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Effect of Supplementation of Rough Lemon Juice, Amla Juice and Aloe Vera Gel on Performance of Broiler Chicken under Summer Season

R. Gowri[1], Suraj Amrutkar[1], Asma Khan[1], Nazam Khan[1], Vikas Mahajan[1], Manpreet Kour[1], D. Chakraborty[1]

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ABSTRACT

Background: Herbal additives are rich in vitamin C, A and other biological active compounds and may act as a good alternative source to overcome heat stress in broiler chicken. Among herbal additives, rough lemon, amla and aloe vera were easily available during summer and also have an additional advantage of throw away price in comparison to synthetic feed additives available in market.

Methods: In order to investigate the effect of supplementation of rough lemon (*Citrus jambhiri* Lush), amla (*Emblica officinalis*) and aloe vera (*Aloe barbadensis* Miller) on the performance of broiler chicken (Cobb strain) under summer season, 240-day old chicks were randomly distributed to four treatment groups (n=60). Basal diet (maize-soya based; T_0) was same for all the groups except the supplementation of rough lemon juice, amla juice and aloe vera gel @ 2% in drinking water in T_1, T_2 and T_3, respectively. Body weight gain, feed Intake, FCR were calculated during the experiment trial lasted for 42 days during June-July at F.V.Sc. and A.H., R.S. Pura, Jammu. The maximum and minimum temperature was recorded daily at 8:30 a.m. and 2:30 p.m. by using digital maximum minimum thermometer.

Result: Body weight gain and FCR was found superior in T_3 (P>0.05) than T_2 and T_1 and was inferior in T_0. Weekly water intake (ml/bird) was lower in T_2 and T_3. Benefit cost ratio was highest in T_3 (1.313) followed by T_2 (1.271), T_1 (1.231) and least in T_0 (1.071). It may be concluded that aloe vera gel supplementation resulted in better broiler performance followed by amla juice and rough lemon juice supplemented groups.

Key words: Aloe vera, Amla, Broiler, Heat stress, Rough lemon.

INTRODUCTION

Birds are homoeothermic and are able to maintain their body temperature (T_b) within a narrow range. Increase in body temperature above the regulated range is lethal for the birds due to exposure to environmental conditions and production of excessive metabolic heat (Piestun *et al.,* 2008, Vishen *et al*., 2021). Heat stress adversely influences the physiological status of the broiler bird and results in poor performance in terms of growth, feed efficiency, meat yield and also causes immuno-suppression and higher mortality in broiler chickens (Borges *et al*., 2004, Rokade *et al*., 2017). High ambient temperature over 32°C is considered to have a detrimental effect on the performance of poultry (Ditle *et al*., 2020, Chauhan *et al*., 2021). Ambient temperature for optimum broiler performance ranges between 18-30°C. The maximum temperature associated with satisfactory poultry performance is approximately 30°C in high relative humidity and above it interventions are mandatory (Hussain *et al*., 2021, Rafique *et al*., 2020).

The health benefits of rough lemon are due to its many nourishing elements like vitamin such as C, B_6, A, E, folic acid, niacin, thiamin, riboflavin, pantothenic acid and rich in minerals such as copper, calcium, iron, magnesium, potassium, zinc, phosphorus and protein (Mohammed *et al*., 2013). This fruit also contains flavonoids, which are composites that contain antioxidant and cancer fighting properties (Khan and Sardar, 2005).

Amla (*Emblica officinalis*) is one of the well-known medicinal plants which are widely used in herbal medicine for the management of stress, arthritis, inflammation and conjunctivitis (Patel *et al.,* 2016). Amla is a superior source of vitamin C and minerals like calcium, phosphorous and iron (Mishra *et al.,* 2009). These active principles have been

[1]Department of Livestock Production Management, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu-180 009, Jammu and Kashmir, India.

Corresponding Author: Suraj Amrutkar, Department of Livestock Production Management, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Jammu-180 009, Jammu and Kashmir, India. Email: suraj_amrutkar@rediffmail.com

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reported to possess immuno-modulatory, general tonic, hepato-protective, anti-stress, growth promoter and antioxidant properties besides antibacterial and anti-fungal properties (Singh *et al.*, 2013). Aloe vera is a perennial plant and relatively easy to cultivate and care (Punetha *et al.*, 2010). It contains a broad spectrum of free amino acids, steroids, polysaccharides, saponins, lignin, anthraquinones, salicylic acid and rich in vitamins such as vitamin A, B_1, B_2, B_3, B_6, B_{12}, C, E, folic acid, choline and minerals such as calcium, copper, iodine, iron, magnesium *etc* (Kumar *et al.,* 2012, Mandal *et al.*, 2017).

Hence, the present study was proposed to evaluate the efficacy of the herbal preparations like rough lemon juice, amla juice and aloe vera gel on the production performance of broilers during summer season.

MATERIALS AND METHODS

The present study evaluated the effect of supplementation of rough lemon juice, amla juice and aloe vera gel on the performance of broiler chicken (Cobb strain) during summer season (June and July) at F.V.Sc. and A.H., SKUAST-Jammu. The maximum and minimum temperature was recorded daily at 8:30 a.m. and 2:30 p.m. by using digital maximum minimum thermometer as shown in Table 1. Temperature humidity index (THI) was calculated using the formula of Johnson *et al.* (1963).

$$THI = 0.72 (T_{db} + T_{wb}) + 40.6$$

Where,

T_{db} = Dry bulb temperature (°C).

T_{wb} = Wet bulb temperature (°C).

Two hundred forty pre-weighed day-old chicks were randomly distributed into four treatment groups (n=60) having 4 replicates of 15 birds each amongst all treatment groups. All the groups were fed standard basal ration (maize soya based). Dietary treatments were: T_0 (No additive supplementation), T_1 (Rough lemon juice supplemented @ 2% in drinking water), T_2 (Amla juice supplemented @ 2% in drinking water) and T_3 (Aloe vera gel extract supplemented @ 2% in drinking water). Experimental trial lasted for 42 days and *ad-libitum* feed and water were provided to birds throughout the trial. Pre-starter, starter and finisher feed containing 23%, 22% and 21% crude protein (C.P.) and 3000, 3100 and 3200 kcal/kg metabolizable energy was purchased from the local market, following the BIS 2007 norms. The broiler (Cobb strain) birds were subjected to various treatment regimes for 42 days.

The chicks were weighed on first day and thereafter at weekly intervals at early morning by using electronic weighing balance. Body weight gain was calculated by subtracting the two recorded body weights at different intervals. Feed intake was calculated at the end of every week by weighing the daily feed offered and residues left in the feeders. Water was also measured twice daily for determining the amount of water consumed.

The data obtained from the experiment was subjected to one way ANOVA analysis by using SPSS 16.0 software.

RESULTS AND DISCUSSION

Body weight gain

The body weight gain values are presented in Table 2. There was significant difference ($P<0.05$) among the aloe vera group in comparison to other treatment groups throughout the experiment. The highest body weight gain was recorded in 4th week. The results revealed that body weight was significantly higher ($P<0.05$) in T_3 followed by T_2, T_1 and T_0 throughout the experimental trial. The bird under stress usually hampers the feed intake leading to less nutrition finally lead less body weight gain. Aloe vera herb rich in antioxidant and vitamins that enhance the body weight gain during stress condition in broilers (Punetha *et al.*, 2010). Mopuri and Islam (2017) also reported that the live weight gain and feed efficiency were significantly ($P<0.05$) better in the broilers provided water containing 15 ml/L aloe vera aqueous extract. Sinurat *et al.,* (2002) reported that feeding aloe vera gel either dry or fresh form increases the body weight. Cahaner and Leenstra (1992) reported that heat stress reduces the body weight gain.

Feed intake

The result depicted in Table 3 shows that the first two weeks of age have no significant difference on feed intake, irrespective of different dietary treatments. But at 3rd week feed intake was significantly higher ($P<0.05$) in T_2 (614.19), T_1 (615.36) than T_3 (586.78) and T_0 (577.03). However, at 5th and 6th week feed intake was statistically higher ($P<0.05$) in herbs supplementation groups in comparison to group which was not supplemented with herbs. Similarly, Singh *et al.* (2013) reported that feed intake in aloe vera supplemented group were more compared to the group which was not supplemented by aloe vera. Singh *et al.* (2014) also stated that broilers treated with amla powder resulted in significant increase in feed intake. In contrary Cerniglia *et al.* (1983) and Boudreau and Beland (2006) revealed that supplementation of aloe vera had no effect on feed intake. Kalam *et al.* (2010) reported that reduced feed intake at 34°C were 50% as compared to bird exposed to temperature 24°C during 2nd and 4th week of age.

Weekly water intake

The mean water intake (ml) depicted in Table 4, the data indicated that entire experimental trial had significantly higher value in T_0 (2045.30) followed by T_1 (1969.80) and T_2 (1942.30) with intermediate value for T_3 (1957.30 ml). The mean water intake (ml) in first week was significantly lower ($P<0.05$) in T_3 (400.32) than T_0 (419.24) and T_2 (412.54), with intermediate value for T_1 (410.63). The mean water intake (ml) at 6th week was significantly higher in T_0 (4085.80) followed by T_1 (3981.70), but T_2 (3928.00) and T_3 (3944.70) has lowest water intake. During the entire trial, weekly water intake was found higher in T_0 in comparison to treatment groups, indicating that the birds were under stress condition. Similar findings also found by Borges *et al.* (2007).

Table 1: Climatic variable temperature recorded during the experimental period.

Period	Max temp	Min temp	Max temp	Min temp	THI*	THI*
	Morning (8:30 A.M)		Afternoon (2:30 P.M)		(Morning)	(Afternoon)
1st week	30.07	23.2	39.7	25.6	78.9	87.61
2nd week	30.07	22.15	39.34	24.81	78.2	86.79
3rd week	30.28	23.42	40.28	24.55	79.12	87.28
4th week	31.28	24.28	42.34	23.18	80.49	87.78
5th week	31.12	24.85	43.39	22.47	81.74	88.02
6th week	32.28	23.75	41.77	22.82	79.51	87.11

*THI: Temperature humidity index.

Table 2: Effect of rough lemon juice, amla juice and aloe vera gel on body weight gain (g) of broiler chickens.

Age (weeks)	Weekly body weight gain (g/bird)			
	T_0	T_1	T_2	T_3
1st week	$99.85^{a}\pm3.72$	$103.30^{a}\pm2.74$	$121.74^{b}\pm3.55$	$122.22^{b}\pm2.66$
2nd week	$232.30^{a}\pm7.15$	$241.56^{a}\pm6.49$	$250.74^{ab}\pm6.44$	$271.07^{b}\pm8.97$
3rd week	$279.22^{a}\pm18.46$	$333.74^{b}\pm13.14$	$342.67^{b}\pm16.96$	$353.78^{b}\pm12.86$
4th week	$376.07^{a}\pm19.67$	$452.78^{ab}\pm21.82$	$460.00^{b}\pm22.82$	$469.63^{b}\pm18.22$
5th week	$338.33^{a}\pm24.33$	$386.11^{b}\pm20.67$	$390.22^{b}\pm24.51$	$395.70^{b}\pm24.24$
6th week	$334.37^{a}\pm42.51$	$394.4^{ab}\pm45.57$	$415.4^{b}\pm37.60$	$432.96^{b}\pm34.97$

T_0 (No additive supplementation), T_1 (Rough Lemon juice supplemented @2% in drinking water), T_2 (Amla juice supplemented @2% in drinking water), T_3 (Aloe vera gel supplemented @2% in drinking water).

Mean values bearing different superscripts a, b and c in a row differ significantly ($p<0.05$) between treatment groups.

Table 3: Effect of rough lemon juice, amla juice and aloe vera gel on feed intake (g) of broiler chickens.

Age (weeks)	Weekly feed intake (g/bird)			
	T_0	T_1	T_2	T_3
1st week	174.30±3.03	176.35±3.53	183.19±1.35	180.13±5.57
2nd week	412.90±7.62	414.62±8.66	411.02±6.21	408.94±7.48
3rd week	$577.03^{a}\pm7.60$	$615.36^{b}\pm8.67$	$614.19^{b}\pm7.02$	$586.78^{a}\pm6.84$
4th week	$769.26^{a}\pm13.05$	$810.54^{c}\pm15.88$	$819.67^{c}\pm18.06$	$790.54^{b}\pm12.94$
5th week	$772.34^{a}\pm20.55$	$854.68^{b}\pm24.61$	$845.75^{b}\pm23.17$	$837.91^{b}\pm23.38$
6th week	$988.17^{a}\pm20.37$	$1021.80^{ab}\pm26.63$	$1032.43^{bc}\pm28.59$	$1090.50^{c}\pm35.09$

T_0 (No additive supplementation), T_1 (Rough Lemon juice supplemented @2% in drinking water), T_2 (Amla juice supplemented @2% in drinking water), T_3 (Aloe vera gel supplemented @2% in drinking water).

Mean values bearing different superscripts a, b and c in a row differ significantly ($p<0.05$) between treatment groups.

Table 4: Effect of rough lemon juice, amla juice and aloe vera gel on water intake of broiler chickens.

Age (weeks)	Weekly water intake (g/bird)			
	T_0	T_1	T_2	T_3
1st week	$419.24^{b}\pm2.81$	$410.63^{ab}\pm1.35$	$412.54^{b}\pm2.83$	$400.32^{a}\pm5.91$
2nd week	682.87±6.26	679.38±5.23	667.30±6.11	676.75±5.55
3rd week	$1426.90^{b}\pm22.75$	$1318.70^{a}\pm20.17$	$1299.00^{a}\pm21.00$	$1329.30^{a}\pm24.79$
4th week	$2296.50^{b}\pm33.37$	$2205.50^{ab}\pm38.34$	$2139.50^{a}\pm32.63$	$2101.70^{a}\pm31.75$
5th week	$3360.20^{c}\pm32.80$	$3222.70^{ab}\pm33.19$	$3207.70^{a}\pm32.93$	$3291.10^{bc}\pm32.43$
6th week	$4085.80^{c}\pm43.51$	$3981.70^{b}\pm41.56$	$3928.00^{a}\pm44.17$	$3944.70^{a}\pm44.49$

T_0 (No additive supplementation), T_1 (Rough Lemon juice supplemented @2% in drinking water), T_2 (Amla juice supplemented @2% in drinking water), T_3 (Aloe vera gel supplemented @2% in drinking water).

Mean values bearing different superscripts a, b and c in a row differ significantly ($p<0.05$) between treatment groups.

Feed conversion ratio

The data depicted in Table 5 indicated that there was no significance difference from 4th week till 6th week of FCR within the treatment group. The high significance difference was seen in control group compared to other herbal treated group. The better FCR was seen in aloe vera treated group followed by amla and rough lemon. Indicating the growth performance was desirable in group treated with aloe vera similar finding was also seen by Brindha *et al.* (2017) where the aloe vera group revealed better FCR compared to other herbs under heat stress condition as they contain vitamin C, A and E which are main antioxidant vitamin that helps to alleviate heat stress condition. Similarly Mandal *et al.* (2017) also reported amla fruit powder improved FCR during summer. Sharma *et al.* (2015) reported that better feed conversion ratio was seen broiler treated with amla. Demir *et al.* (2003) stated that herbal feed additives had better FCR compared to antibiotic treated groups.

Effect of herbal feed additives on mortality

Mortality pattern is presented in Table 5. There was less mortality observed in the broiler birds supplemented with herbs. Hence, it is predicted as supplementation of rough lemon, amla and aloe vera alleviates the heat stress in broiler. Eevuri and Putturu (2013) also reported that less mortality was observed in broiler fed with herbal growth promoter containing. Mehala and Moorthy (2008) stated that 100% livability was observed with inclusion of aloe vera and curcuma longa and their combination in broiler diet. Kumar *et al.* (2005) reported that mortality was reduced in birds supplemented with either amla fruit powder or its mixture with other herbs.

Herbal feed additives on economics of production

The net profit per bird (Rs.) for groups T_3 (47.41) followed by T_2 (45.64), T_1 (38.25) and T_0 (26.08) as depicted in Table 6. The results revealed even though the treatment group supplemented with aloe vera spare more the cost of production because of supplements addition in the rations of broilers. But high profit was shown in increasing order by amla, rough lemon and control. Similarly, Yadav *et al.* (2017) and have reported that aloe vera treated groups were found to be beneficial in terms of net profit. However, Patel *et al.* (2016) revealed significant results which were similar to present findings.

Table 5: Effect of rough lemon juice, amla juice and aloe vera gel on FCR of broiler chickens.

Age (weeks)	Feed conversion ratio (FCR)			
	T_0	T_1	T_2	T_3
1st week	1.746^{b}±0.02	1.707^{ab}±0.05	1.505^{ab}±0.02	1.475^{a}±0.06
2nd week	1.800^{b}±0.06	1.716^{ab}±0.00	1.648^{ab}±0.11	1.508^{a}±0.01
3rd week	2.082^{b}±0.11	1.844^{a}±0.02	1.793^{a}±0.05	1.658^{a}±0.01
4th week	2.123±0.29	1.791±0.03	1.782±0.02	1.684±0.04
5th week	2.291±0.09	2.214±0.02	2.169±0.05	2.118±0.04
6th week	2.990±0.18	2.614±0.18	2.487±0.04	2.524±0.08

T_0 (No additive supplementation), T_1 (Rough Lemon juice supplemented @2% in drinking water), T_2 (Amla juice supplemented @2% in drinking water), T_3 (Aloe vera gel supplemented @2% in drinking water).

Mean values bearing different superscripts a and b in a row differ significantly ($p<0.05$) between treatment groups.

Table 6: Economics of total broiler birds reared in various treatments.

Economics of total birds	T_0	T_1	T_2	T_3
No of chicks	60	60	60	60
Cost of chicks @ Rs. 22.50/chick	1350	1350	1350	1350
Cost of litter (Rs.)	235	235	235	235
Cost of feed (Rs.)	6360.67	6587.83	6815	6701.42
Mortality	4	2	0	1
Total input cost (Rs.)	7945.67	8172.83	8400	8286.42
weekly mean body weight	1.704	1.960	2.0163	2.090
Selling bags and litters	400	400	400	400
Total weight of birds (kg)	95.46	113.72	120.98	123.31
Income from bird (Rs 85/kg)	8514.21	10066.45	10683.30	10881.53
Total difference over control (Rs)		1552.24	2169.09	2367.32
Difference over control/bird (Rs)		26.77	36.15	40.12
Benefit cost ratio	1.071	1.231	1.271	1.313

T_0 (No additive supplementation), T_1 (Rough Lemon juice supplemented @2% in drinking water), T_2 (Amla juice supplemented @2% in drinking water), T_3 (Aloe vera gel supplemented @2% in drinking water).

CONCLUSION

Performance of broiler chicks supplemented aloe vera gel showed significantly higher body weight gain, better feed intake and FCR followed by amla and rough lemon juice supplementation as compared to control group.

Conflict of interest: None.

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