EFFECT OF DIETARY VITAMIN E SUPPLEMENTATION ON THE QUALITY OF FRESH AND VACUUM-PACKAGED BEEF

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Background

Lipid oxidation in muscle foods is initiated in the highly unsaturated phospholipid fraction of subcellular membranes (Gray and Pearson, 1987). It is generally accepted that susceptibility to lipid and colour oxidation is influenced by tissue levels of α-tocopherol. Studies have shown that dietary vitamin E supplementation delayed lipid oxidation and colour deterioration in beef (Faustman et al., 1989; Arnold et al., 1993).

The objective of the present study was to determine the effects of dietary vitamin E supplementation on tissue α-tocopherol levels in oxidative and glycolytic muscle and on the susceptibility of freshly chilled and vacuum-packaged (4°C x 4 weeks) beef (*M. longissimus dorsi* (glycolytic), *M. gluteus medius* (intermediary) and *M. psoas major* (oxidative)) to lipid oxidation and colour deterioration.

Methods

Fresian steers (n=6) were divided into two groups (n=3) and were fed diets containing 20 (basal) or 2000 (supplemented) IU/head/day for 50 days prior to slaughter. Following slaughter, the carcasses were chilled overnight and *M. longissimus dorsi*, *M. gluteus medius* and *M. psoas major* removed from each carcass. Each muscle was divided into two portions and vacuum packed. The beef portion for fresh analysis was used immediately while the second portion was placed in the chill at 4°C for 4 weeks.

Steaks (3 cm thick) were cut from each muscle and duplicate meat cores (2.5 cm diam.) were taken from each steak, placed on polystyrene/EVOH/polyethylene trays and overwrapped with oxygen permeable (6000-8000 $cm^3/m^2/24$ h) polyvinyl-chloride film. All packaged cores were held in retail display conditions for 10 days at 4°C under fluorescent lighting (616 lux).

Lipid oxidation in meat samples was assessed by the 2-thiobarbituric acid 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. The proportion of metmyoglobin was determined by the method of Krzywicki (1979). The α-tocopherol content in the muscle tissues was determined using the extraction of procedures of Bieri et al. (1975) with the modifications of Buttriss and Diplock (1984) and quantified by HPLC (Sheehy et al., 1993).

Results

There were significant ($p < 0.001$) differences in α-tocopherol levels between supplemented (2000 IU/head/day) and basal (20 IU/head/day) groups. There were significant differences in the α-tocopherol levels between supplemented *M. longissimus dorsi* (4.7 ± 0.5 μg/g) and *M. psoas major* (7.8 ± 1.2 μg/g) ($p < 0.001$) and supplemented *M. gluteus medius* (5.1 ± 0.3 μg/g) and *M. psoas major* (7.8 ± 1.2 μg/g) ($p < 0.01$). No significant differences in α-tocopherol levels were observed between muscles from the basal groups. In general, supplemented fresh and vacuum-packed chilled beef showed greater colour and oxidative stability than meat from the basal group (Fig. 1). Meat samples taken from *M. longissimus dorsi* were more colour stable and were more resistant to lipid oxidation than *M. psoas major*. 'a' values, proportion of metmyoglobin and TBARS values for *M. gluteus medius* were intermediary between those of *M. longissimus dorsi* and *M. psoas major*.

Conclusions

The dietary supplementation of cattle with α-tocopheryl acetate appears to be an effective means for improving the colour and oxidative stability of both fresh chilled and vacuum-packaged (4°C x 4 weeks) beef cuts. Different muscles contain different levels of vitamin E based on requirements due to oxidative or glycolytic activities.

References

Arnold, R.N., Arp, S.C., Scheller, K.K., Williams, S.N. and Schaefer, D.M. (1993). *J. Anim. Sci.*, **71**, 105-118. Bieri, J.G., Tolliver, T.J. & Catignani, G.L. (1979). *Am. J. Clin. Nutr.*, **32**, 2143-2149. Buttriss, J.L. and Diplock, A.T. (1984). *Methods in*

Enzym ., **105**, 131-138. Faustman, C., Cassens, R.G., Schaefer, D.M., Buege, D.R., Williams, S.N. & Scheller, K.K. (1989). *J. Food Sci.*, **54**: 858-862. Gray, J.I. & Pearson, A.M. (1987). In: Pearson, A.M. Dutson, A.R. (eds.) Advances in Meat Research. New York, Van Nostrand Reinhold Company. 221-229. Ke, P.J., Ackman, R.J., Linke, B.H. and Nash, D.M. (1977). J. *Food Tech.*, **12**, 37-47. Sheehy, P.J.A., Morrissey, P.A. and Flynn, A. (1993). *Brit. Poultry Sci.*, **34**, 367-381. Krzywicki, K. (1979). *Meat Sci.*, **3**, 1-10.

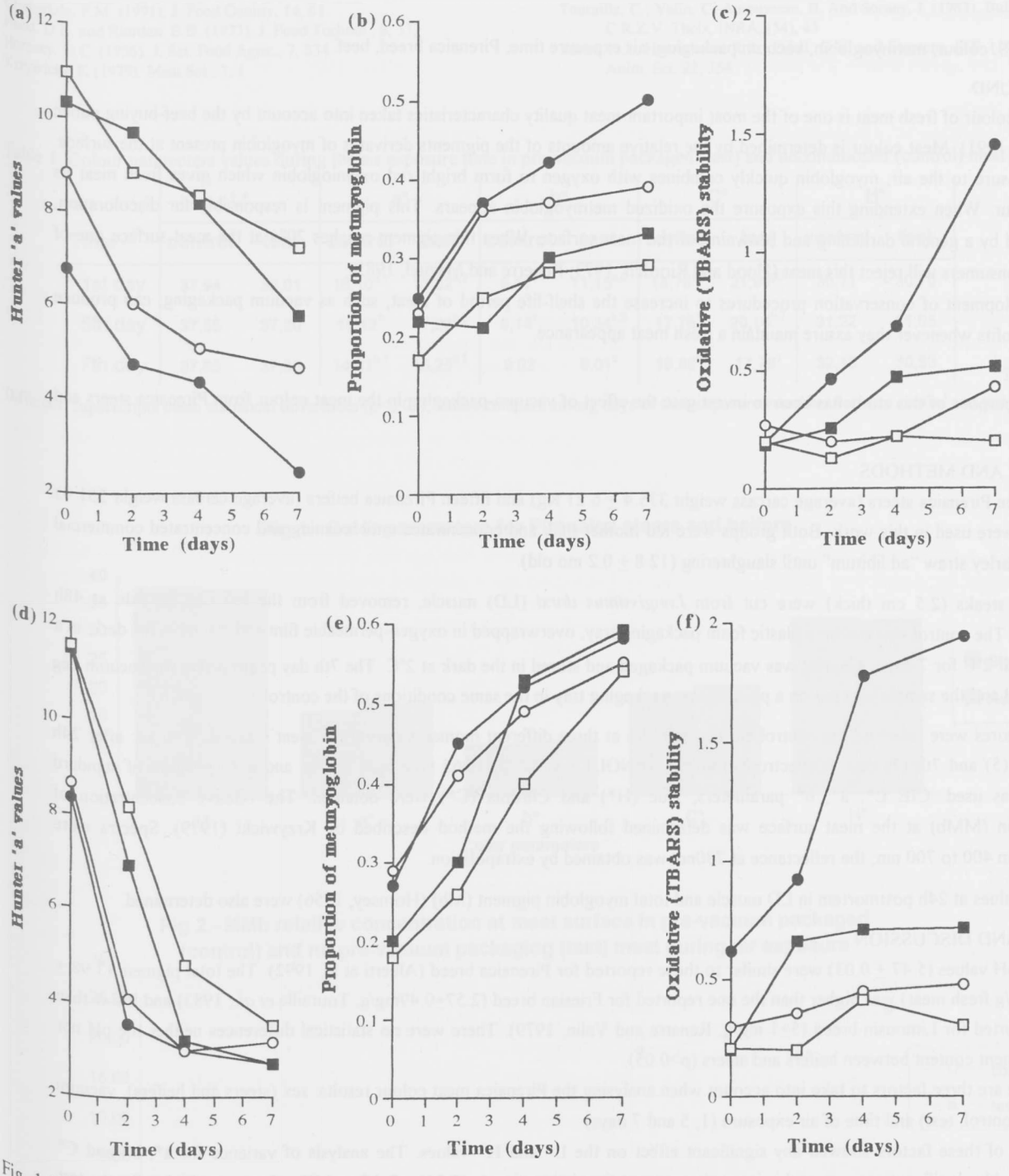

Fig. 1 Effect of dietary α-tocopheryl acetate supplementation on (**a**) and (**d**) Hunter 'a' values, (**b**) and (**e**) metmyoglobin formation and (**c**) and (**f**) oxidative stability of freshly chilled and vacuum-packed (4°C x 4 weeks), respectively, during refrigerated display at 4°C for 7 days. (■) *M. longissimus dorsi* from basal group and (□) from supplemented group (●) *M. psoas major* from basal group and (○) from supplemented group. Basal and supplemented groups fed 20 and 2000 IU/head/day α-tocopheryl acetate for 50 days, respectively.