EFFECT OF PASTURING OR VITAMIN E SUPPLEMENTATION ON COLOUR AND METHMYOGLOBIN FORMATION IN BEEF HELD UNDER DIFFERENT PACKAGING CONDITIONS

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Background

The colour of fresh meat is a key factor used by the consumer to indicate meat quality and freshness and its rate of sale is directly related to the degree of discolouration (MacDougall and Taylor, 1975). The development of Modified Atmospheric Packaging (MAP) has provided a new approach for extending the shelf-life of fresh meat products (Hood and Mead, 1993). MAP for fresh red meats involves the use of high concentrations of oxygen to maintain or produce a deep layer of bright red oxymyoglobin and lower concentrations of carbon dioxide which have a bacteriostatic effect (Church and Parsons, 1995). Dietary α-tocopheryl acetate supplementation in cattle diets has been shown to improve colour stability in beef held under retail conditions (Arnold et al., 1993). The objective of the present study was to compare the effect of MAP and other forms of packaging, on colour and methmyoglobin formation in *M. gluteus medius* produced by varying the dietary conditions of crossbreed Friesian cattle.

Materials and Methods

Crossbreed (Friesian x Charolais) heifers (n=12) were divided into four groups (n=3). Group 1 was overwintered indoors and fed a basal concentrate diet containing 20 mg α-tocopheryl acetate/head/day. Group 2, also overwintered indoors, was fed a supplemented concentrate diet containing 3000 mg α-tocopheryl acetate/head/day for 50 days prior to slaughter. Both of these groups received silage *ad libitum*. Group 3 was overwintered indoors, fed basal concentrate and silage diets and pastured for 6 weeks on late Spring (April-May) grass prior to slaughter. Group 4 was pastured from April and slaughtered in late Autumn (October). Following slaughter, carcass sides were chilled (4°C x 24 hours). *M. gluteus medius* was removed from each carcass, vacuum packed and frozen (-20°C x 3 months).

Steaks (2.5 cm thickness) were cut from each muscle and duplicate cores (2.5 cm diameter) were taken from each steak. These were packaged aerobically, under vaccum and in 80 : 20 (O_2 : CO_2) MAP prior to refrigerated (4°C / 616 lux fluorescent lighting) display for 10 days. Vacuum packaged samples were stored in darkness and allowed to bloom, following overwrapping, for a minimum of 3 hours prior to colour analysis. Meat cores were MAP and vacuum packaged using low oxygen permeable (8-12 cm^3/m^2/24 hours) polystyrene/EVOH/polyethylene and (45 cm^3/m^2/24 hours) polyamide/polyethylene films, respectively. Aerobically packaged samples were overwrapped with oxygen permeable (6000-8000 cm^3/m^2/24 hours) polyvinyl-chloride film.

Hunter 'a' values for meat cores were recorded using a Minolta Colorimeter. Metmyoglobin content was determined by the method of Krzywicki (1979), using a Perkin-Elmer (Lambda 2) spectrophotometer. α-Tocopherol concentrations in muscle tissues was determined using the extraction procedures of Bieri et al. (1975) with the modifications of Buttriss and Diplock (1984) and quantified by the HPLC method of Sheehy et al. (1993).

Results

There was a significant ($p < 0.001$) difference in α-tocopherol levels between the α-tocopheryl acetate supplemented group (Group 1, 7.1 ± 0.4 μg/g tissue) and all other dietary groups. There was no significant difference between basal (Group 2, 4.4 ± 0.3 μg/g tissue) and Autumn pastured (Group 4, 3.5 ± 0.4 μg/g tissue) groups, however, both of these dietary groups had significantly ($p < 0.01$) higher α-tocopherol levels compared to the Spring pastured (Group 3, 1.8 ± 0.3 μg/g tissue) group. In general, Hunter 'a' values decreased with respect to the dietary group in the order: supplemented group 1 > basal group 2 > Autumn pastured group 4 > Spring pastured group 3. With the exception of the Spring pastured group, Hunter 'a' values were higher in all dietary beef groups held under MAP (Figure 1a) than observed under aerobic (Figure 1b) and vacuum (Figure 1c) conditions. Vacuum packaged samples (Figure 1c) gave the lowest Hunter "a" values for all dietary groups. Overall, α-tocopheryl acetate supplementation significantly ($p < 0.05$) improved Hunter "a" values on days 2, 6 and 8 under MAP as compared to aerobic and vacuum packaged meat. Metmyoglobin formation increased in all dietary groups over the 10 day period. In general, metmyoglobin formation decreased with respect to dietary groups in the order: Spring pastured group 3 > Autumn pastured group 4 > basal group 2 > supplemented group 1. Metmyoglobin formation was delayed under MAP (Figure 2a) but promoted by vacuum packaging (Figure 2c), Metmyoglobin formation in aerobically (Figure 2b) packaged meat lay between those levels formed under other packaging methods.

Conclusions

Dietary supplementation of cattle with α-tocopheryl acetate resulted in significant increases in α-tocopherol concentrations in meat tissue. Supplementation also increased colour stability and slowed down the development of metmyoglobin to a greater extent than observed in other dietary groups. The colour stability of supplemented meat was further enhanced by 80:20 MAP. In general, MAP promoted better colour for meat from all dietary groups compared to other packaging methods.

References

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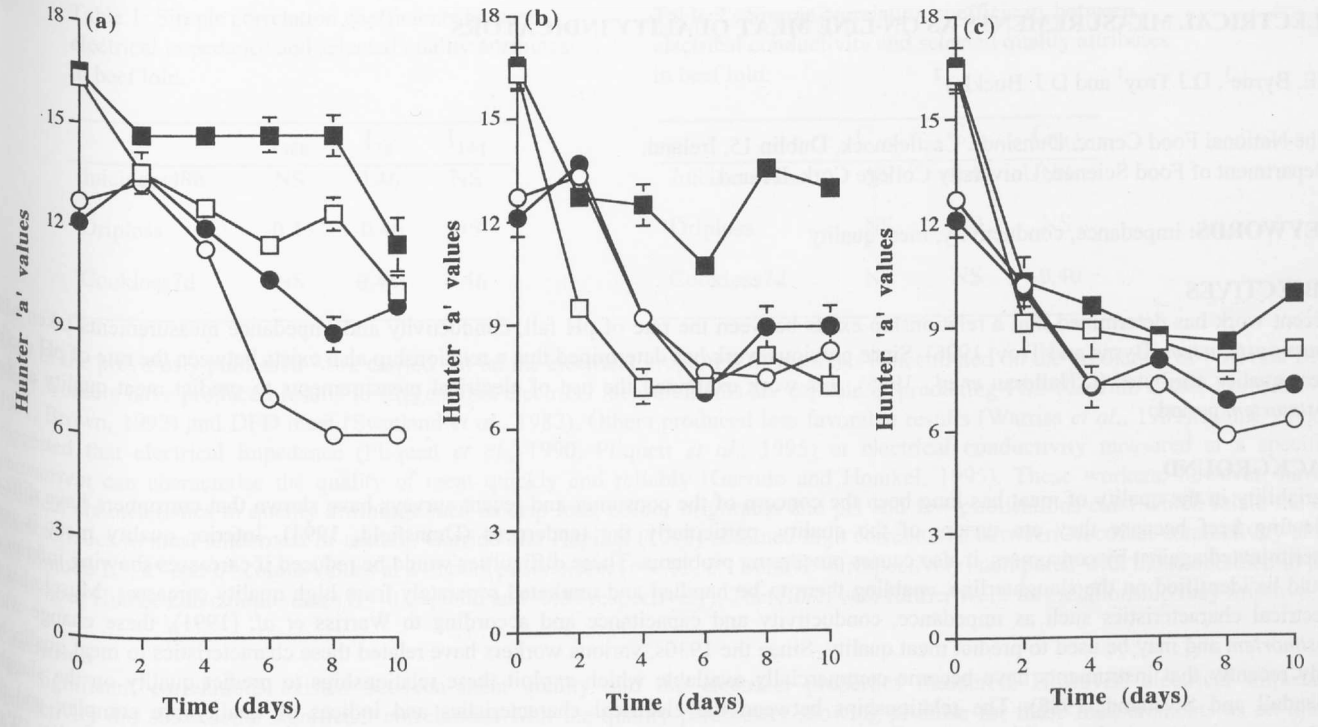

Figure 1 Effect of diet and packaging on Hunter 'a' values from beef *M. gluteus medius* steak cores during refrigerated (4°C) display for 10 days. Meat cores were packaged under (**a**) MAP (80:20) (**b**) Air and (**c**) Vacuum. (□) Beef fed a basal diet (Group 1), (■) Beef fed a supplemented diet (Group 2), (○) beef pastured on late Spring grass (Group 3), (●) beef pastured over whole season on grass (Group 4).

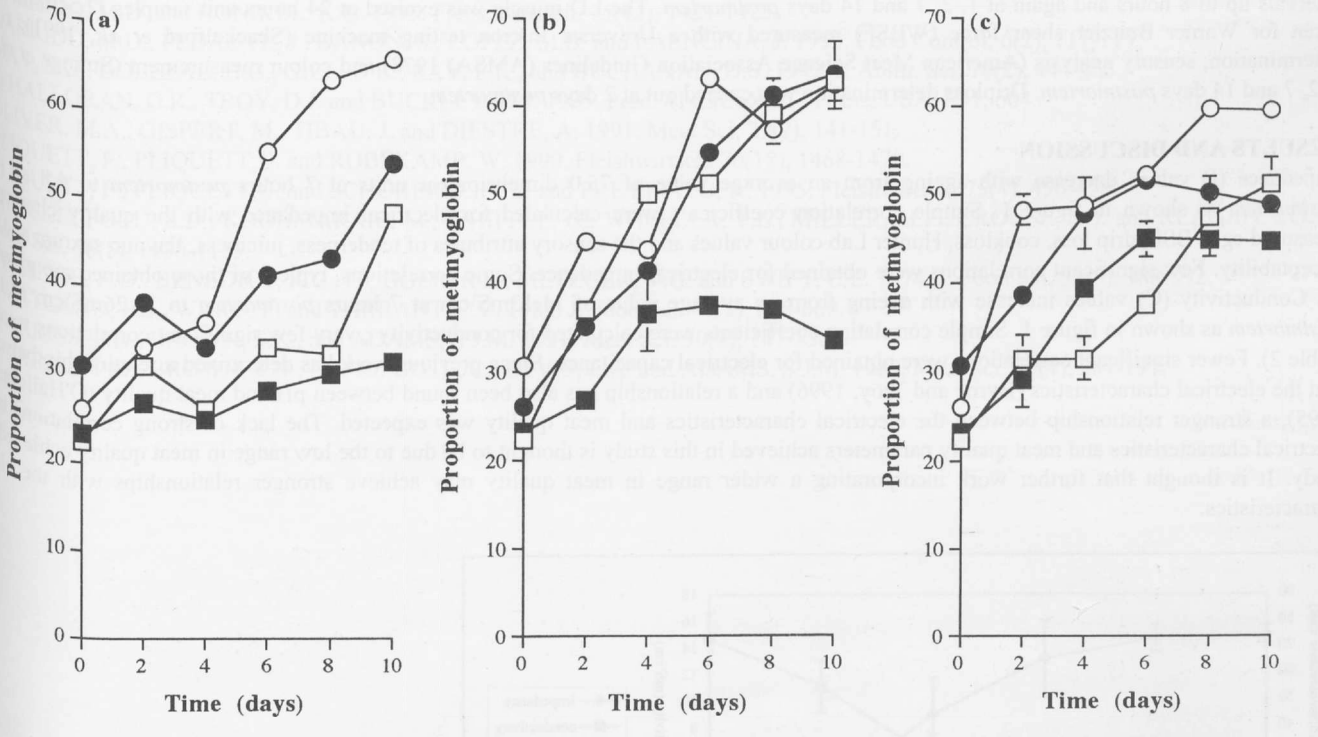

Figure 2 Effect of diet and packaging on metmyoglobin formation in beef *M. gluteus medius* steak cores during refrigerated (4°C) display for 10 days. Meat cores were packaged under (**a**) MAP (80:20) (**b**) Air and (**c**) Vacuum. (□) Beef fed a basal diet (Group 1), (■) beef fed a supplemented diet (Group 2), (○) beef pastured on late Spring grass (Group 3), (●) beef pastured over whole season on grass (Group 4).