EFFECT OF DIETARY VITAMIN E ON THE LIPID OXIDATION AND α-TOCOPHEROL LEVELS IN NELORE STEERS MUSCLE

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Background

One of the greatest problems with the meat tissue is the lipid instability that occurs due to failure of the enzymatic systems, predisposing the meat constituents to oxidation, mostly lipids, changing important characteristics as color and flavor.

Lots of efforts have been made in order to decrease this oxidation, most of them prioritize the use of natural antioxidants as vitamin E (α-tocopherol). It is noted that α-tocopherol supplementation in the animals' diet increases tocopherols concentration in the muscular cell thus, decreasing the effects of the oxidation and the severity of subsequent changes in muscular tissue. This brings great benefits for the several segments involved with this food.

Objectives

This study has the objective of evaluating the effects of dietary α-tocopherol supplementation on the lipid stability and intra-muscular α-tocopherol concentration in Nelore steers.

Methods

Twenty-four 30 months old Nelore steers (*Bos indicus*), with average weight of 279 Kg at the beginning of the experimental period and 421Kg at the end, were used. Half the animals were supplemented with 1,000 mg of α-tocopherol acetate for 98 days. They were slaughtered and then the muscles *supraspinatus* (SS), *longissimus lumborum* (LL) and *semitendinosus* (ST) were excised, aged 14 days, and frozen at 20°C until required for analysis. Then they were thawed, cut in steaks and displayed in polystirene trays with oxygen permeable plastic film and under cool white illumination for 5 days at 7°C.

The analysis of α-tocopherol in the muscle was accomplished by HPLC in normal phase according to KATSANIDIS & ADDIS (1999).

The analysis of 2-tiobarbituric acid reactive substances (TBA) was accomplished according to RAHARJO et al. (1992), but excluding the washing phase with solid phase extraction cartridge. The analyses of TBA were done before and after the 5 days of display in simulated retail conditions.

The statistical analysis of the data was run from the values obtained in duplicate, using the software SAS (1985). The procedure GLM was used to evaluate the effects of the muscle type (1,2,3), treatment (1,2) and time of display (0 and 5 days), for items analyzed. A T test was used to accomplish multiple comparisons between pairs of individual average measures (Least squares means).

Results and Discussion

The results are demonstrated in Graphics I and II. The supplementation was efficient in increasing α-tocopherol concentration in muscles. The difference between the supplemented and the not supplemented muscles was highly significant ($P<0,0001$). These results agree with previous studies (ARNOLD et al., 1993; CHAN et al., 1996; CHAN et al., 1998; EIKELENBOOM et al., 2000; GATELLIER et al., 2001; HOUBEN et al., 2000; LIU et al., 1996; MITSUMOTO et al., 1998; GRADY et al., 1998), which showed the efficiency of supplementation in elevating the cellular levels of α-tocopherol. The concentration of α-tocopherol found in the not supplemented muscles was relatively high, considering the values found in the literature (ARNOLD et al., 1993; CHAN et al., 1996; CHAN et al., 1998; EIKELENBOOM et al., 2000; GATELLIER et al., 2001; HOUBEN et al., 2000; LIU et al., 1996; MITSUMOTO et al., 1998; GRADY et al., 1998). This probably occurred due to the previous pasture-fed history before the experiment. YANG et al. (2002) demonstrated that the levels of α-tocopherol in the muscle were higher in pasture-fed than grain-fed cattle, but contrary to the present study, they did not find significant difference among supplemented pasture-fed cattle (2,500 UI/head/day) and controls. Some researchers reported that the access to pastures before the experiment affected negatively the antioxidant effects of α-tocopherol supplementation (FAUSTMAN et al., 1998; GATELLIER et al., 2001). Probably the highest levels of unsaturated fatty acids in the pasture-fed cattle meat explain this verification (YANG et al., 2002). ARNOLD et al. (1993) established an optimum intra-muscular α-tocopherol concentration to maximum metamyoglobin inhibition (3.3 μg/g) and for lipid stability (3.1 μg/g), while LIU et al. (1996) found the values 3.0 to 5.7 μg/g to retard substantially these oxidizing processes. At this work, despite the supplemented animals showed superior values than the ones mentioned, the supplementation was efficient in the oxidation inhibition.

Among muscles, the reddest exhibited higher α-tocopherol levels, being SS>LL>ST the order of intra-muscular concentration. This tendency has been the same in previous studies. Chan et al. 1996, supplementing cattle with 1,204 UI/head/day, noted that both controls and supplemented muscles followed the concentration order PM (*psoas major*)>GM (*gluteus medius*)>LL. The concentration increased 8.9, 8.2 and 9.2 times in supplemented muscles, 0.68 to 6.26 μg/g in LL, 0.97 to 7.98 μg/g in GM and 1.23 to 10.93 μg/g to PM. Arnold et al. (1993) reported a higher concentration in GM (1.6 μg/g) than LL (1.2 μg/g). LIU et al. (1996) also observed muscular differences: GM (2.69 μg/g) > SM-*semimembranosus* (2.24 μg/g) > LL (1.97 μg/g).

TBA's analysis (Graphic II) showed that, after meat display under simulated retail conditions, supplemented muscles obtained significantly lower values ($P<0.05$) than controls, demonstrating better lipid stability in the first. These results are in agreement with previous studies (EIKELENBOOM et al., 2000; GATELLIER et al., 2001; HOUBEN et al., 2001; LIU et al., 1996; MITSUMOTO et al., 1998; GRADY et al., 1998; STUBBS et al., 2002), while YANG et al. (2002) did not find effect in meats of fed pasture cattle. The effect of supplementation on the lipid stability was observed, mostly, after display period under retail conditions. STUBBS et al. (2002) noted that TBA's values were reduced sensibly in cattle meat supplemented with vitamin E and packed under modified atmosphere compared to the controls. However, there was not significant difference to first two days of display. GATELLIER et al. (2001) analyzed cattle meat and verified that TBA's values were significantly decreased, mostly at the end of the time of stock (for TB (*triceps brachii*) and LL packed under modified atmosphere, and for TB with oxygen permeable film, but not for LL with oxygen permeable film).

There was significant difference ($P<0.05$) of lipid stability when supplemented muscles were compared, after display period under simulated retail conditions, being LL>ST>SS. SS had smaller lipid stability, despite of the higher α-tocopherol concentration, in comparison to other analyzed muscles.

Conclusion

The supplementation of vitamin E in the diet of Nelore steers was efficient to increase the intra-muscular α-tocopherol concentration, as well as in animals with previous history of pasture feeding. The lipid stability was significantly improved in these animals. SS, in spite of the highest α-tocopherol concentration, demonstrated lower lipid stability in comparison to muscles LL and ST.

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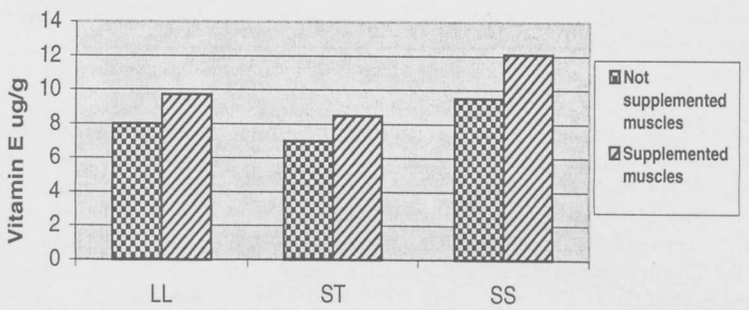
Graphic I –Vitamin E concentration in Nelore steers muscle



Graphic II – TBA concentration in Nelore steers muscle display under retail conditions