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Effect of Dietary Herbal Antioxidants on Meat Quality of Stressed Broilers

B. Swathi, P.S.P. Gupta and M.V.L.N. Raju

College of Veterinary Sciences, Sri Venkateswara Veterinary University
Rajendranagar ,Hyderabad - 500 030

ABSTRACT

A study was performed with two hundred and sixteen 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+viatamin E(200mg/Kg);T_3-BD+vitaminE(200mg/Kg) +selenium(0.15mg/kg);T_4-BD+Tulsi(0.25%);T_5-BD+Tulsi(0.5%);T_6-BD+Turmeric(0.2%);T_7-BD+Turmeric(0.4%);T_8-BD+Tulsi(0.25%)+Turmeric(0.2%);T_9-BD+Tulsi(0.5%)+Turmeric (0.4%). Additionally 12 chicks were raised separately in stress free environment that served as the control group. Supplementation of diets with antioxidants ranged from 3.75-4.15(colour), 3.6-4.1(texture), 3.48-4.0(juiciness),3.5-3.98(Flavor)& 3.6-4.0(overall acceptability) on 5 point hedonic scale. Antioxidant supplementation in different levels and combinations improved the scores over that of heat stressed (HS) with more striking hike with GroupT_3.The TBARS (mg of melonoldehyde/Kg) levels was higher in HS group and were reduced in groups T_3 followed by group T_2. Tulsi at 0.5% and Turmeric at 0.4% were more effective than when supplemented at 0.25 and 0.2%, respectively in reducing MDA concentration. However, combination of herbals at different doses added no additive benefit than their sole inclusions,

Key words: *Broilers, summer stress, antioxidants, herbals and meat quality.*

INTRODUCTION

Meat often loses its quality by many factors and one of the causes for such deterioration is heat stress. Besides producing unpleasant odours, it is responsible for the loss in flavor, texture, consistency, appearance and nutritional value of meat. These undesirable side effects can be reverted by adding antioxidants as additives to poultry diets. They not only protect food components from oxidative processes but also promote *in vivo* and postmortem effects possibly after incorporation to the bird's metabolism (Fellenberg and Speisky 2006).However, choice of anti stress compound should aim not only to improve the meat quality under heat stress but also should be safer and should not have cumulative residual effect. Hence herbs known to contain certain antioxidants are preferred. Keeping in view of the above facts, an experiment was conducted to study the effect of heat stress and supplementation of herbal antioxidants Tulsi and Turmeric on the meat quality of broiler chicken.

MATERIALS AND METHODS

Two hundred and sixteen day old vencob broiler chicks were procured and conducted an experiment in two batches during summer months THI (temperature humidity index) ranging from 73.8 to 78.14 at poultry experimental station, College of Veterinary Science, Rajendra Nagar. 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 (THI ranging from 61.5 to 65.78) and served as the control group. After feeding the respective diets for 42 days, 4 birds from each group were sacrificed and collected the breast and thigh meat samples for studying organoleptic properties and lipid peroxidation.

Corresponding author, e-mail: swathibn@yahoo.co.in

The organoleptic attributes of cooked breast meat samples were assessed by subjecting to sensory analysis for flavor, juiciness and tenderness by semi trained member taste panel consisting of different age groups and sexes. Cooked cubes of approximately 1.5 cm cut from the breast muscle were served to the taste panel members with a five point hedonic scale (Carr *et a*l.1999) to assess the flavor, Juiciness, colour and tenderness of the sample served. Lipid peroxidation was assayed by estimating thibarbituric acid reacting substances (TBARS) (Subramanian *et al*.1988).The data thus obtained from two batches was averaged and analyzed statistically (Snedecor and Cochran 1994).The differences between means was tested using Duncan's multiple comparison tests (Duncan 1955).

RESULTS AND DISCUSSIONS

Sensory evaluation in terms of colour, texture, juiciness and flavor for breast meat scored significantly higher (Pd<0.05) values for the birds reared in stress free environment (control birds) and were lower in heat stressed (HS) birds (Table 2). The colour of the meat was better (Pd<0.05)

Table 1. Dietary group details of experimental birds.

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

when birds were fed with Turmeric (irrespective of dos and combination) followed by vitamin E and Se combination and was comparable with that of control birds. In other antioxidant supplemented birds the colour of the meat was better (Pd<0.05) than HS birds. But, the values were lower than control birds. The texture of meat improved with supplementation of antioxidants compared to HS ones and were comparable to that of control birds. Heat stress considerably reduced the juiciness and flavour scores (3.42 and 3.22, respectively). Supplementation with various antioxidants at different levels and combinations improved the scores over that of HS birds with more striking significant (Pd<0.01) score observed with the supplementation of vitamin E in combination with Se (4.04 for juiciness and 3.98 for flavor) which were comparable with the values obtained for control birds (4.15 and 4.16 for juiciness and flavor, respectively). Overall acceptability scores were highest (4.12) for control group and were least for HS birds (3.14). Though all the antioxidants used in the present study significantly (Pd<0.05) improved overall acceptability scores, more acceptable and comparable scores with that of control birds were obtained with vitamin E and Se combination (4.03) followed by supplementation of Turmeric at either of the dosed used.

The mean concentration of MDA was significantly (Pd<0.01) higher in breast and leg samples of HS birds and were 0.24 and 0.55 µm in respective tissues than control birds (0.08 and 0.12 µm, respectively). The higher MDA values in HS birds were reduced in muscles of broilers received antioxidant supplementation. The reduction in MDA concentration was more striking when fed with vitamin E and Se (0.05 µm for breast and 0.23 µm for leg muscle). In this group, the reduction in MDA concentration for breast muscle was significantly better (Pd<0.01) even than that observed with control birds. Breast and leg meat analysis revealed that birds fed diet containing herbal inclusions had significantly lower (Pd"0.01) MDA concentrations (ranged from 0.13 to 0.19 µm for breast muscle and 0.29 to 0.39 µm for leg muscle). However, significant response was observed with the addition of Tulsi at 0.5% (0.13 and 0.29 µm for breast and leg muscles, respectively) than at supplementation rate of 0.25% (0.18 and 0.38 µm for breast and leg muscles, respectively). A similar trend of concentration dependant reduction was observed with Turmeric at 0.4% (0.15 and 0.33 µm for breast and leg muscles, respectively) than that of 0.2% inclusion rate (0.20 and 0.39 µm for breast and leg muscles, respectively). The combination of

Table 2. Sensory evaluation of meat of heat stressed broilers supplemented with various antioxidants (Hedonic scale 1-5)

Treatment	Colour	Texture	Juiciness	Flavour	Overall acceptability
Stress free control	4.21 ± 0.171 [a]	4.23 ± 0.132 [a]	4.15 ± 0.052 [a]	4.16 ± 0.023 [a]	4.12 ± 0.120 [a]
G-1	3.42 ± 0.232 [c]	3.12 ± 0.011 [c]	3.42 ± 0.031 [d]	3.22 ± 0.092 [c]	3.14 ± 0.092 [d]
G-2	3.81 ± 0.133 [b]	3.62 ± 0.123 [ab]	3.53 ± 0.092 [cd]	3.51 ± 0.132 [b]	3.67 ± 0.121 [c]
G-3	4.05 ± 0.061 [ab]	3.71 ± 0.092 [ab]	4.04 ± 0.071 [a]	3.98 ± 0.033 [a]	4.03 ± 0.092 [a]
G-4	3.73 ± 0.223 [b]	3.65 ± 0.013 [ab]	3.71 ± 0.132 [b]	3.61 ± 0.041 [b]	3.71 ± 0.192 [abc]
G-5	3.82 ± 0.041 [b]	3.92 ± 0.252 [a]	3.93 ± 0.161 [ab]	3.65 ± 0.012 [b]	3.85 ± 0.211[ab]
G-6	3.92 ± 0.221 [ab]	4.12 ± 0.112 [a]	3.84 ± 0.082 [ab]	3.94 ± 0.141 [a]	3.92 ± 0.113 [a]
G-7	3.91 ± 0.123 [ab]	4.14 ± 0.082 [a]	3.93 ± 0.153 [ab]	3.75 ± 0.081[ab]	3.91 ± 0.073[a]
G-8	3.98 ± 0.112 [ab]	3.82 ± 0.261 [ab]	3.83 ± 0.133 [ab]	3.90 ± 0.073 [a]	3.83 ± 0.072[ab]
G-9	4.15 ± 0.114 [a]	3.73 ± 0.152 [ab]	3.48 ± 0.161 [cd]	3.75 ± 0.152[ab]	3.61 ± 0.052[c]
P value	0.014	0.033	0.017	0.023	0.032

a b c……Means with different superscripts in a column differ significantly : Pd”0.05

herbals at different doses was having similar effect as their independent inclusions in reducing MDA concentration thus added no additive benefit.

The colour of meat was better (Pd<0.05) when birds were fed with vitamin E and Se combination which could be related to the amount of á tocopherol incorporated into tissues and reduced oxidative changes in membrane lipids (Machlin and Bendich 1987). Among the herbals skin colour intensity was highest in broilers fed with Turmeric followed by Tulsi at either dose or combination vowing to their antioxidant potentials. Improved scores observed for tenderness and juiciness in birds given vitamin E and Se might be due to inhibition of phospholipase A_2 which stabilizes mitochondrial membrane thus reducing exudative losses from cells contributing to juiciness (Al Khader et al.1996). Supplementation of herbals Turmeric at either dose, its combination with Tulsi at lower dose and Tulsi as sole supplementation at higher dose also improved juiciness scores due to their antioxidant potential there by preventing any damage to meat. The improvement observed in flavor scores in antioxidant supplemented groups may be due to reduction in lipid peroxidation.

In the present study it has been observed that there was a significant rise (Pd<0.05) in MDA level in meat samples of HS birds due to cellular damage and increased susceptibility to lipid peroxidation (Table 3). Vitamin E being fat soluble could have

Table 3. Thiobarbituric acid reactive substances (TBARS) values in breast and leg tissues of heat stressed broilers supplemented with various antioxidants

Treatment	TBARS (µm of MDA / mg of tissue)	
	Breast	**Leg**
Stress free control	0.08 ±0.004 [e]	0.12 ± 0.006 [f]
G-1	0.24 ± 0.008 [a]	0.55 ± 0.012 [a]
G-2	0.08 ± 0.007 [e]	0.27 ± 0.005 [d]
G-3	0.05 ± 0.005[f]	0.23 ± 0.004 [e]
G-4	0.18 ± 0.006 [c]	0.38 ± 0.009 [b]
G-5	0.13 ± 0.009 [d]	0.29 ±0.007 [d]
G-6	0.20 ± 0.005 [b]	0.39 ± 0.006 [b]
G-7	0.15 ±0.006 [d]	0.33 ± 0.007 [c]
G-8	0.19 ± 0.004 [b]	0.39 ± 0.008 [b]
G-9	0.15 ± 0.004 [d]	0.38 ±0.009 [b]
P value	0.001	0.001

a b c d…..Means with different superscripts within a column differ significantly (P<0.01)

been absorbed more rapidly at intestinal level and synergistic effect of Se as part of glutathione peroxidase enzyme might contributed to increased antioxidant potential of vitamin E, thus more striking reduction in MDA concentration was observed with birds received vitamin E and Se combination.

Dietary herbal supplementation proved beneficial in lowering lipid peroxidation. Tulsi owing to the presence of certain flavanoids such as ursolic acid and eugenol could reduce free radical level

(Balanehru and Nagarajan, 1991) and convert lipid peroxides to alcohol derivatives and not to MDA (Sethi *et al*. 2003). Similarly, Turmeric due to its active principle Curcumin was capable of scavenging free radicals thus inhibitibg lipid peroxidation (Stano *et al*.2000) thus responsible for reduction in MDA concentration as observed in the present study. This can be further substantiated with the findings of Selvam *et al*. (1995) who isolated Turmeric antioxidant protein (TAP) from aqueous extract of Turmeric and showed that TAP has a concentration dependant inhibitory effect on lipid peroxidation. The present study could not find any synergistic effect of Tulsi and Turmeric as reported with other herbals such as Oregano and rosemary essential oil in broilers by Basnacioglu *et al*. (2004) and with Oregano oil and tocopherol acetate alone by Papageorgiou *et* . (2003) Whether the dose that was employed in the study was not suitable for the compatibility of both the herbs needs further study.

CONCLUSION

The study indicated that the antioxidants vitamin E (200mg/Kg), its combination with Se (0.15mg/ Kg), herbals Tulsi and Turmeric at higher inclusion levels were effective in reducing lipid peroxidation and improving meat quality of heat stressed birds. Supplementing combination of Tulsi and Turmeric had no synergistic effect in improving the meat quality than their independent inclusions. But considering the safety of meat and meat products herbals Tulsi and Turmeric at 0.5 and 0.4% level of inclusion may be considered as natural alternative in amelioration of heat stress induced changes in meat.

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