REDUCED NITRITE LEVELS AND VITAMIN E SUPPLEMENTATION: EFFECTS ON COLOUR STABILITY OF COOKED HAMS

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Background

Nitrite contributes to colour formation in cured meats by reacting with myoglobin and upon heat processing, forming a heat stable pink cured pigment (Claus *et al.*, 1994). A recent study by Sarasua and Savitz (1994) reported positive associations between brain tumours and childhood consumption of cured meats. Consequently, there is a search for suitable alternatives to nitrite. Vitamin E, when incorporated into the diets of animals, is a highly effective and natural lipid soluble, chain breaking antioxidant which is acceptable to the consumer (Faustman *et al.*, 1989). While the exact mechanism of the interaction between lipid oxidation and metmyoglobin formation has not been defined, it is now widely accepted that dietary supplementation with α-tocopheryl acetate effectively controls lipid oxidation and colour deterioration in pork (Monahan *et al.*, 1992).

The objective of the present study was to examine the the effects of reduced nitrite levels and dietary vitamin E supplementation on the colour stability of cooked hams produced from both male and female porcine *M. semitendinosus.*

Methods

Pigs (n=12) were selected at ~32-36 kg live weight and were comprised of male (n=6) and female (n=6) animals. Half of each gender group were fed a basal diet of 10 mg α-tocopheryl acetate per kg feed and the remainder fed a supplemented diet of 1000 mg α-tocopheryl acetate per kg feed for a period of 10 w. After slaughter, *M. semitendinosus* (n=12) were removed from the left hind limb of each pig in each feed group, vacuum packed and stored at -20°C until required. Male and female *M. semitendinosus* from both supplemented (1000 mg/kg feed) and basal (10 mg/kg feed) dietary groups were cured to 115% of initial weight with input sodium nitrite levels of 25 and 100 mg/kg meat and an input salt level of 2% giving a total of 4 ham samples (i) supplemented muscles plus 100 mg/kg input nitrite, (ii) supplemented muscles plus 25 mg/kg input nitrite, (iii) basal muscles plus 100 mg/kg input nitrite and (iv) basal muscles plus 25 mg/kg input nitrite for each of male and female pigs. After curing, samples were massaged and tumbled for 10 min in every 30 min for 17 h at 10 rpm (Kerry, 1997) at 4°C. This meat was vacuum packed, held at 4°C for 36 h and cooked in a Zanussi Oven (Zanussi, Sweeden) at 80°C to an internal meat temperature of 72°C. Cooked hams were cooled at 4°C for 6 h, sliced and overwrapped in oxygen permeable (6000-8000 cm^3/m^2/24 h at STP) clingfilm and stored in a display cabinet under flourescent light (Osram Natura De Luxe L36W/76-1) at 4°C for 10 days. α-Tocopherol in muscle tissues was determined using the procedures outlined by Sheehy *et al.* (1993). Ham Hunter 'a' values were analysed using a Minolta Chromameter CR-300 (Minolta, Japan).

Results

Concentrations of α-tocopherol were significantly ($p<0.001$) greater in supplemented muscles than basal muscles for both male and female pigs. Mean α-tocopherol concentrations for male and female basal and supplemented muscles were 0.6 and 0.5 (μg/g meat and 5.5 and 5.5 (μg/g meat, respectively. No significant differences in α-tocopherol levels were observed between either male or female muscles from the respective dietary groups. Residual nitrite values ranged from 26-47%. Hunter 'a' values of overwrapped cooked ham slices from supplemented and basal muscles, treated with high and low levels of nitrite are shown in Fig. 1(a) (male *M. semitendinosus*) and Fig. 1(b) (female *M. semitendinosus*). Hams from supplemented muscles resulted in significantly ($p<0.001$) higher Hunter 'a' values than hams from basal muscles and the trends were the same for hams from both male and female muscles. Hams from muscles cured with 100 mg/kg nitrite had significantly ($p<0.001$) higher Hunter 'a' values than muscles cured with 25 mg/kg. This trend was also similar for hams produced from both male and female muscles. Hams from male and female supplemented muscles treated with 25 mg/kg nitrite showed significantly ($p<0.05$) greater colour stability during storage than from basal male or female muscles treated with 100 mg/kg nitrite. Hams from female porcine muscles had significantly ($p<0.01$) higher Hunter 'a' values than hams from male porcine muscles and trends are shown in Fig. 2.

Conclusions

Dietary supplementation of pigs with α-tocopheryl acetate improved the colour stability of cooked hams manufactured from both male and female *M. semitendinosus*. Results of the present study have shown that vitamin E may be a practical substitute for nitrite in the stabilisation of cooked ham colour. However, the effects of dietary α-tocopheryl acetate supplementation and reduced nitrite levels in hams on other quality attributes still have to be assessed.

References

Claus, J.R., Colby, J.W. and Flick, G.J. (1994). Processed meats/poultry/seafood. In : *Muscle Foods* , pp106-162. Faustman, C., Cassens, R.G., Schaefer, D.M., Buege, D.R., Williams, S.N. and Scheller, K.K. (1989). *J. Food Sci.,* 54, 858-862. Kerry, J.F. (1997). Apparatus for processing meat, Pat. Appl. No. 5970258. Monahan, F.J., Buckley, D.J., Morrissey, P.A., Lynch, P.B. and Gray, J.I. (1992). *Meat Sci.,* 31, 229-241. Sarasua, S. and Savitz, D.A. (1994). *Cancer Causes Control,* 5, 141-148. Sheehy, P.J.A., Morrissey, P.A. and Flynn, A. (1993). *British Jn. Nutr.,* 71, 53-65.

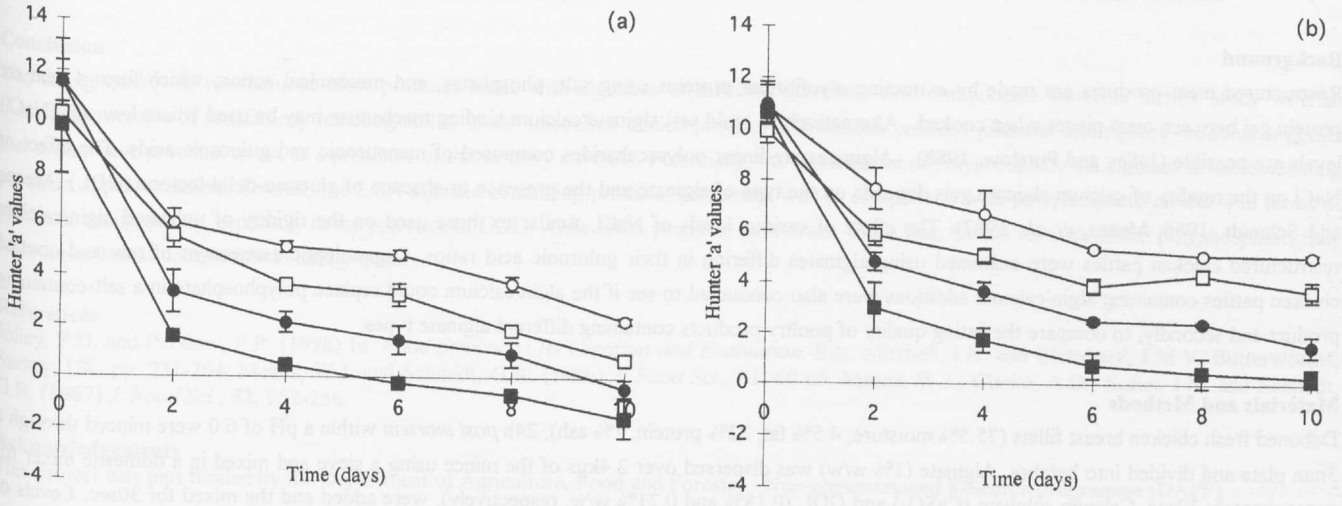

Fig. 1. Effect of dietary vitamin E supplementation and reduced nitrite levels on the Hunter 'a' values of overwrapped cooked ham slices manufactured from (a) male *M. semitendinosus* and (b) female *M. semitendinosus* and stored under flourescent light at 4°C for 10 d. (O) supplemented muscles plus 100 mg/kg nitrite (❑) supplemented muscles plus 25 mg/kg nitrite (●) basal muscles plus 100 mg/kg nitrite (■) basal muscles plus 25 mg/kg nitrite.

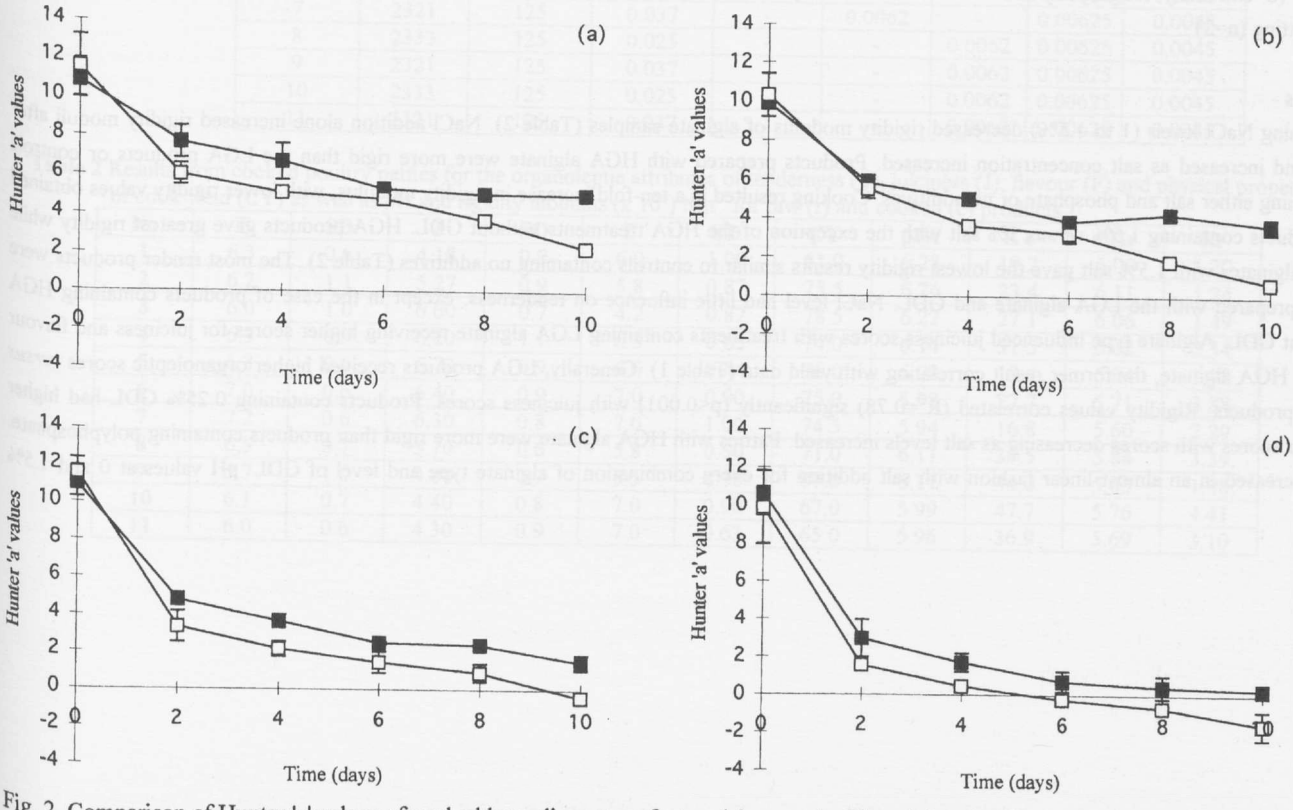

Fig. 2. Comparison of Hunter 'a' values of cooked ham slices manufactured from male (❑) and female (■) *M. semitendinosus* across four treatments (a) supplemented muscles plus 100 mg/kg nitrite (b) supplemented muscles plus 25 mg/kg nitrite (c) basal muscles plus 100 mg/kg nitrite (d) basal muscles plus 25 mg/kg nitrite.