The Effect of Dietary Vitamin E Supplementation on the Stability of Oxidative and Glycolytic Pork Muscles.

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Background

Lipid oxidation in muscle foods is initiated in the highly unsaturated phospholipid fraction of subcellular membranes (Rhee *et al.*, 1987). Increased tissue α-tocopherol levels can improve oxidative stability (Diplock, 1985). Recent studies in our laboratories have shown that dietary vitamin E supplementation inhibits lipid and cholesterol oxidation, colour deterioration and drip loss in muscle foods from pigs, lamb and poultry.

The objectives of this study were to determine the effects of dietary vitamin E supplementation on oxidative and glycolytic muscle α-tocopherol levels, and on the susceptability of those muscles to lipid oxidation and colour deterioration following frozen storage.

Methods

Pigs (n=9), were selected at random and divided into three groups (n=3) and fed diets containing no added (basal), 20 (low supplemented) and 160 (high supplemented) mg Dl-α-tocopheryl acetate/kg feed for a period of 130 days prior to slaughter. After slaughter, carcasses were chilled at 4°C overnight prior to dissection. Forty muscles were identified and removed from the left side of each animal for each dietary group. Muscles were vacuum packed and frozen at -20°C until required for analysis.

Cores (2.5 cm diam.) were taken from muscles (-20°C x 6 Months), placed on polystyrene trays and overwrapped with an oxygen permeable PVC wrap having an oxygen transmission rate of 6000 to 8000 cm^3 O_2/m^2/24hr. Meat samples were stored at 4°C under flourescent light (616 LUX) for 7 days.

Lipid oxidation in meat samples was measured by the method of Ke *et al.* (1977). Measurement of tristimulus colour coordinates (L, a, b) of muscle were recorded using a Perkin Elmer (Lambda 2) spectrophotometer. Metmyoglobin content was determined using the method of Stewart *et al.* (1965). α-Tocopherol in tissue was determined using the extraction method of Bieri *et al.*. (1975), the Buttriss and Diplock (1984) modification and quantified by HPLC (Sheehy *et al.*, 1993).

Results

The mean α–tocopherol levels in pork muscles were significantly ($p < 0.05$) higher in the high supplemented group (160 mg α-tocopheryl acetate/kg of feed) compared to the low-supplemented (20 mg/kg of feed) and unsupplemented group (no added α-tocopheryl acetate) (Fig. 1). The muscles of the thoracic limb (Fig. 1a), *M. deltoideus, M. tensor fasciae antebrachii, M. infraspinatus, M. supraspinatus, M. triceps brachii caput laterale* and *M. triceps brachii caput longum* are more oxidative than the muscles of the back and pelvic limb (Fig. 1b), *M. obliquus internus abdomonis, M. longissimus dorsi* and *M. gluteobiceps* which are glycolytic (Renerre *et al.*, 1993). In this study the oxidative muscles from the thoracic limb had a greater uptake of α-tocopherol than the glycolytic muscles from the pelvic limb. Metmyoglobin formation occurred at a faster rate for the low-supplemented group than for the high-supplemented group (Fig.2a). The oxidative muscle *M. triceps brachii caput longum* had greater initial and final metmyoglobin levels than *M. longissimus dorsi* , however metmyoglobin in the former developed at a slower rate (Fig. 2a). Muscles from the 160 mg α-tocopherol acetate group were the most stable to lipid oxidation (Fig. 2b). The oxidative muscle *M. triceps brachii caput longum* was more stable to lipid oxidation than the glycolytic muscle *M. longissimus dorsi.*

Conclusions

The dietary supplementation of pigs fed with α-tocopheryl acetate appears to be an effective means for improving the colour and oxidative stability of frozen pork. Oxidative muscles have a greater α–tocopherol uptake and are less prone to colour and oxidative deterioration than glycolytic muscles.

References

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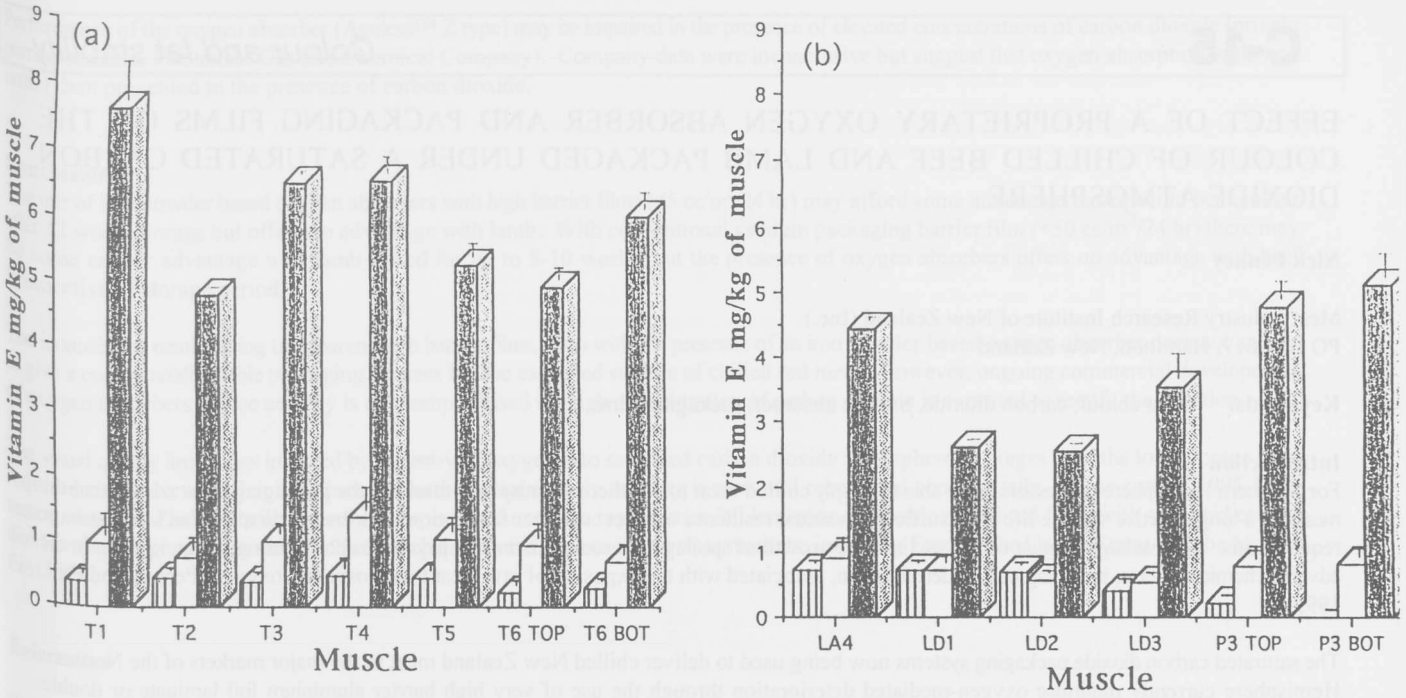

Fig. 1. Effect of α-tocopheryl acetate supplementation on the α-tocopherol content of muscle tissue in the **thoracic limb**. (**a**) T1= *M. deltoideus*, T2= *M. tensor fasciae antebrachii*, T3= *M. infraspinatus*, T4= *M. supraspinatus*, T5= *M. triceps brachii caput laterale*, T6= *M. triceps brachii caput longum*. (Top and Bottom portions) and (**b**) **the back and pelvic limb**,LA4= *M. obliquus internus abdominis*, LD= *M. longissimus dorsi*. P3= *M. gluteobiceps*.

▩ =160 mg α-tocopheryl acetate/kg of feed

□ = 20 mg α-tocopheryl acetate/kg of feed

▥ = unsupplemented

Mean ± SEM of 3 analyses performed in duplicate.

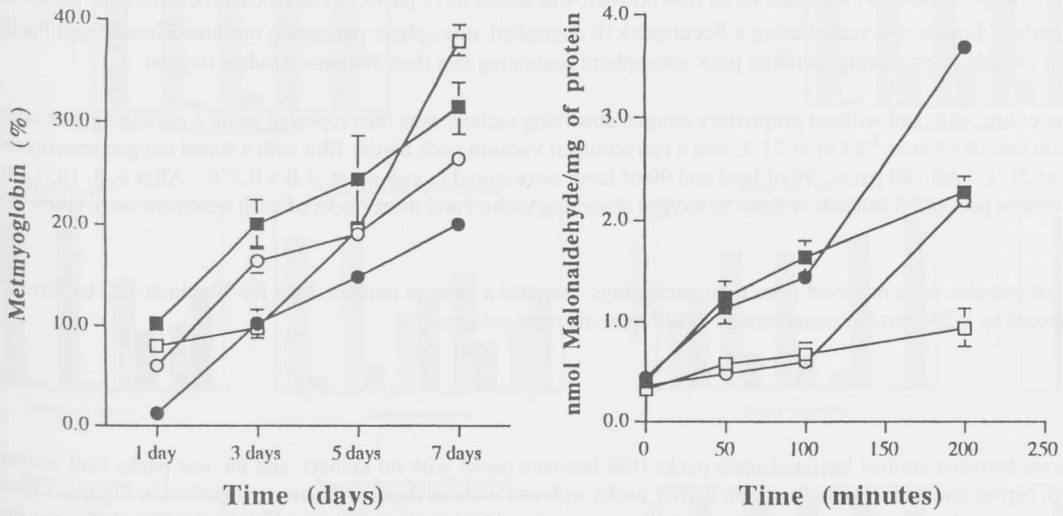

Fig. 2a. Effect of dietary α-tocopheryl acetate supplementation on the percentage of metmyoglobin formed in muscle tissue during refrigerated display at 4°C. *M. triceps brachii caput longum* (Oxidative muscle) (■) = 160 mg α-tocopheryl acetate/kg of feed and (□) =20 mg /kg of feed. *M. longissimus dorsi* (Glycolytic muscle) (●)= 160 mg α-tocopheryl acetate/kg of feed, (○) = 20 mg /kg of feed.
Mean ± SEM of 3 analyses performed in duplicate.

Fig. 2b. The effect of dietary α-tocopheryl acetate supplementation on iron induced lipid peroxidation of muscle tissue. *M. triceps brachii caput longum* (Oxidative muscle) (■).= 160 mg α-tocopheryl acetate/kg of feed and (□) =20 mg /kg of feed.
M. longissimus dorsi (Glycolytic muscle) (●) = 160 mg α-tocopheryl acetate/kg of feed, (○) = 20 mg /kg of feed .
Mean ± SEM of 3 analyses performed in duplicate.