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EFFECT OF TULSI (*OCIMUM SANCTUM*) AND TURMERIC (*CURCUMA LONGA*) ON BROILER PERFORMANCE AND BLOOD CONSTITUENTS DURING HEAT STRESS IN BROILERS.

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ABSTRACT

A study was performed with 216 day old vencobb broiler chicks in two batches during summer. In each batch, 108 chicks were divided into 9 dietary treatment groups viz, T_1- fed on basal diet (BD) alone; T_2-BD + Vitamin E (200mg/Kg);T_3-BD + Vitamin E (200mg/Kg) + Selenium (0.15 ppm); T_4–BD+Tulsi(0.25%);T_5–BD+Tulsi(0.5%);T_6BD+Turmeric(0.2%);T_7-D+Turmeric(0.4%);T_8-BD+Tulsi(0.25%)+Turmeric(0.2%);T_9-+Tulsi(0.5%)+Turmeric(0.4%). Additionally, a control group of 12 chicks were raised separately in stress free environment. Body weights and feed efficiency were recorded at weekly intervals and blood samples were collected from wing vein at 4thand 6th wk of age for estimation of Red blood cells (RBC), hemoglobin (Hb) and packed cell volume (PCV) and white blood cell (WBC) counts. Bodyweights, feed efficiency, RBC, Hb and PCV values were significantly (P≤0.01) lower, while WBC counts were higher in T_1 group compared to control group. These attributes were improved with the supplementation of Turmeric followed by Tulsi at either doses and were comparable with the supplementation of vitamin E alone or in combination with Se. However, combination of herbals at different doses had no additive benefit than their sole inclusions.

KEYWORDS: **Broilers, summer stress, antioxidants, herbals and blood parameters**

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INTRODUCTION

Heat stress is that condition in which the body temperature is elevated and interferes with normal body function and may lead to exhaustion and death. Hence, there is a need to explore the efficient means to improve the thermo tolerance of broiler chickens in hot climates without affecting their productivity. Attempts for genetic manipulation (evolving naked neck birds and dwarf gene etc), manage mental techniques (improving house ventilation, provision of evaporative cooling systems and reducing stocking density etc.) were proved effective in mitigating heat induced changes. However, these techniques are complex and expensive. Hence nutritional manipulation with inclusion of anti stress compounds (enzymes, minerals and vitamins etc.) make a practical alternative in alleviating the effects of high ambient temperature in poultry. However, there has been increasing criticism of using chemicals or synthetic feed additives due to the reasons of high cost, contraindications and cumulative residual effect etc. Hence use of plants (or) herbs like Tulsi and Turmeric claims advantage in that they are safe, economical, effective and easily available. The effect of Tulsi on the body weight was studied earlier in rats[1] rabbits [2]and broilers[3&4] and was reported to be beneficial. Turmeric supplementation was also reported [5,6&7] to improve the body weight gains of broiler chicken. However, the information on the role of these herbals on broiler performance and blood changes during heat stress is meager. Hence, a study was taken up to study the efficacy of different levels of Tulsi, Turmeric and their combination in improving the performance and blood values during summer in broiler chicken.

MATERIALS AND METHODS

Two hundred and sixteen day old vencobb broiler chicks were procured to conduct an experiment in two batches during summer months (environmental temperature 37-45°C) at poultry experimental station, College of Veterinary Science, Hyderabad, India. In each batch, 108 chicks were randomly allotted into 9 groups, each group consisting of 12 chicks and were subjected to different dietary regimens (Table 1). Additionally, a group of 12 chicks was raised separately in stress free environment (environmental temperature 32-35°C) and fed no antioxidant served as the control group.

Table: 1
Dietary group details of experimental birds.

Group	Diet
1	Basal diet (BD) (without inclusion of any antioxidant)
2	BD+ vitamin E (200 mg/kg diet)
3	BD+ vitamin E (200mg/kg diet)+ selenium (0.15 ppm/kg diet)
4	BD+ Tulsi (0.25%)
5	BD+ Tulsi (0.5%)
6	BD+ Turmeric (0.2%)
7	BD+ Turmeric (0.4%)
8	BD+ Tulsi(0.25%) +Turmeric (0.2%)
9	BD+ Tulsi (0.5%) +Turmeric (0.4%)
Heat stress free (control)	

Body weights and feed conversion ratios (FCR) were recorded at weekly intervals. Two to three milliliters of blood was collected in sterile heparinised tubes on 4th and 6th week(wk) of age from wing vein and was analyzed for total erythrocyte (RBC) count, total leucocyte (WBC) count, packed cell volume (PCV) and hemoglobin (Hb) concentration using whole blood automatic analyzer (Huma count, Med source ozone, Biomedical Pvt. Ltd, India) . The data obtained from two batches was averaged and subjected to statistical analysis by applying two way (RBC, Hb and WBC concentration) and one way ANOVA (body weights, FCR and PCV) using statistical package SPSS 10.0 version. Differences between means were tested using Duncan's multiple comparison tests [8].

RESULTS

Table 2

Weekly body weights (g) of heat stressed broilers supplemented with antioxidants (0-6 Weeks)

	Age (in weeks)						
Diet	**0**	**I**	**2**	**3**	**4**	**5**	**6**
Stress free control	38.28 ± 0.717^{a}	93.24± 1.892^{a}	228.47±5.852^{ab}	494.51 ± 9.226^{a}	902.67 ± 1.172^{a}	1350.83 ±41.472^{a}	1684.17 ±30.532 ^{a}
1	39.17± 0.723^{a}	81.77 ± 2.761^{bcd}	199.42 ±9.964^{b}	410.33 ± 1.583 ^{c}	661.33 ±34.675^{d}	978.33± 59.830 ^{d}	1285.33 ± 3.063 ^{d}
2	38.92 ±0.382^{a}	82.99± 2.782^{abcd}	226.33 ±9.135^{ab}	467.75 ±20.670^{ab}	707.59± 15.440 ^{bc}	1183.17 ± 4.572^{bc}	1637.52 ±40.237^{ab}
3	37.56 ± 1.243^{a}	90.86 ± 2.134^{ab}	227.52 ± 9.342^{ab}	475.33± 13.712 ^{a}	733.17± 19.863^{b}	1195.83 ± 46.853 ^{bc}	1656.67 ±37.041^{a}
4	39.55 ± 0.930^{a}	77.53± 2.124^{cd}	214.58 ± 7.013^{ab}	437.42 ±12.013^{abc}	710.83±30.132^{bc}	1175.83 ± 53.37 2^{bc}	1519.25± 71.912 ^{c}
5	37.71 ± 0.884^{a}	81.79± 4.44^{bcd}	211.37 ±9.512^{b}	440.08 ±22.912^{abc}	723.67 ±45.383^{b}	1181.67 ±27.33 1^{bc}	1539.00±52.172^{b}
6	37.73± 0.523^{a}	88.23 ± 2.571^{abc}	241.64 ± 5.243^{a}	449.17± 11.931 ^{ab}	737.58 ± 29.721^{b}	1211.67 ±26.714 ^{bc}	1627.50±48.991 ^{ab}
7	38.20 ±0.534^{a}	74.57 ±6.923^{d}	203. 95 ± 6.571^{b}	407.42 ± 32.712^{bc}	745.88± 28.952 ^{b}	1246.67± 32.896 ^{ab}	1629.17± 40.742^{ab}
8	38.36 ± 0.572^{a}	85.84 ± 2.635^{abc}	220.59 ±9.162^{ab}	434.92 ±15.083^{abc}	685.92 ±2 0.663^{c}	1081.67± 58.352 ^{c}	1353.50 ± 1.951 ^{d}
9	39.05± 0.701^{a}	78.41± 2.713^{cd}	201.97 ±6.912^{b}	385.83 ± 9.722^{cd}	682.33± 36.561^{c}	1063.59 ±22.533^{c}	1307.08 ± 2.512 ^{d}
Pvalue	0.107	0.002	0.032	0.003	0.001	0.001	0.001

Means with different superscripts in a column differ significantly: P≤0.05; P≤0.01

At the start of experiment, the average body weight of the birds in different groups was not significantly different (Table 2). Variations in body weights among dietary groups were observed from 1st wk onwards. The body weight of heat stress free birds was highest (P≤0.01) and was least in heat stressed (HS) birds with no antioxidant supplementation throughout the feeding trial. Vitamin E (200mg/kg) supplementation in combination with selenium significantly (P≤0.01) improved the body weights followed by vitamin E as sole supplement. The herbal antioxidants (Tulsi and Turmeric) significantly (P≤0.01) influenced the body weights of heat stressed birds from 4th wk onwards and the body weights were comparable with those fed vitamin E solely or its combination with Se. By the end of 6th wk,

Turmeric supplemented at either dose improved the body weights and were similar to that of stress free (control) birds. Combination of herbs at either dose (VIII and IX) had no beneficial effect than their sole inclusions in improving the body weights of heat stressed birds.

Table 3
Feed conversion ratios of heat stressed broilers supplemented with antioxidants (1-6 Weeks)

	Age (in weeks)					
Diet	**1**	**2**	**3**	**4**	**5**	**6**
Stress free control	1.62± 0.021^{e}	1.38 ± 0.011^{f}	1.52 ± 0.022^{d}	1.55 ± 0.012^{e}	1.48 ± 0.011^{e}	1.82 ± 0.020^{g}
1	2.27 ± 0.034^{b}	1.73 ± 0.032^{ab}	1.87 ± 0.053^{ab}	1.90 ± 0.042^{a}	1.93 ± 0.052^{b}	2.71 ± 0.041^{a}
2	2.02 ± 0.032^{cd}	1.51± 0.032^{de}	1.65 ± 0.042^{c}	1.60 ± 0.013^{e}	1.74 ± 0.023^{c}	2.03 ± 0.042^{e}
3	1.67 ± 0.034^{e}	1.46± 0.023^{ef}	1.43 ± 0.022^{e}	1.56 ± 0.021^{e}	1.94 ± 0.032^{b}	1.92 ± 0.023^{fg}
4	2.27 ± 0.072^{b}	1.55 ± 0.051^{cd}	1.80 ± 0.005^{b}	1.70 ± 0.006^{cd}	1.61 ± 0.012^{d}	2.17 ± 0.052^{d}
5	2.57 ± 0.031^{a}	1.62 ± 0.042^{c}	1.95 ± 0.041^{a}	1.68 ± 0.021^{d}	1.63 ± 0.034^{d}	2.07± 0.053^{de}
6	2.05 ± 0.035^{c}	1.57 ± 0.023^{cd}	1.80 ± 0.007^{b}	1.75 ± 0.021^{bc}	1.57 ± 0.020^{d}	2.02± 0.042^{ef}
7	2.03 ± 0.043^{cd}	1.7 3± 0.042^{b}	1.82 ± 0.022^{b}	1.60± 0.009^{e}	1.42 ± 0.012^{e}	1.63 ± 0.013^{h}
8	2.16 ± 0.064^{b}	1.61± 0.021^{c}	1.59 ± 0.004^{cd}	1.80 ± 0.006^{b}	1.95 ± 0.005^{ab}	2.29 ± 0.006^{c}
9	1.90 ± 0.008^{d}	1.80 ± 0.009^{a}	1.91 ± 0.01^{a}	1.94 ± 0.041^{a}	2.02 ± 0.045^{a}	2.41 ± 0.042^{b}
P value	0.001	0.001	0.001	0.001	0.001	0.001

Means with different superscripts within a column differ significantly: P≤0.01

Throughout the feeding trial, the feed efficiency was lower (as indicated by higher feed conversion ratios) in heat stressed (HS) birds compared to stress free birds (Table 3). Supplementation of vitamin E (200 mg/kg) improved (P≤0.01) the feed efficiency in HS birds, but its combination with Se was more effective and the FCR was comparable to stress free birds. Significant effect of herbal antioxidants was observed from 4th wk onwards. At 4th wk, feed efficiency was higher (P≤0.01) in birds fed Turmeric and Tulsi at either doses. However, birds supplemented with 0.4% Turmeric (FCR values 1.60 at 4th wk and 1.42 at 5th wk) was comparable to stress free birds and higher than control birds at 6th wk of age. The feed efficiency of birds that received combination of herbs at either dose was lower than that of individual antioxidant supplemented birds.

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Table 4
Hemoglobin-Hb (g/dl) and Erythrocyte count-RBC (Millions/cmm) of heat stressed broilers supplemented with antioxidants

Diet	Hb		RBC	
	4th wk	6th wk	4th wk	6th wk
Stress free control	14.98 ± 0.403 ^{abc}	15.47 ± 0.351 ^{ab}	2.36 ± 0.072 ^{b}	2.76 ± 0.033 ^{a}
1	11.08 ± 0.152 ^{g}	14.18 ± 0.173 ^{cd}	1.48 ± 0.041^{g}	1.87 ± 0.034 ^{cde}
2	13.72 ± 0.611^{e}	15.25± 0.682 ^{abc}	1.80 ± 0.073 ^{cdef}	1.93 ± 0.112 ^{cd}
3	14.28 ± 0.224 ^{bcd}	15.03± 0.313 ^{abc}	1.82 ±0.030 ^{cdef}	1.96 ± 0.065 ^{c}
4	14.52 ± 0.192 ^{bcd}	14.95 ± 0.322 ^{abc}	1.71 ± 0.051 ^{ef}	1.86 ± 0.064 ^{cde}
5	14.25± 0.641 ^{cd}	15.83 ± 0.091 ^{a}	1.79 ± 0.072 ^{cdef}	1.93 ±0.032^{cd}
6	14.32± 0.293 ^{bcd}	14.88± 0.382 ^{abcd}	1.7 0± 0.044 ^{ef}	1.82± 0.050 ^{cdef}
7	14.38± 0.204 ^{bcd}	14.25 ± 0.383 ^{cd}	1.76 ± 0.142 ^{def}	1.84 ± 0.081 ^{cdef}
8	13.05 ± 0.293 ^{f}	14.82± 0.392 ^{abcd}	1.67 ± 0.034 ^{f}	1.87 ± 0.043 ^{cde}
9	12.78 ± 0.231 ^{f}	14.33 ±0.324 ^{bcd}	1.67 ± 0.032 ^{f}	1.82 ±0.043 ^{cdef}
P value	0.001	0.001	0.001	0.001

Means with different superscripts for attributes differ significantly at P≤0.01

The HS birds showed significantly (P≤0.01) lower RBC (Red blood cell), Hb (hemoglobin) and PCV (packed cell volume) values compared to stress free group at both 4th and 6th wk of age (Table 4&5). The RBC and Hb values were comparable among the supplemented group at both 4th and 6th wk of age except Hb concentration in the groups received combination of herbals at either doses at 4th wk. PCV had shown significant improvement in group received vitamin E and Se combination followed by the sole supplementation of vitamin E. PCV values were comparable among the sole herbal antioxidant supplemented groups. However combination of herbals at either dose did not show any additional improvement than their sole inclusions. The total WBC counts were higher in groups of birds reared in hot months on diet without any supplementation compared to stress free group. Among the supplemental groups, Turmeric followed by Tulsi could reduce the WBC counts significantly (P≤0.01).

At 4th wk, supplementation of Turmeric at 0.4% and Tulsi at 0.5% resulted in lower WBC counts than supplemented at lower doses (0.2 and 0.25% of Turmeric and Tulsi, respectively). But such a concentration dependant reduction was not noticed at 6th wk. Combination of herbals at low doses shown lower WBC counts than when supplemented at higher dose and neither of the combinations shown any additional advantage than their sole inclusions.

Table 5
Packed Cell Volume-PCV (%) and Leucocytes-WBC (thousand/cmm) count in heat stressed broilers supplemented with antioxidants

Diet	PCV			WBC	
	4th wk	6th wk	Average ± SEM	4th wk	6th wk
Stress free control	30.27± 0.132	32.70± 0.632	31.48 ±0.321 [a]	24.83±0.461[f]	25.65±1.151 [e]
1	20.55 ±0.245	21.82± 0.451	21.17±0. 312 [f]	32.04 ±1.253 [b]	35.68±2.834 [a]
2	24.13± 0.721	26.35± 0.691	25.24 ±0.322 [c]	26.72±0.570 [e]	28.12±1.232 [cd]
3	25.97± 0.393	27.01 ±0.930	26.48 ±0.324 [b]	26.71±0.511 [e]	27.78±0.823 [d]
4	22.17 ±0.263	22.32± 0.224	22.24± 0.314 [de]	29.35±0.844[c]	30.15±2.702 [c]
5	23.37±0.354	23.73± 0.213	23.55 ±0.311[de]	26.72±0.513 [e]	29.32±0.563 [c]
6	21.48 ±0.362	23.18± 0.382	22.33±0. 320 [de]	27.42±0.563 [d]	26.34±1.532 [e]
7	21.24 ±0.194	23.03± 0.311	22.12 ±0.341 [de]	24.68±0.472 [f]	25.58±0.931 [e]
8	21.32± 0.345	23.52 ±0.183	22.41± 0.342 [ef]	26.41±1.753[e]	27.45±0.525 [d]
9	21.23± 0.293	21.67± 0.312	21.45± 0.312 [ef]	30.27±1.731[c]	28.32±0.474 [cd]
P value			0.001	0.001	0.001

Means with different superscripts for attributes differ significantly at P≤0.01

DISCUSSION

The present study on performance indicated lower body weights and poor feed efficiency in the heat stressed group and were comparable with the earlier findings[9, 10 &11]. During the stress, nutrients are not digested and absorbed efficiently and animal must rely on nutrient reserves of the body which is mostly diverted to perform the vital functions of the body depriving the energy to less important functions such as egg production, growth and immunity. Also the muscle protein synthesis is retarded as the carbon skeleton of the amino acids is used for energy. Thus the full genetic potential of the bird for growth is not expressed during stress[12], thus resulting in lower body weights as observed in the present study. The oxidative stress during heat stress increased the red blood susceptibility to per oxidation accounting for reduction in erythrocyte count, a consequent reduction in PCV and Hb concentration in HS birds. The increased WBC count observed in HS group could be due to stress related increase in cortisol concentration which is responsible for increased production of leucocytes[13].

Supplementation of vitamin E and vitamin E in combination with Se alleviated the effects inflicted by heat stress due to antioxidant capacity of vitamin E and selenium resulting in increased body weights and better feed efficiency (Table 3).The present study findings corroborated with the results of other studies when supplemented with vitamin E[14] and organic Se[15] supplementation. During oxidative stress, expression of erythropoietin protein (or) mRNA in hepatic cell lines is strongly repressed by the production of hydrogen peroxide[16]. Vitamin E and its combination with Se could have reduced such an oxidative stress resulting in higher RBC, consequently PCV and Hb values in vitamin E alone or along with Se supplemented groups.

Increased body weights and better feed efficiencies observed in the present study(Table 2&3) with the treatment of Turmeric and Tulsi at different levels of inclusions corroborated with the results of other studies in chicken using Tulsi leaf powder [4] and Turmeric powder[6&7].The improvement observed could be attributed to their flavor which can influence the eating pattern, total feed intake, and secretion of digestive fluids, stimulation of intermediary metabolism, antioxidant capacities and hepato protective actions of these supplementations. Turmeric is known to produce an antimicrobial effect in the digestive tract of broiler chicken[7] and pharmacologically active levels of curcumin are found in liver following its ingestion[18] and was shown to ameliorate many forms of hepatic insult[19] resulting in enhanced protein synthesis by birds enzymatic system necessary to put on body weights. However, supplementation of herbals in combination at different levels (group VII &IX) failed to yield beneficial results in terms of feed efficiency which might be due to incompatibility at higher concentration of supplements as reflected by lower body weights.

Treatment with herbals such as Tulsi and Turmeric was responsible for lessening radical formation[20], thus protected membrane integrity of RBC and Hb contributing to their raised levels observed in the present study as also reported earlier with inclusion of Tulsi[2] and Turmeric[7] due to higher availability of iron and proteins in treated groups. The cortisol sparing effect of these herbals[21] might have been responsible for lowering of WBC count as observed in the present study.

CONCLUSION

Heat stress reduced the performance as well as had adverse effect on hematological constituents in broilers. The herbals, Turmeric followed by Tulsi at either dose as sole supplements improved the body weights, feed efficiency and Hb, RBC, PCV values and lowered the WBC count in heat stressed birds and were comparable with the results obtained with the supplementation of vitamin E and its combination with Se. However, no synergistic effect of combination of herbals was observed on broiler performance or hematological attributes. Hence, it could be concluded that dietary natural antioxidants Turmeric and Tulsi supplemented at 0.2 and 0.25% were effective in improving broiler performance and haematological parameters during heat stress.

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