ₂	-	153.14 $\pm$ 5.11	491.12 $\pm$ 16.36	914.20 $\pm$ 8.46	1327.08 $\pm$ 34.26	1314.20 $\pm$ 23.80	1580.19 $\pm$ 15.68
T ₁	-	155.16 $\pm$ 5.18	473.10 $\pm$ 15.76	921.24 $\pm$ 6.71	1792.06 $\pm$ 38.75	1944.28 $\pm$ 24.82	2323.14 $\pm$ 17.44
T ₂	-	175.13 $\pm$ 1.28	479.15 $\pm$ 12.37	968.26 $\pm$ 10.01	1871.02 $\pm$ 31.37	2394.25 $\pm$ 20.82	2659.11 $\pm$ 12.20
T ₃	-	185.17 $\pm$ 6.19	514.14 $\pm$ 17.13	1248.27 $\pm$ 4.60	1767.04 $\pm$ 33.04	2487.20 $\pm$ 28.30	2797.10 $\pm$ 13.23
Weight gain(g)							
C ₁	-	93.11 $\pm$ 3.48	207.11 $\pm$ 2.12	634.67 $\pm$ 11.54	865.33 $\pm$ 8.86	1153.11 $\pm$ 7.97	1254.71 $\pm$ 6.43
C ₂	-	86.11 $\pm$ 4.52	251.44 $\pm$ 3.13	610.22 $\pm$ 3.63	645.89 $\pm$ 5.86	8.21.89 $\pm$ 2.96	1253.80 $\pm$ 5.60
T ₁	-	111.13 $\pm$ 3.37	356.58 $\pm$ 6.92	737.81 $\pm$ 5.22	943.67 $\pm$ 5.79	1259.69 $\pm$ 2.26	1647.80 $\pm$ 6.73
T ₂	-	113.00 $\pm$ 2.29	408.22 $\pm$ 3.13	734.56 $\pm$ 1.48	917.33 $\pm$ 1.09	1266.53 $\pm$ 1.13	1908.60 $\pm$ 4.79
T ₃	-	116.89 $\pm$ 0.97	433.33 $\pm$ 2.95	754.22 $\pm$ 1.18	937.00 $\pm$ 1.47	1305.80 $\pm$ 1.93	2086.00 $\pm$ 1.50
Feed Conversion Ratio(g)							
C ₁	-	1.24 $\pm$ 0.06	1.97 $\pm$ 0.03	1.22 $\pm$ 0.02	1.61 $\pm$ 0.03	1.52 $\pm$ 0.02	1.49 $\pm$ 0.04
C ₂	-	1.26 $\pm$ 0.02	1.71 $\pm$ 0.02	1.41 $\pm$ 0.01	1.75 $\pm$ 0.01	1.62 $\pm$ 0.02	1.53 $\pm$ 0.02
T ₁	-	1.06 $\pm$ 0.01	1.20 $\pm$ 0.01	1.19 $\pm$ 0.01	1.58 $\pm$ 0.02	1.50 $\pm$ 0.03	1.38 $\pm$ 0.04
T ₂	-	1.17 $\pm$ 0.02	1.07 $\pm$ 0.01	1.26 $\pm$ 0.01	1.52 $\pm$ 0.01	1.51 $\pm$ 0.05	1.36 $\pm$ 0.02
T ₃	-	1.19 $\pm$ 0.03	1.08 $\pm$ 0.01	1.57 $\pm$ 0.02	1.37 $\pm$ 0.02	1.47 $\pm$ 0.01	1.31 $\pm$ 0.02

Mean $\pm$ SE with different superscripts in row wise (a,b,c) and column wise (A,B,C) differ significantly ($p<0.05$).

Microbial analysis

The microbial analysis of Cobb strain broiler chicken in different treatment and control groups in their growth period are represented in Table 3. An increasing trend of *E. coli* count was observed in C₁ and C₂ groups from day 3 to 42. When comparing the microbial analysis among different

groups, higher *E. coli* count was recorded in C₂ (heat stressed) group followed by C₁ (normal temperature) group than those of the treatment groups (T₁, T₂ and T₃) on 28 and 42 day. Between the treatment groups lower values were observed in T₃ group than those of T₁ and T₂ group on day 28 and 42 of study period.

Table 3: Effect of lemongrass and *Aloe vera* supplementation on the *E. coli* count of ileal content (cfu/mlx10⁷) in Cobb strain broilers under normal and heat stress conditions.

Days of experiment ↓ Groups	03	28	42
C ₁	1.7x10 ⁷	6.8 x10 ⁷	8.3 x10 ⁷
C ₂	1.9 x10 ⁷	8.6 x10 ⁷	10.8 x10 ⁷
T ₁	2.0 x10 ⁷	3.9 x10 ⁷	3.1 x10 ⁷
T ₂	1.5 x10 ⁷	3.8 x10 ⁷	2.8 x10 ⁷
T ₃	1.6 x10 ⁷	2.8 x10 ⁷	2.6 x10 ⁷

Discussion

Performance traits

Present study (Table 2) revealed that weekly body weight and feed intake were significantly increased ($p<0.05$) in all the experimental groups of broiler chicks (C₁, C₂, T₁, T₂ and T₃) with the advancement of age. It was found that body weight, feed intake and body weight gain of Cobb Strain broiler chicks were significantly higher ($p<0.05$) in lemongrass, *Aloe vera* and combination of lemongrass and *Aloe vera* supplemented groups, when the values were compared with that of both the control groups during the entire experimental period. Higher body weight and feed intake were observed in C₁ as compared to C₂ group. The lemon grass oil may be used as a growth promoter in broiler production. Many studies have shown positive effects of dietary lemon grass oil on body weight gain. Supplementing the dietary lemon grass oil would stimulate the growth performance of broilers [5]. Mukhtar *et al.* (2012) [6] reported that broilers fed diets supplemented with various levels of lemon grass oil consumed significantly more amount of feed compared to the broilers fed control diet; their results also showed significant improve in body weight gain of broiler fed diets supplemented with lemon grass oil compared with control group. Lemongrass along with organic acid supplementation in marketable layers diet reduced the heat stress [7]. Tekeli (2011) [8] also showed that addition of lemongrass essential oil to broiler chicks resulted better feed conversion ratio when compared with the control group. 1% lemongrass leaf supplementation to broiler diet improved the feed conversion ratio [9]. Our finding was in contrary to the finding of Thayalini *et al.* (2011) [10], who reported that broilers feed with 2% lemongrass leaf supplemented diet, had reduced body weight; supplementation of 1.5% and 3% lemongrass leaf did not affect the feed conversion ratio in quail.

Aloe vera contains a phytochemical substance, which attributes to changes in feed taste and stimulates appetite [11]. Herbs can stimulate appetite and endogenous secretions which, in turn, improve growth performance in poultry [12]. *Aloe vera* enhances the feed intake, endogenous digestive enzyme secretion, antioxidation status and antibacterial properties [13]. Improved growth effects have also been positively correlated with positive effects on intestinal histological features in broilers and other poultry species. *Aloe vera* has the capacity to stimulate growth in broiler chicks, and its effects are similar to those of antibiotic growth promoters [14]. Olupona *et al.* (2010) [15] reported increased feed intake and body weight gain in broilers treated with *Aloe vera* gel dissolved in water. Inclusion of *Aloe vera* induces better feed efficiency and body weight growth in broilers dosed

with water-based infusions of polyherbal plants, including *Aloe vera* @ 20 ml/L of drinking water [16].

Lower FCR indicates higher efficiency. In the present study, it was observed that significantly lower ($p<0.05$) FCR were recorded in supplemented groups (T₁, T₂, T₃) as compared to C₁ and C₂ groups. FCR were found significantly higher ($p<0.05$) in heat stressed control (C₂) group as compared to normal control (C₁) group. Broilers fed a diet containing 1.5% garlic powder and 1.5% *Aloe vera* gel had the greatest final body weights, the highest feed consumption and the lowest FCR [17]. *Aloe vera* supplementation had better feed efficiency in broilers [18].

Microbial analysis

An increasing trend in the *E. coli* count of ileum was observed in C₁ and C₂ group with the advancement of age. As per the present study (Table 3), when comparing the *E. coli* count among different experimental groups, higher values were recorded in C₂ groups followed by C₁ than those of treatment groups on day 28 to 42. Heat stress had a significant impact on gut microbial organisms by increasing the number of *Escherichia* causing dysbiosis [19]. According to Olorunnisola *et al.* (2014) [20] the lemongrass has rich composition of phytochemicals phenols, tannins and flavonoids. One of the main ingredients of lemongrass essential oil is citral, a substance that suppresses the growth of microorganisms. While, Leite *et al.* (2007) [21] observed that lemongrass essential oil contains pinene that has displayed a wide spectrum of antimicrobial activities thereby lowering the population of *E. coli* in broilers.

Aloe vera can improve the intestinal microflora and its ecosystem in broilers' intestines; increase in *Aloe vera* gel in broiler feeds (1.5%, 2%, and 2.5%) leads to decreased *E. coli* count in broilers [22]. Herbs and polysaccharide contained in *Aloe vera* can reduce *E. coli* count by inhibiting their growth [23]. However, the polysaccharide contained in *Aloe vera* i.e. acemannan having prebiotic effect [24].

Conclusion

The current study illustrated that the inclusion of lemongrass and *Aloe vera* in feed significantly enhanced performance traits and lesser microbial load when compared to heat stressed group. The birds fed with combination of lemongrass and *Aloe vera* @ 15 mg + 1.5 mg/kg i.e. T₃ group showed better results than the birds fed *Aloe vera* alone @ 1.5 mg/kg (T₂ group) as compared to the birds fed lemongrass alone @ 15 mg/kg (T₁ group).

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