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ORIGINAL ARTICLE

Effect of selenium yeast and vitamin E supplementation on meat quality of male goats (*Capra hircus*)

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Abstract

An experiment was conducted on 24 male goats (average body weight 6.80±0.20 kg) to elucidate the effect of supplemental selenium yeast and/or vitamin E on their meat quality. Group I served as control (without any supplementation), groups II, III and IV were supplemented with 0.3 mg Se as Se yeast, 100 mg of DL-α-tocopheryl acetate, and both 0.3 mg Se as Se yeast and 100 mg DL-α-tocopheryl acetate respectively. Animals were fed on concentrate mixture and oat straw to meet their nutrient requirements. Feeding continued for 180 days. 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 IV. Lovibond tintometer color units for red and tenderness value showed increased trend in all the supplemented groups. It may be concluded that supplementation of 0.3 mg Se as selenium yeast and 100 IU of vitamin E/animal/day increased the redness and tenderness of meat and reduced the shear force value and TBA concentration in meat.

Key words: Goats, meat quality, selenium yeast, vitamin E.

Introduction

Selenium (Se) and vitamin E enhanced antioxidant status in the muscle and tends to improve meat quality and shelf life (Mitsumoto *et al.*, 1998). Dietary supplementation with Se and vitamin E increases the concentration of α–tocopherol in muscles and reduces the susceptibility of the muscle to the lipid oxidation (Morrissey *et al*., 1998). Supplementation of diet with Se and α –tocopherol acetate has been shown to control the loss of desirable color, lipid oxidation and accumulation of metmyoglobin in beef (Arnold *et al*., 1993). Alpha tocopherol becomes an intimate component of biological membranes where lipid-lipid interaction between α–tocopherol and polyunsaturated phospholipids occur (Dass *et al.*, 2011). Now a days animal nutritionists paid more attention to produce Se and vitamin E enriched products that will increase Se and vitamin E status of consumers. While many studies have shown the benefits of Se and vitamin E supplementation on meat quality of poultry, but little is known on the effects of Se and vitamin E supplementation on meat quality of goats. Therefore aim of present study is to determine the combined effect of Se yeast and vitamin E supplementation on meat quality of male goats (*Capra hircus*).

Materials and Methods

Preparation of Se yeast

Se yeast was prepared by growing *Saccharomyces cervisiae* in broth media followed by addition of aqueous solution of sodium selenite.

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 24 male kids (*Capra hircus*; about 2-3 months of age, average live weight 6.80±0.20 kg) 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 four different groups of six 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 four 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 0.3 ppm Se as Se yeast; group III supplemented with 100 mg DL-α-tocopheryl acetate and group IV supplemented with both 0.3 mg Se as Se yeast and 100 mg DL-α-tocopheryl acetate 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 hours 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.

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 applying Tukey's test using SPSS (1999) computer package.

Result 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 20.6 and 4.3%, respectively. Se concentration in concentrate mixture and oat straw was 0.12 and 0.11mg kg^{-1} feed, respectively.

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
Se, mg kg^{-1}	0.12	0.11
α-tocopherol, mg kg^{-1}	13.75	1.90

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 Skrinova *et al*. (2007) in calves and Zhan *et al*. (2007) in pigs reported that

supplementation of Se yeast had no effect on dry matter, protein, fat and ash content of meat. Similarly Dass *et al*. (2011) did not observe any change in moisture, CP, lipid concentration in muscle of buffaloes supplemented with 300 and 600 IU of vitamin E. Contrary to these, Mikulski *et al*. (2009) observed that supplementation with 0.3 ppm Se as Se yeast in turkey for 112 days had significantly increased the crude fat content of muscle. This may be due to the variation in species.

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 5.22, 6.00, 6.50 and 6.88 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. Similarily 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/day. Increased tenderness value may be due antioxidant effect of these micronutrients on the muscle cells.

Physiochemical properties of meat

Meat p^H, 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 four groups of goats for meat p^H values after 4 hr of slaughter. 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 p^H. Vignola *et al*. (2009) also did not observe any change in meat p^H in lambs fed with 0.45 ppm Se as Se- yeast for 63 days as compared to control. 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 Se and 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 Se and 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 Se-yeast and vitamin E supplemented group.

Table 2: Chemical composition and organoleptic evaluation of *Semi tendinosus* (SD) muscle on eight point Hedonic scale

	Group				
Attributes	I	II	III	IV	SEM
Chemical composition (%)					
Moisture (%)	75.50	74.90	74.70	75.00	0.55
Total Ash (%)	1.30	1.20	1.20	1.20	0.09
Crude protein (%)	18.40	19.10	18.70	19.00	0.38
Ether extract (%)	4.10	3.90	3.80	3.90	0.35
Organoleptic evaluation score					
Appearance	6.10	6.38	6.50	6.13	0.23
Flavor	6.25	6.38	6.50	6.50	0.13
Juiciness	6.25	6.50	6.50	6.50	0.14
Tenderness*	5.75 [a]	5.88 [a]	6.50 [b]	6.88 [b]	0.16
Overall acceptability	6.20	6.50	6.40	6.55	0.15

[abc] *Means bearing different superscripts in a row differ significantly * (P<0.05); SEM: Standard Error of means.*

#Animals fed on Basal diet (concentrate mixture + oat straw) (Group I) and 0.3 ppm Se as selenium yeast (Group II) and 100 mg DL-α-tocopheryl acetate (Group III) and both 0.3 mg Se as selenium yeast and 100 mg DL-α-tocopheryl acetate (group IV)

Table 3: Physiochemical properties of *Semi tendinosus* (SD) muscle in goats supplemented with Selenium yeast and vitamin E

	Group				
Attributes	I	II	III	IV	SEM
pH	6.90	6.70	6.70	6.60	0.15
WHC (%)	29.54	30.93	31.03	30.06	0.95
SFV (kg/cm^2)	3.80^{c}	3.40^{b}	3.40^{b}	3.10^{a}	0.04
TBARS (mg malonaldehyde/ kg)	0.72^{c}	0.61^{b}	0.54^{ab}	0.48^{a}	0.06
***Lovibond Tintometer color unit**					
Red (a)	2.38^{a}	2.80^{ab}	3.26^{b}	3.86^{c}	0.15
Yellow (b)	2.80^{a}	3.40^{a}	4.01^{ab}	5.40^{b}	0.32

^{abc}*Means bearing different superscripts in a row differ significantly (P<0.05)*
#Animals fed on Basal diet (concentrate mixture + oat straw) (Group I) and 0.3 ppm Se as selenium yeast (Group II) and 100 mg DL-α-tocopheryl acetate (Group III) and both 0.3 mg Se as selenium yeast and 100 mg DL-α-tocopheryl acetate (group IV)

Similarly Bobcek *et al*. (2004) observed decreased TBARS concentration in muscle of pig supplemented with 0.3 ppm organic Se for 97 days. Similarly Walsh *et al*. (1993) observed decreased TBARS concentration in muscles of crossbred calves supplemented with sodium selenite at 0.438 ppm for 50 weeks. Zavodnik *et al*. (2011) observed 32% reduction in TBARS concentration in meat of pig fed with concentrate mixture containing 250 g Se- yeast per ton for 178 days. Contrary to present findings, Vignola *et al*. (2009) did not observe any change in TBARS values in meat of lambs fed with 0.45 ppm Se as Se yeast for 63 days as compared to control. The result of this experiment indicated that supplementation of Se yeast in the diet of goats had positive effect on Lovibond tintometer colour units. Meat redness and yellowness value of Se and vitamin E supplemented animals was significantly (P<0.05) higher than control. Similar to this, Miezeliene *et al*. (2011) observed that supplementation of 0.5 ppm Se and 40 mg of vitamin E in broiler birds enhanced the redness of meat. Contrary to this 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. Similarly, Vignola *et al*. (2009) did not observe any change in meat colour intensity in lambs fed with 0.45 ppm Se as Se yeast for 63 days as compared to control. 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 0.3 ppm Se as Se yeast 100 IU of vitamin E improved the redness, tenderness and keeping quality of meat of male goats.

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