EFFECT OF DIETARY SUPPLEMENTATION WITH α-TOCOPHERYL ACETATE ON THE STABILITY OF LOW NITRITE COOKED TURKEY HAM.

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Background

Lipid oxidation is one of the main causes of deterioration in the quality of meat and meat products during storage (Tichivangana & Morrissey., 1985). The process occurs as a result of the reaction between atmospheric oxygen and unsaturated fatty acids. Peroxides are intermediate products in the oxidation process, which in turn break down to odour and flavour producing compounds such as aldehydes, ketones, and alcohols etc. (Rendl et al ., 1982). The flavour and odour of this mixture renders the meat unacceptable for human consumption.
Nitrite has been found to be effective in preventing lipid oxidation and is also responsible for desirable colour formation in cured meat products (Rubin., 1977). However in recent years there has been some controversy over the use of nitrite due to nitrosamine formation. During heating residual nitrite may react with certain amines to produce nitrosamines.These compounds are considered to be carcinogenic (Sen et al., 1973; Gray et al., 1982). The maximum level of nitrite allowed in meat is 200 ppm in Ireland and 120 ppm in the U.S.A (Tichivangana et al., 1984). Therefore, it is desirable to reduce the nitrite levels in meat. α-Tocopherol has shown good antioxidant properties (Buckley & Connolly., 1980), and therefore could be used to replace some of the nitrite in processed meats.

Objective

The objective of this study was to investigate the effect of reducing added nitrite levels in cooked turkey ham produced from meat containing high and low levels of dietary α-tocopheryl acetate.

Experimental Design

In this study, turkeys were fed diets containing either low α-tocopheryl acetate of 20 mg/kg or high supplemented α-tocopheryl acetate (600 mg/kg) from 1 week old up to slaughter at 21 weeks. The breast meat was manufactured into cooked turkey ham using commercial manufacturing procedures. The input levels of nitrite in the cooked turkey ham were 0 ppm, 50 ppm, and 100 ppm. The effect of storage in a display cabinet, illuminated under fluorescent light (616 LUX) at 4°C on vacuum packed (30-100 cm^3/m^2/24 hours) and over-wrapped oxygen permeable film (6000-8000 cm^3/m^2/24 hours) samples was determined by measuring oxidative (TBARS) and colour (Hunter "a" values) changes.

Materials and Methods

- α-TOCOPHEROL ANALYSIS
  Performed by High performance liquid chromatography. The extraction procedure is based on the method of Butriss and Diplock (1984), while,the HPLC method is a modification of Bieri et al. (1979).
- THIOBARBITURIC ACID (TBARS)
  Performed according to the method of Tarladgis et al . (1960)
- COLOUR ANALYSIS
  Analysed by the Hunter L, a , b system, using the minolta colorimeter (Model: -CR 300)

Results and Discussion

The residual α-tocopherol level in the raw turkey breast meat from birds fed the supplemented diet was 5 µg/g by comparison to 1µg/g for breast meat from the basal group. In the oxygen permeable overwrapped samples (FIG. 1 & 2) and the vacuum packaged product (FIG. 3 & 4) the same general trends were detected. However, the differences in the vacuum packaged product were not as evident. At low levels of α-tocopherol the product with 50 ppm $N0_2$ had poor colour stability by comparison to the product with 100 ppm NO_2 (FIG. 2). The product with high α-tocopherol and 50 ppm input NO_2 had improved colour stability over time compared to the product with 50 ppm NO_2 at low levels of α-tocopherol. At low levels of α-tocopherol the oxidative stability was lower in the product with 50 ppm NO_2 than in the product with 100 ppm input NO_2 (FIG. 1). It was found that at high α-tocopherol levels the oxidative stability of the product with 50 ppm added NO_2 showed no difference to the product with 100 ppm input NO_2 at the same level of α-tocopherol up to day 6 (FIG. 1). At high α-tocopherol levels the product with 50 ppm input NO_2 showed much better oxidative stability over time than the product with the 50 ppm nitrite at low α- tocopherol levels.

Conclusions

- At high α-tocopherol levels the over-wrapped cooked turkey ham with 50 ppm input NO_2 had better oxidative stability and better colour stability than the product with 50 ppm NO_2 at low α-tocopherol levels
- The vacuum-packed cooked turkey ham containing high α-tocopherol and 50 ppm input NO_2 had better oxidative stabiliy and colour stability than the product with low a-tocopherol and 50 ppm input NO_2.
- Reduction of input nitrite levels from 100 ppm to 50 ppm at high α-tocopherol levels maintains colour and oxidative stability for a longer period of time.

Literature cited

BIERI, J.G.; TOLLIVER, T.J & CATIGNANI, G.L. (1979). Simultaneous determination of α-tocopherol and retinol in plasma or red cells by high pressure liquid chromatography *Am. J. Cl. Nutr, 32: 2143-2149.*

BUCKLEY, D.J. & CONNOLLY, J.F. (1980). Influence of α-tocopherol (vitamin E) on the storage stability of raw pork and bacon. *J. Food protection, 43: 265-257*

BUTRISS, J.L. & DIPLOCK A.T. (1984). High performance liquid chromatographic methods for vitamin E. In L.E PACKER, ed. *Methods in Enzymology, 105. pp. 131-138.* (New York, Academic Press).

GRAY, J.I.; REDDY, S.K; PRICE, J.F; MANDAGERE, A. & WILKENS, W.F. (1982). Inhibition of N-nitrosamines in bacon. *Food Technol., 35: 39-45*

RENDL, B. & STAN, H.J. (1982). Determination of volatile aldehydes in meat as 2,4-Dinitrophenylhydrazones using reversed-phase high-performance liquid chromatography. *J. Agric. Food. Chem. 30: 849-854*

RUBIN, L.J. (1977). Nitrites and Nitrosamines in prespectiive. *Can. Inst. Food Sci. Technol. J. 10-11 A*

SEN, L.J.; MILES, W.F.; DONALDSON, B.; PANALAKS, T. & IYENGER, J.R.; (1973). Formation of nitrosamines in meat curing mixture. *Nature 245 (5420): 104-105*

TARLADGIS, B.G.; WATTS, B.M.; YOUNATHAN, M.J & PUGAN, L (1960). A distillation method for the quantitative determination of malonaldehyde in rancid foods. *J. am. oil. chem. soc., 37-44.*

TICHIVANGANA, J.Z.; MORRISSEY, P.A. & BUCKLEY, D.J. (1984). Acceptability of nitrite free bacon. *Irish. J. Food. Sci. Technol. 8: 99-104*

TICHIVANGANA, J.Z. & MORRISSEY, P.A. (1985). Metmyoglobin and inorganic metals as pro-oxidants in raw and cooked muscle systems. *Meat sci., 15: 107*

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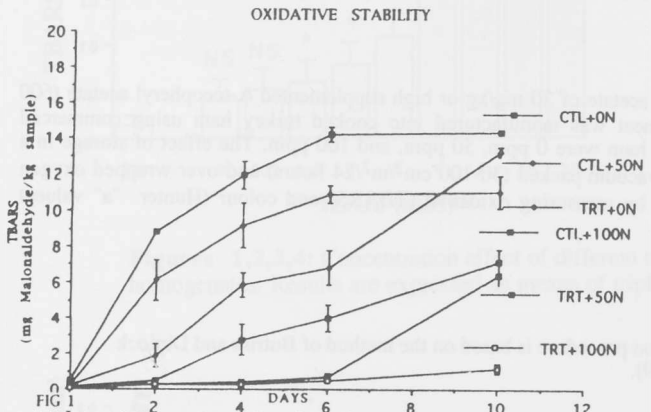

FIG 1
Influence of dietary vitamin E on the oxidative stability (TBARS) of overwrapped cooked turkey ham, stored at 4° C under fluorescent light in a display cabinet.

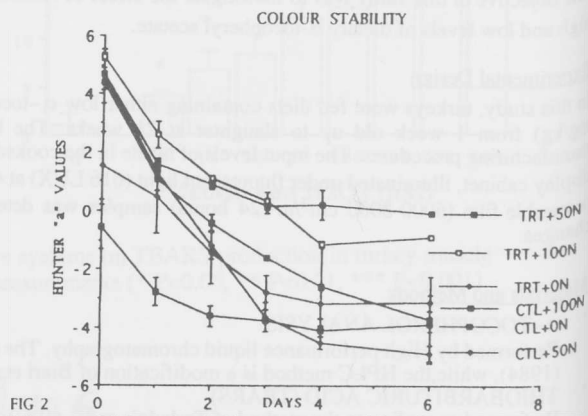

FIG 2
Influence of dietary vitamin E on the colour stability of over-wrapped cooked turkey ham, stored at 4° C under fluorescent light in a display cabinet.

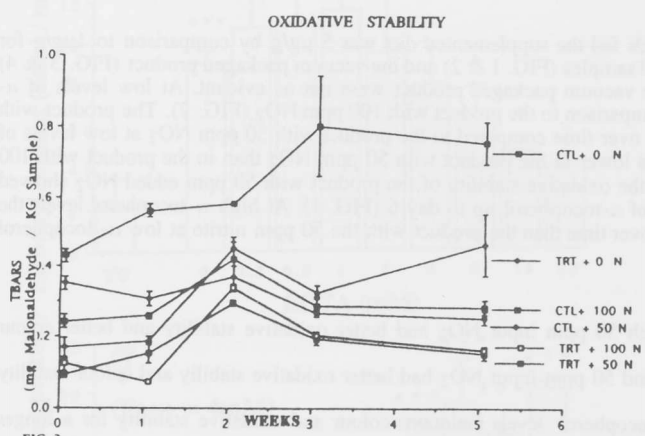

FIG 3
Influence of dietary vitamin E on the oxidative stability (TBARS) of vac-packed cooked turkey ham stored at 4°C under fluorescent light in a display cabinet.

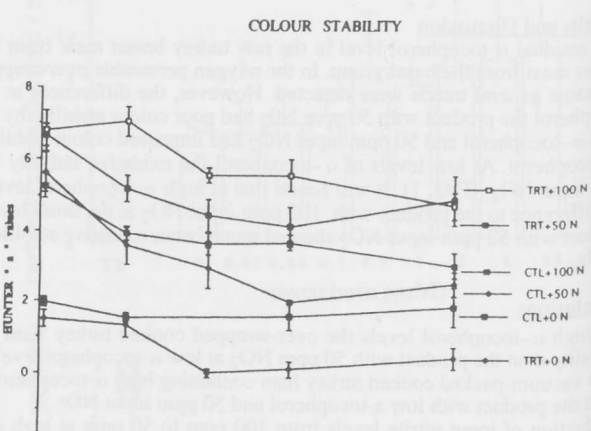

FIG 4
Influence of dietary vitamin E on the colour stability of vac-packed cooked turkey ham stored at 4°c under fluorescent light in a display cabinet.