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Effect of graded level vitamin E supplementation on meat quality of male goats (*Capra hircus)*

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ABSTRACT

To assess the effect of vitamin E supplementation on meat quality, fifteen male non- descriptive local kids (6.41 ± 0.37 kg BW and 2 to 3 months old) were divided into three groups and were fed on oat straw and concentrate mixture. Kids were supplemented with 0,100 and 200 IU vitamin E (á-tocopherol acetate) in group I II and III, respectively. Feeding continued for 6 months. Immediately after sacrificing the animals, carcass samples were collected to study the meat quality. Chemical composition of muscle sample of carcass showed non-significant differences between the groups for moisture, crude protein, total ash and ether extract. pH and sensory characteristics like appearance, flavor, juiciness and overall acceptability did not differ among all the groups. However, shear force values and thiobarbituric acid reactive substances decreased from group I to III. Lovibond tintometer color units for red and tenderness value showed increased trend in all the supplemented groups. It may be concluded that supplementation of 100 IU and 200 IU of vitamin E/animal/day increased the redness and tenderness of meat and reduced the shear force value and thiobarbituric acid reactive substances concentration in meat.

Key words: Goat, meat quality, supplementation, vitamin E

INTRODUCTION

Vitamin E is a generic form that includes all entities that exhibit the biological activity of á-tocopherol. Dietary supplementation with vitamin E increases the concentration of á- tocopherol in muscles and reduces the susceptibility of the muscle to the lipid oxidation (Morrissey *et al.,* 1998). Vitamin E supplementation has shown positive effect on fattening performance, carcass characteristics and meat quality (Hill *et al.,* 1987). Supplementing cattle with supranutritional levels of vitamin E (alpha-tocopherol acetate) had improved meat color and lipid stability (Arnold *et al.,* 1993). Extension of beef colour display life depends on the level and duration of supplementation with dietary vitamin E (Liu *et al.,* 1995). Alpha tocopherol becomes an intimate component of biological membranes where lipid-lipid interaction between á –tocopherol and polyunsaturated phospholipids occur (Diplock, 1971). Only prolonged dietary supplementation allows for incorporation of

á–tocopherol into sub cellular compartments (Buckley *et al*., 1995). Now a days animal nutritionists paid more attention to produce vitamin E enriched products that will increase vitamin E status of consumers. While many studies have shown the benefits of vitamin E supplementation on meat quality of poultry and cattle, but little is known on the effects of vitamin E supplementation on meat quality of goats. Therefore, aim of present study is to determine the effect of vitamin E supplementation on meat quality of male goats (*Capra hircus*).

MATERIALS AND METHODS

Animal's management and feeding

Present experiment was approved by the "Committee for the Purpose of Control and Supervision of Experiments on Animals" (CPCSEA), India, and conducted on fifteen male non- descriptive local kids (6.41 ± 0.37kg BW and 2 to 3 month old) procured from Sheep and Goat Farm of Indian Veterinary Research Institute, Izatnagar, India. These animals were adapted on the experimental diet comprising of concentrate mixture and oat straw for a period of one month during which they were treated against ecto and endo parasites and subsequently at regular intervals. All the kids were vaccinated against foot and mouth disease and *peste des petits* of ruminants (PPR). These animals were distributed into three different groups of five kids in each on the basis of their body weights following randomized block design, and were kept in a well ventilated shed with individual feeding and watering arrangements. Kids in all the three groups were fed on concentrate mixture and oat straw to meet their nutrient requirements for 50 g daily weight gain (NRC, 2007). The concentrate mixture consisted of (%) crushed maize grain 30, soybean meal 37, wheat bran 30, mineral mixture 2 and common salt 1.Treatments were: group I (control), without any supplementation, group II supplemented with 100 IU and group III supplemented with 200 IU vitamin E (DL-á-tocopheryl acetate) respectively through the concentrate mixture. Oat straw was provided to the animals after total consumption of concentrate mixture. All the kids were offered about 100 g of the available green berseem (*Trifolium alexandrium*) fodder once a week to meet their vitamin A requirements. Clean and fresh drinking water was provided twice a day to all the animals.

Slaughter of the animals

This experimental feeding practice lasted for 180 days. Twenty-four hr prior to slaughter, the body weight of the animals was recorded. The feed was withdrawn and only *ad lib* water was provided twice during the day. The slaughter of animals was carried out following proper ethical standards using ritual 'halal' method. About one kg of *semitendinosus* (ST) muscle was collected immediately after slaughter of each animal. After removing the separable fat and connective tissues, the samples were brought to laboratory for further analysis.

Analytical Techniques

Feed and meat of the experimental animals were analysed for proximate constituents (AOAC, 2001). pH of meat samples was determined after 4 hr of slaughter of the animals (Strange *et al*., 1977). Shear Force Value (SFV) of muscle sample was estimated by placing the cores of meat samples in the blade attached to the Warner-Bratzler shear force apparatus. The distillation methods of Witte *et al.* (1970) were followed for the estimation of Thio Barbituric Acid Reactive Substances (TBARS) number which was expressed as mg malonaldehyde/kg of meat sample. The color units were determined by using Lovibond Tintometer (Model F, UK) as per the method of Conforth (1994).

Organoleptic evaluation

Pooled ST muscle samples from each group were pressure cooked with salt (1.5%; w/w) and subjected to organoleptic evaluation on 8 point Hedonic scale by a panel of six semi-trained judges to evaluate appearance, flavor, juiciness, tenderness and overall acceptability (Keeton, 1983).

Statistical analysis

The data obtained from above studies was subjected to one way analysis of variance as per Snedecor and Cochran (1989). Difference among

means was tested by using SPSS (1999) computer package.

RESULTS AND DISCUSSION

Chemical composition of the ration

The chemical composition of the feeds offered to experimental goats is presented in Table 1. The crude protein content in concentrate mixture and oat straw was 20.40 % and 4.30%, respectively. Vitamin E concentration in concentrate mixture and oat straw was 13.75 and 1.90 mg kg^{-1} feed, respectively.

Chemical composition of meat

Moisture, crude protein (CP), ether extracts (EE) and total ash content in meat sample is presented in Table 2. No significant difference could be noticed with respect to moisture, protein, fat and total ash content of ST muscle due to different dietary treatments. Similarly Houben *et a*l. (2000) Arnold *et al.*(1992) did not find any significant effect on moisture percent of beef supplemented with vitamin E. Similarly, Yang et al. (2002) also showed non-significant (P>0.05) difference for lipid concentration in muscles of animals given vitamin E in comparison to non-supplemented animals. Dass *et al*. (2011) also observed non significant (P> 0.05) change in moisture, CP, lipid concentration in muscle of buffaloes supplemented with 300 and 600 IU of vitamin E for 180 days.

Sensory attributes of cooked meat

The scores for appearance, flavor, juiciness, tenderness and overall acceptability for ST muscle is presented in Table 2.The organoleptic evaluation of pressure cooked meat with salt by semi trained judges for sensory attributes viz., appearance, flavor, juiciness and overall acceptability did not show any appreciable variation (P>0.05) due to dietary treatments, as they were found statistically comparable. Similarly, Garber *et al*. (1996) did not find any effect of vitamin E supplementation on flavour, juiciness of beef. The tenderness value in different group of animals are 5.65, 6.11 and 6.23 respectively which differ significantly (P<0.05) in supplemented groups than un supplemented group. Contrarily Svedaite *et al*. (2009) observed that feeding a diet containing 0.1 ppm Se and 20 IU of vitamin-E to pigs for 4 months had no effect on tenderness of the meat. Similarly, Dass *et al*. (2011) observed non significant difference in flavor, tenderness, juiciness in Longismus dorsi muscle of buffaloes supplemented with 300 IU of vitamin E/D. Increased tenderness value may be due antioxidant effect of vitamin E on the muscle cells.

Physiochemical properties of meat

Meat pH, water holding capacity, shear force value, thiobarbituric acid reactive substance (TBARS) and Lovibond tintometer color unit number are presented in Table 3. Non-significant (P>0.05) differences were observed among three groups of goats for meat pH and water holding capacity of meat. Similarly, Svedaite *et al*. (2009) observed that feeding a diet containing 0.1 ppm Se and 20 IU of vitamin E to pigs for 4 months had no effect on meat pH and water holding capacity.

Table 1. Chemical composition (%) of concentrate mixture and oats straw

Nutrients	Concentrate mixture	Oat straw
Crude protein	20.40	4.30
Ether extract	2.30	1.20
Neutral detergent fiber	34.50	78.30
Acid detergent fiber	11.60	57.10
Hemicelluloses	22.90	21.20
Cellulose	9.50	43.90
Total ash	9.10	6.70
Calcium	1.57	0.85
Phosphorus	0.86	0.14
α-tocopherol, mg kg^{-1}	13.75	1.90

Table 2. Chemical composition and organoleptic evaluation of *semi tendinosus* muscle on eight point Hedonic scale

Attributes	Group			
	I	II	III	SEM
Moisture (%)	75.90	74.50	75.00	0.49
Total Ash (%)	1.70	1.60	1.58	0.06
Crude protein (%)	18.20	19.12	18.50	0.32
Ether extract (%)	4.01	3.96	3.81	0.17
Organoleptic evaluation score				
Appearance	6.50	6.72	6.95	0.28
Flavor	6.60	6.82	6.91	0.15
Juiciness	6.50	6.67	6.71	0.16
Tenderness*	5.65^{a}	6.11^{b}	6.23^{b}	0.13
Overall acceptability	6.50	6.81	6.73	0.14

^{ab}Means bearing different superscripts in a row differ significantly ($P < 0.05$)

Table 3. Physiochemical properties of *semi tendinosus* muscle in goats supplemented with vitamin E

Attributes	Group			
	I	II	III	SEM
pH	6.30	6.20	6.20	0.11
WHC (%)	29.25	30.52	31.00	0.82
SFV (kg/cm^2)	3.45^{b}	3.11^{a}	3.11^{a}	0.02
TBARS (mg malonaldehyde/ kg)	0.53^{c}	0.42^{b}	0.51^{ab}	0.04
Lovibond Tintometer color unit				
Red (a)	2.11^{a}	2.52^{ab}	3.21^{b}	0.12
Yellow (b)	2.50^{a}	3.25^{a}	3.92^{ab}	0.29

Contrary to these findings, Lynch *et al.* (2000) reported higher ($P<0.01$) pH values of meat from the vitamin E supplemented bulls, which may be due to very high dose of vitamin E (2000 IU) given to bulls in comparison to present study.

Shear force values ($kg\ cm^{-2}$) in muscles of goats given vitamin E were significantly lower in comparison to control group. Contrary to this, no treatment effect on the force required to shear the meat was observed in beef cattle (Arnold *et al.*, 1992; Garber *et al.*, 1996). Lower SFV in meat samples of vitamin E treated animals could be due to non-significant lower growth rate and increased tenderness of the muscle.

The TBARS (thiobarbituric acid reactive substances) number, which indicates the oxidative stability and keeping quality of meat, were significantly ($P < 0.05$) differed among the four groups, being lowest in vitamin E supplemented group. Similar observations were reported by Stubbs *et al*. (2002) in top loin steaks of vitamin E supplemented steers as compared to control group. Similarly, Arnold *et al.* (1992) also reported delayed lipid oxidation by vitamin E supplementation. These results revealed that vitamin E supplementation was effective in reducing the lipid oxidation of the meat samples. Contrary to present findings, Yang *et al*. (2002) did not observe increased in TBARS values in the meat of steers supplemented with 2500 IU of alpha-tocopheryl acetate/d.

The result of this experiment indicated that supplementation of Vitamin E in the diet of goats had positive effect on Lovibond tintometer colour units. Meat Redness and yellowness value of vitamin E supplemented animals was significantly ($P < 0.05$) higher than control. Similarly, Lynch *et al*. (1999)

observed that dietary vitamin E supplementation (2000 mg á- tocopheryl acetate/ kg feed) for approximately 50 days prior to slaughter improved the colour in fresh beef than un supplemented beef. Similarly, Muhlis *et al.* (2003) reported that vitamin E supplementation (45 mg vitamin E per lamb per day for 75 days) in the diet of Morkaraman male lambs significantly reduced lipid oxidation and tended to maintain meat redness. Similarly, Dass *et al.* (2011) observed increased redness and yellowness value in muscles of buffaloes supplemented with 600 IU of vitamin E. Contrary to these, Guo *et al.* (2006) observed that supplementation of vitamin E @ 40 IU to 200 IU/kg for 63 days in finishing pigs had no effect on color intensity of meat. Svedaite *et al.* (2009) observed that feeding a diet containing 0.1 ppm Se and 20 IU of vitamin-E for 4 months had no effect on meat colour of pigs . Extension of color display of the meat depends on level and duration of supplementation of vitamin E and Se (Liu *et al.*, 1995).

CONCLUSION

It may be concluded that supplementation of 100 IU and 200 IU of vitamin E improved the redness, tenderness and keeping quality of meat of male goats.

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