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Response of Japanese Quail on Supplementing Different *Aloe vera* Forms During Summer

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ABSTRACT

In order to investigate the effect of different dosage and routes of *Aloe vera* (AV) supplementation on Japanese quail performance during summer, 300 day old commercial quail chicks were randomly distributed in 5 groups (n=60) and each group has further 4 replicates of 15 birds. All the birds were fed maize-soya based basal diet, but AV powder @ 0.4 and 0.6% was additionally supplemented as dietary additive in T1 and T2 groups, whereas AV gel was supplemented @ 0.4 and 0.6% in T3 and T4 groups via drinking water. These additives were supplemented for six consecutive weeks. Dry-wet bulb temperature was recorded at 7:30 am and 2:30 pm daily during 42 days experiment for calculating the Temperature humidity index (THI). Growth traits, nutrient metabolizability, intestinal micrometry, carcass traits and economics were studied. THI data revealed that quail birds experienced moderate to very severe heat stress during morning hours, but birds were in very severe heat stress during day time. Although, feed intake (g) showed no difference, but body weight gain (g) and feed conversion ratio (FCR) was found significantly ($P<0.05$) better in AV supplemented groups at sixth week. The metabolizability of different nutrients was found statistically similar. But amongst different intestinal micrometry components, epithelial height of jejunum and ileum was found higher ($P<0.05$) in T3 and T4 than C, with intermediate values for T1 and T2. The cost benefit ratio was found better in T4 followed by T3, T2, T1 and was least in C. It may be concluded that 0.6% AV gel supplementation through drinking water is beneficial to alleviate summer stress in quail birds and is economical.

KEYWORDS: *Aloe vera* gel, *Aloe vera* powder, Cost benefit ratio, Heat stress, Quail

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INTRODUCTION

Quail (Bater) (*Coturnix coturnix*) meat is a delicacy, contains low cholesterol and fetches handsome price (Khalifa et al., 2016). Its rearing requires low capital investment (less feed and space requirement), has fast growth and gives earlier return (ICAR, 2013; Khan et al., 2022). It is the third ranked poultry species, which may be used for augmenting white meat production. But maximum genetic potential of any species can be fully exploited, when they are reared in thermo-comfort zone. The performance of poultry birds is negatively affected during summer months. High ambient temperature coupled with humidity during and around summer season adversely effects poultry growth performance and leads to diminished feed intake, altered nutrient digestion and intestinal morphology, besides effecting bird's physiology (Ranjan et al., 2019; Wasti et al., 2020) and meat quality (Song and King, 2015). Summer stress not also lessen bird's immunity (Hirakawa et al., 2020), but it also increases mortality rate (Lara and Rostagno, 2013). The fast growing strains of broiler bird results in high metabolic load which further warrants heat load (Rajkumar et al., 2015).

Amongst different nutritional strategies, certain nutritional supplements can be exploited to alleviate/curb summer stress (Mishra et al., 2015; Sheikh et al., 2017). Now-a-days, there is increased human concern for safe finished poultry product and phyto-additives addition may fulfil this criterion. *Aloe vera* (AV) is wonder herb/phyto-additive bearing anti-

oxidant properties besides other properties (antimicrobial, antifungal, etc), which can be subjugated to halt summer stress (Nalge et al., 2017). It has low cost and round the year availability. Previous researchers also stated the positive effects of AV supplementation (including summer trials) on poultry performance *viz*. growth, production, blood biochemical parameters (Shokraneh et al., 2016; Nalge et al., 2017 and Singh et al., 2017). But, the advantage of its supplementation relies on many factors like form of use (powder, gel), dosage, route of intake, etc. Considering these facts into account, current study evaluated the efficacy of graded levels of different forms (powder and gel form) of AV supplementation on performance of quail during summer.

MATERIALS AND METHODS

The experiment was conducted at Poultry shed of Division of Animal Nutrition, Faculty Veterinary Sciences & Animal Husbandry, SKUAST-Jammu, R.S. Pura, during summer months (1stApril – 12th May, 2021). Day-old, same hatch 300 Japanese quail chicks were randomly distributed into five different groups (n=60), whereas, every group has further 4 replicates of 15 birds. The birds were raised in deep litter system. Basal diet (starter and finisher diet) is composed of maize, meat bone meal, soybean meal, refined soybean oil, feed additives, trace minerals and vitamin supplements and was formulated as per specifications given by ICAR (2013). Control group is fed basal diet, but T1 and T2 groups were supplemented with 0.4 and 0.6 % AV powder as dietary additive, whereas, T3 and T4 groups were delivered AV gel @ 0.4 and 0.6 % through drinking water for six consecutive weeks.

Preparation/Source of *Aloe vera* (AV) powder and gel

Pure AV powder was provided free of cost by AMORVET (Animal Health Division), Roorkee, Haridwar, Uttarakhand, India. Whereas for AV gel, fresh AV leaves were collected, washed and de-skinned by using sharp edged knife. The gel was separated from the latex part and was blended in the mixer. The crushed pulp so obtained was then squeezed in muslin cloth to collect the liquid product.

Temperature humidity index (THI) calculation

Dry-wet bulb temperature was recorded daily at 7:30 am and 2:30 pm by using Dry-wet bulb thermometer for six consecutive and was installed in shed near window at a height of 1.5 meters. THI was calculated by using the formula of NRC (1971).

$$THI = 0.72 (Tdb + Twb) + 40.6$$

Where, Tdb = dry bulb temperature (!); Twb = wet bulb temperature (!)

Different parameters measured during trial

Feed intake, weight gain and Feed conversion ratio (FCR) was recorded at weekly intervals. A metabolism trial of four successive days was also conducted in cages after 4 weeks of experimental trial. Two birds per replicate, *i.e.*, eight birds from each treatment unit were used for this trial. Samples of feed offered, residual feed and faecal dropping of four successive days after oven drying were thoroughly mixed, powdered and estimated for proximate analysis as per AOAC (2012). Apparent digestibilities of nutrients in all experimental groups were noticed by adopting above mentioned method. These birds were also slaughtered at 42 days of age for collecting specimens of duodenum, jejunum and ileum. After collection, the tissues were fixed in 10% Neutral Buffered Formalin solution (Luna, 1968) for histo-morphological processes. The micrometrical observations were recorded on Haematoxylin and Eosin-stained sections with the help of ocular micrometry duly calibrated with stage micrometer.

Statistical analysis

The data so generated was analyzed as per the method of Snedecor and Cochran (1994). Means of different treatments were also exposed to Duncan multiple range test (DMRT, 1955).

RESULTS AND DISCUSSION

The results revealed that temperature humidity index (THI) of whole trial varied between 84.01-86.68 in the morning period, whereas it ranged between 86.54 - 89.35 for the afternoon period (Table 1).

Table 1. Environmental parameters recorded during the experimental period

Days	THI	
	M*	A+
1	84.0	86.5
7	84.1	87.4
14	85.2	89.0
21	82.7	86.2
28	86.2	88.4
35	86.6	89.3
42	86.0	88.6

M*- observation recorded at 07:30 am, A+ observation recorded at 02:30 pm
THI -Temperature humidity index

A similar trend for THI was observed in both the periods, it increased in a linear fashion up to 14th day, decreased on 21st day, followed by increase in rest of the periods. The morning THI values represents that birds were in moderate heat stress during 1st and 3rd week, severe heat stress in 2nd week, and very severe heat stress in 4th, 5th and 6th week. Whereas, in afternoon period, birds experienced very severe heat stress throughout the trial. Similar scale of THI was used for stress classification of poultry by Habeeb et al. (2018).

The average weekly feed intake (FI; g) showed no difference throughout the experimental period (Table 2).

Table 2. Effect of supplementation of different forms of *Aloe vera* on weekly feed intake (g)

Particulars	Groups				
	C	T1	T2	T3	T4
Week 1	23.0±2.16	25.4±2.38	26.0±1.25	28.0±1.62	29.0±1.93
Week 2	55.2±4.66	64.0±2.93	64.7±4.84	67.9±3.02	69.5±3.62
Week 3	108.7±5.95	106.4±6.37	109.8±6.57	112.1±6.76	116.0±8.97
Week 4	131.0±6.92	128.3±9.48	139.9±11.05	136.4±8.63	136.7±11.74
Week 5	147.5±10.83	150.7±12.23	148.9±13.42	156.0±15.34	150.2±14.99
Week 6	166.7±15.24	188.5±11.61	186.8±12.51	189.4±10.34	185.7±11.85

Similar to our findings, Amini and Vali (2016) reported similar FI (g/d) on supplementing 0.2, 0.4 and 0.6% AV powder as dietary additive in Japanese quails. The present results also corroborate with the conclusions of Islam et al. (2020) and Amber et al. (2021), who also reported that supplementation of AV in drinking water, had no effect on FI of broiler chicken. The body weight at start and end of trial ranges between 7.00-7.04g and 165.75-189.78g, respectively. The average weekly BWG (g) was observed similar in all the experimental groups except at 2nd and 6th week, in which it was found lower ($P<0.05$) in C (24.45 and 13.40 g) than AV fed groups (29.1 and 17.5; 28.9 and 17.5; 31.2 and 17.7; 32.7 and 17.6 in T1, T2, T3, T4 at week 2 and 6, respectively; Table 3).

Table 3. Effect of supplementation of different forms of *Aloe vera* on weekly body weight gain (g)

Particulars	Groups				
	C	T1	T2	T3	T4
Week 1	13.1±0.86	14.5±1.01	14.7±0.86	15.7±0.81	16.4±0.88
Week 2	24.4^{a}±1.24	29.1^{b}±1.43	28.9^{b}±1.84	31.2^{b}±1.12	32.7^{b}±0.99
Week 3	41.9±1.37	40.2±2.39	43.0±1.69	44.6±1.65	44.7±1.92
Week 4	40.2±2.42	38.9±3.84	44.3±2.01	43. ±2.58	43.6±2.71
Week 5	25.5±1.65	27.1±1.23	26.6±1.61	27.5±1.83	27.4±1.54
Week 6	13.4^{a}±1.74	17.5^{b}±0.65	17.5^{b}±0.71	17.7^{b}±0.61	17.6^{b}±0.76

^{ab}Mean with different superscript within a row differ significantly ($P<0.01$)

The above results signified that AV supplementation as powder form and gel form improves BWG, which may be attributed to antimicrobial, antioxidant, anti-stress and growth promotor properties of AV (Nalge et al., 2017). Besides above-mentioned properties, AV is also rich in nutrients (protein, carbohydrates, vitamins, enzymes, minerals, saponins and salicyclic acid) which could have added to the nutritional composition and could be the probable reason for improved BWG (Boudreau and Beland, 2006; Surjushe et al., 2008). Another possible explanation is that AV inhibits pathogenic bacteria and increases beneficial bacteria (*Lactobacillus species*) in the gut (Amber et al., 2021). FCR data was similar for first five weeks, but at week 6, FCR was found significantly higher in C than AV supplemented groups (Table 4).

Table 4. Effect of supplementation of different forms of *Aloe vera* on weekly feed conversion ratio

Particulars	Groups				
	C	T1	T2	T3	T4
Week 1	1.81±0.06	1.74±0.04	1.77±0.04	1.78±0.04	1.76±0.03
Week 2	2.25±0.08	2.20±0.06	2.23±0.03	2.18±0.05	2.12±0.11
Week 3	2.59±0.06	2.65±0.06	2.55±0.08	2.50±0.07	2.58±0.10
Week 4	3.26±0.08	3.32±0.08	3.15±0.12	3.17±0.07	3.12±0.11
Week 5	5.79±0.18	5.54±0.25	5.58±0.22	5.74±0.13	5.44±0.23
Week 6	12.6^{b}±0.59	10.7^{a}±0.45	10.6^{a}±0.30	10.6^{a}±0.28	10.5^{a}±0.31

^{ab}Mean with different superscript within a row differ significantly (P<0.01)

Further, FCR of entire trial was significantly better (P<0.05) in T4 (3.76) than C (3.98) and T1 (3.96) with intermediate values for T2 (3.86) and T3 (3.84). Higher weight gain and well utilization of feed may be the credible reason for better FCR in AV supplemented groups. The present results validate with the findings of Akram et al. (2019), Barman et al. (2019), Islam et al. (2020) and Amber et al. (2021), who too found improved FCR on AV supplementation.

During metabolism trial, metabolizability of different nutrients *viz*. DM, OM, CP, CF, NFE, EE and TA showed non-significant difference (P>0.05) among different treatment groups (Table 5).

Table 5. Effect of supplementation of different forms of *Aloe vera* on digestibility (%) of nutrients

Attributes	Groups				
	C	T1	T2	T3	T4
DM	69.4±1.00	70.4±1.03	71.4±1.23	70.4±1.10	71.0±1.72
OM	70.0±1.21	70.7±1.26	71.1±1.48	71.9±1.51	72.2±1.29
CP	68.8±1.37	69.5±1.19	70.7±1.22	71.1±1.48	71.7±1.50
EE	74.7±2.14	74.9±1.08	76.2±1.06	75.9±1.52	76.2±1.10
CF	48.2±1.08	49.4±1.57	51.2±1.72	51.3±1.82	50.6±1.71
TA	55.3±0.81	57.0±0.75	56.6±0.88	55.7±0.87	56.1±1.24
NFE	71.5±2.04	72.7±1.82	73.7±1.61	71.9±2.00	72.8±3.14

Similar to our results, Barman et al. (2019) reported similar digestibility coefficients of DM, CP, EE and CF, but reported higher (P<0.05) NFE digestibility for 0.5% AV fed group than control. However, Tariq et al. (2015) noted that apparent total tract digestibility of DM, CP and EE was significantly higher in AV supplemented groups than control. No previous literature was available for comparison with regards to AV effect on digestibility during heat stress, so the results cannot be discussed accordingly.

The health condition of intestine can be assessed by structure of its intestinal mucosa (Xu et al., 2003). Changes in intestinal morphology, such as reduced villus height, increased crypt depth may also indicate the presence of toxins and/or abnormality (Darabighane et al., 2011). Duodenal parameters *i.e.,* epithelial height, villi length, glandular epithelial height and gland diameter showed no difference (Table 6).

Table 6. Effect of supplementation of *Aloe vera* on micrometry of different components of small intestine

Attributes	Groups				
	C	T1	T2	T3	T4
			Duodenum		
Epithelial height (µm)	28.6±0.76	31.5±1.92	30.6±0.41	33.1±1.23	35.2±2.68
Length of villi (µm)	606.2±12.88	602.8±24.49	615.7±25.10	611.6±10.12	619.0±10.90
Glandular epithelial height (µm)	21.7±0.96	22.2±0.82	22.2±0.75	23.1±0.63	23.1±0.93
Diameter of glands (µm)	55.5±0.94	54.0±1.44	54.1±0.86	56.4±0.86	57.2±1.46
			Jejunum		
Epithelial height (µm)	24.5^{a}±1.03	26.9^{ab}±0.57	25.0^{ab}±0.67	27.2^{b}±0.91	27.1^{b}±0.62
Length of villi (µm)	422.5±11.55	455.8±22.94	434.4±5.84	456.7±7.68	458.5±16.05
Glandular epithelial height (µm)	19.8±0.85	20.0±0.32	20.1±0.86	20.9±0.76	21.0±0.77
Diameter of glands (µm)	42.2±0.26	44.8±0.98	43.0±0.97	45.0±0.45	45.7±1.52
			Ileum		
Epithelial height (µm)	20.3^{a}±1.10	22.6^{ab}±0.65	22.4^{ab}±0.63	23.8^{b}±0.75	23.2^{b}±0.71
Length of villi (µm)	295.1±22.87	308.7±25.26	298.4±5.65	308.2±3.47	309.0±7.21
Glandular epithelial height (µm)	19.2±0.41	19.8±0.54	19.2±0.42	19.7±0.53	20.3±0.73
Diameter of glands (µm)	38.6±0.78	40.3±1.77	39.2±2.06	40.6±1.00	40.6±0.71

^{ab}Mean with different superscript within a row differ significantly (P<0.05)

Similar to our finding, Shokra et al. (2016) stated that villus height of duodenum was not influenced by AV supplementation in broilers. But in jejunum and ileum, epithelial height (µm) was observed to be significantly higher (P>0.05) in T3 and T4 than C with intermediate values for T1 and T2. Although, Darabighane et al. (2011) reported significantly higher villus height of ileum in broilers than control, but the levels of AV supplementation are higher (2 and 2.5%) than the current study (0.4 and 0.6%). In contrast to our observations, Sujatha et al. (2017) reported significantly improved height of villi in

duodenum, jejunum and ileum while supplementing AV @ 3ml/day/chick. Difference in AV dosage, species and microenvironment may be the probable reasons for differences in these studies. To our knowledge, this is the first study to investigate the comparative effect of AV as dietary additive and gel supplementation through drinking water on gut morphology of quails during heat stress, so the results cannot be discussed. Cost benefit ratio is presented in Table 7.

Table 7. Effect of supplementation of different forms of *Aloe vera* on cost economics

Attributes	Groups				
	C	T1	T2	T3	T4
No. of quail chicks	60.0	60.0	60.0	60.0	60.0
Cost of quail chicks @RS.20/chick	1200.0	1200.0	1200.0	1200.0	1200.0
Cost of litter (Rs.)	170.0	170.0	170.0	170.0	170.0
Cost of starter feed (Rs.)	391.8	423.0	432.0	449.4	471.8
Cost of finisher feed (Rs.)	847.1	889.3	904.8	916.8	899.1
Total cost of feed (Rs.)	1238.9	1312.4	1336.8	1366.2	1371.0
Cost of feed additive (Rs.)	0.00	62.7	65.9	66.5	79.8
Mortality (in no.)	6.00	3.00	3.00	3.00	2.00
Mortality (%)	10.0	5.00	5.00	5.00	3.33
Total live quail birds (in no.)	54.0	57.0	57.0	57.0	58.0
Total input cost (in Rs.)	2608.9	2745.1	2772.7	2802.7	2820.9
Final body weight of treatment groups(kg)	8.95	9.95	10.38	10.66	11.01
Feed cost per kg live weight gain (in Rs.)	138.4	131.9	128.7	128.1	124.5
Income from quail birds (@ Rs.60 per 100g live bird)	5370.0	5970.0	6228.0	6396.0	6606.0
Total difference over control (Rs.)	0.00	600.0	858.0	1026.0	1236.0
Difference over control/bird (Rs.)	0.00	10.5	15.0	18.0	21.3
Cost benefit ratio	1.06	1.17	1.25	1.28	1.34

The total input cost (Rs.) which excludes rearing cost was higher in 0.6 and 0.4% AV gel supplemented group followed by 0.6 and 0.4% AV powder groups and least in control. But revenue realized by marketing birds (@ Rs. 600/kg live weight) was more in T4 followed by T3, T2, T1 and lowermost in C. The cost benefit ratio was highest in T4 (1.34) followed by T3 (1.28), T2 (1.25), T1 (1.17) and least in C (1.06). The highest cost benefit ratio in T4 may be attributed to improved FCR and better utilization of nutrients. Similar to our findings, Barman et al. (2019) reported higher return over feed cost (Rs/broiler bird) for 0.5% AV powder fed group (209.65) than control (208.74). Darabighane et al. (2011) also found higher gross return/broiler in 10ml/L and 15ml/L AV supplemented groups followed by 20ml/L and 5ml/l AV groups, but least return was observed in control group (no additive given).

CONCLUSION

Based on results, it may be concluded that 0.6% *Aloe vera* (AV) gel supplementation through drinking water in meat quails performed better in respect of growth performance and cost benefit ratio.

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