EFFECT OF DIETARY α-TOCOPHEROL AND SUNFLOWER OIL ON THE OXIDATIVE STABILITY CHICKEN TISSUES.

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MARY
effects of feeding fresh or heated sunflower oil on the α-tocopherol status and oxidative stability of ken muscle were investigated.
ers were fed fresh or heated sunflower oil (140°C x 24 h; 54 meq peroxide oxygen/kg) containing l levels of 30 mg of α-tocopheryl acetate/kg feed or supplemented levels of 200 mg/kg over a six k period. The consumption of heated sunflower oil resulted in significant reductions in α-tocopherol s in broiler thigh and breast muscle. Heated sunflower oil also resulted in increased rates of oxidation thigh and breast muscle. However, overall dietary α-tocopheryl acetate supplementation had a ficant protective effect against the destabilizing effect of oxidized dietary lipids in muscle.

RODUCTION
id oxidation is one of the major causes of deterioration in the quality of meat and meat products during age. The rate and extent of lipid oxidation are dependent on a number of factors, the most important g the level of polyunsaturated fatty acids present in the particular muscle system. Oils are usually ed in poultry feeds to meet the high energy demand of fast growing broilers (Brue and Latshaw, 1985). wever, very little work has been done on the effects of feeding low quality or oxidized oil on the growth health of broilers or the quality of the muscle food. Oxidation of unsaturated fatty acids results in the nation of a complex mixture of carbonyls (Reindl and Stan 1982; Morrissey and Apte, 1988) which ct many quality characteristics such as colour, flavour, texture, nutritive value and safety (Pearson et 1983).
re is evidence that some oxidation products may be absorbed from the intestine (Draper et al.,1984; ki et al., 1984) and it is possible that they may be incorporated into tissues and result in oxidative abilization of membrane phospholipids. Dietary α-tocopherol may offer an effective means of imizing the adverse effects of increased unsaturated fatty acid intake on the oxidative stability of at and meat products. It is well established that α-tocopherol supplementation of poultry diets reases α-tocopherol concentrations in the tissue and consequently increases the stability of the meat dan et al., 1983; Lin et al., 1989). Lakesvela (1960) described an improvement in the flavour of cken meat by dietary vitamin E supplementation, while Marusich et al., (1975) reported a good relation between TBA value as a parameter of lipid oxidation or index of rancidity and the α-opherol content of breast muscle in both broilers and turkeys.
e aim of this study was to investigate the effects of heated sunflower oil in broiler diets on:
the α-tocopherol concentrations of muscle tissue,
the susceptibility of muscle tissue to iron-ascorbate induced peroxidation and
the oxidative stability of thigh and breast muscle.

TERIALS AND METHODS

imals and diets
e hundred and forty four Cobb 500 broilers obtained from a commercial hatchery were randomly assigned 5 groups and fed diets containing 6% fresh sunflower oil containing 30 mg α-tocopherol/kg diet (FSO-30), sh sunflower oil supplemented with 200 mg α-tocopheryl acetate/kg diet (FSO-200), heated sunflower oil SO), heated sunflower oil supplemented with 30 mg α-tocopheryl acetate/kg diet (HSO-30) and 200 mg α-opheryl acetate/kg diet (HSO-200). The heated sunflower oil diet (HSO) contained no α-tocopherol. Feed d water were provided ad libitum. Body weight was determined weekly. After 6 weeks chicks were ughtered. Tissues were stored at -20°C until required for analysis.

eparation of oil
nflower oil was heated in an oil bath at 140°C for 24h with aeration. The peroxide value of fresh and ated oil was determined by the method of Lea (1946). The peroxide value increased to a maximum of 54 eq of peroxide oxygen/kg. α-Tocopherol in muscle tissue was extracted by the method of Buttriss and block (1984) and determined by HPLC (Sheehy et al., 1991). Total lipid content was determined by the thod of Burton and Ingold (1985). The stability of muscle tissues to iron-induced lipid peroxidation was

determined by the method of Kornbrust and Mavis (1980). Thiobarbituric acid reacting substances (TBARS) were determined by the method of Beuge and Aust (1978) and reported as nmoles malonaldehyde per mg protein. Protein was determined by the method of Lowry et al., (1951).

Oxidative stability of muscle

Thigh and breast muscle were trimmed and minced with or without 1% NaCl, using a conventional meat grinder. Samples of muscle were assessed for lipid oxidation immediately and at regular intervals during storage at 4°C for 14 days.

The extent of lipid oxidation was assessed by the 2-thiobarbituric acid method of Ke et al., (1977). TBARS were expressed as mg malonaldehyde per kg of tissue.

RESULTS

α-Tocopherol concentrations

The effect of feeding fresh or heated sunflower oil on the α-tocopherol concentrations in chick muscle are shown in Figure 1. Thigh and breast muscle from chicks consuming HSO had lower α-tocopherol concentrations when compared to muscle from chicks fed FSO-30. Chicks consuming HSO-30 had higher α-tocopherol concentrations than those fed HSO, but α-tocopherol levels were lower than those of chicks fed FSO-30.

Tocopherol concentrations in thigh and breast muscle of the groups fed HSO-200 and FSO-200 were significantly ($p<0.05$) higher than those of chicks fed HSO-30 and FSO-30. However, values for the group fed HSO-200 were significantly ($p<0.05$) lower than those of chicks fed FSO-200. Higher concentrations of α-tocopherol were deposited in the thigh than in breast muscle. This finding is in accordance with the earlier observations of Sheldon (1984). This effect may be associated with the more highly developed vascular system and higher lipid content (Lin et al., 1989) of thigh muscle.

Iron-ascorbate induced lipid peroxidation

The susceptibility of muscle to lipid peroxidation was determined by incubation of tissue homogenates with iron-ascorbate for various lengths of time. The TBARS concentrations in muscle tissue from chicks fed various fresh or heated sunflower oil diets did not differ significantly ($p<0.05$) at time zero (Figure 2). As incubation time increased, TBARS concentrations increased more rapidly in thigh and breast muscle from chicks fed HSO, compared to those fed HSO-30 and FSO-30. Muscle tissue from chicks fed HSO-200 was more resistant to peroxidation than that of chicks fed HSO, HSO-30 or FSO-30. However, TBARS concentrations were significantly ($p<0.05$) greater than those in muscle from chicks fed FSO-200 an incubation period of 140 min. In general, the results indicate that high dietary and tissue α-tocopherol concentrations are associated with increased stability of muscle to iron-ascorbate induced lipid oxidation.

Storage stability of muscle

TBARS concentrations in thigh and breast muscle from chicks fed HSO-30 were higher than those in chicks fed FSO-30, after 14 days of storage at 4°C (Figure 3). Chicks fed HSO-200 and FSO-200 had lower TBARS concentrations in muscle compared to those fed HSO-30 and FSO-30. Thigh and breast muscle from chicks fed FSO-200 was the most stable to oxidation after 14 days of storage at 4°C.

These results are in accordance with the beneficial effects of α-tocopherol supplementation on the storage stability of raw chicken during refrigerated storage reported by Marusich et. al., (1975) and Bartov and Bornstein (1981).

The addition of sodium chloride at a level of 1% resulted in an increase in TBARS concentrations in muscle from all groups (Figure 3). Thigh and breast muscle from the HSO-30 group was most susceptible to oxidation after 14 days of refrigerated storage. Tocopherol supplementation reduced the pro-oxidant effect of salt, since thigh and breast muscle from chicks fed HSO-200 and FSO-200 was significantly more stable than muscle from chicks fed HSO-30 or FSO-30. Muscle from FSO-200 fed chicks was the most stable to oxidation.

In conclusion, these results show that oxidation products in heated oils significantly ($p<0.05$) reduce muscle α-tocopherol concentrations. In addition, the susceptibility of muscle tissues to iron-ascorbate induced lipid oxidation was increased by feeding heated oils. Supplementation of fresh and heated oil diets with α-tocopheryl acetate increased the oxidative stability of thigh and breast muscle during refrigerated storage and also protected against the pro-oxididant effect of salt.

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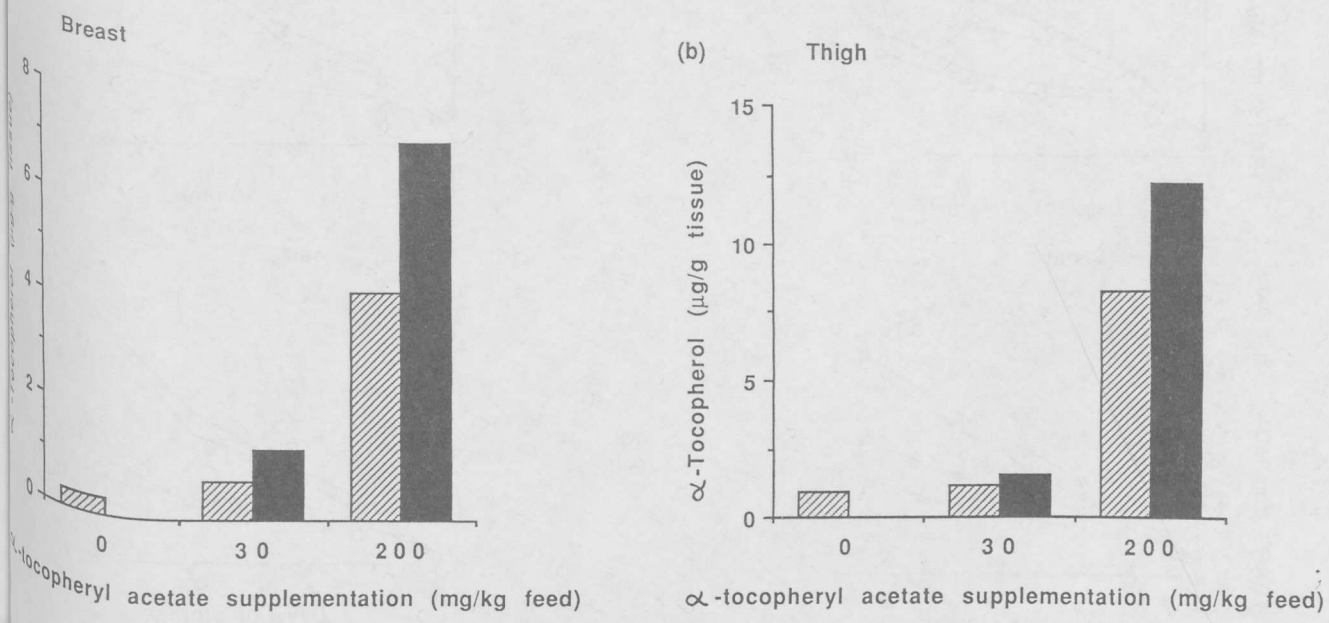

1 Effect of heated sunflower oil on α-tocopherol concentrations in (a) chick breast muscle and (b) chick thigh muscle. ■, fresh sunflower oil; ▨, heated sunflower oil.

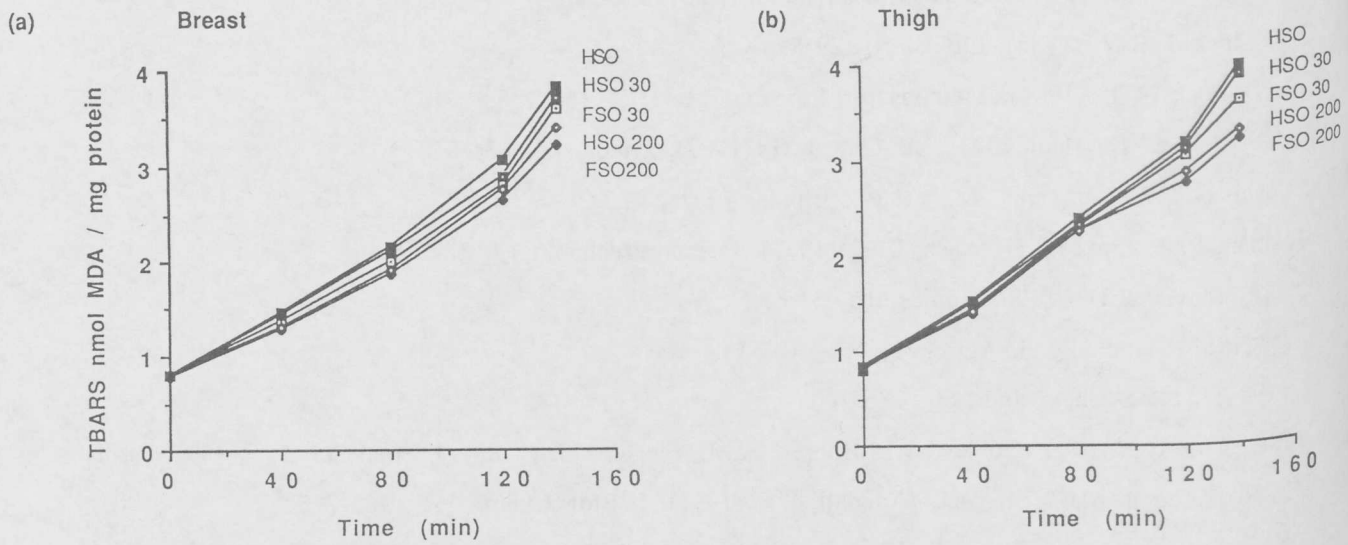

Fig. 2 Effect of heated sunflower oil on susceptibility of (a) chick breast muscle and (b) chick thigh muscle to iron-ascorbate induced lipid peroxidation. FSO-30, fresh sunflower oil diet containing 30 mg α-tocopherol/kg feed; FSO-200, fresh sunflower oil containing 200 mg α–tocopheryl acetate/kg feed; HSO, heated sunflower oil; HSO-30, heated sunflower oil containing 30 mg α-tocopherol/kg feed; HSO-200, heated sunflower oil containing 200 mg α– tocopheryl acetate/kg feed.

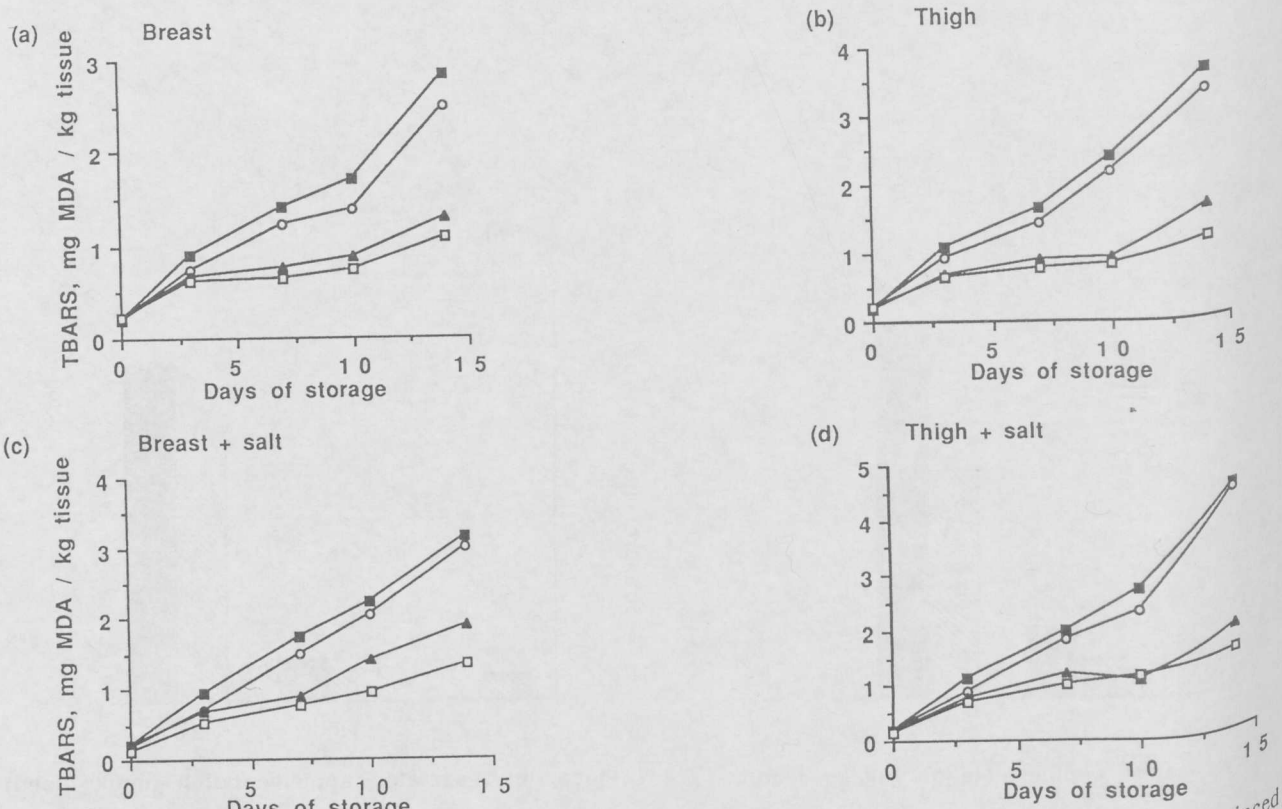

Fig. 3 Effect of heated sunflower oil on TBARS of (a) raw minced breast muscle and (b) raw minced thigh muscle (c) raw minced breast muscle +NaCl (1%) and (d) raw minced thigh muscle + NaCl (1%) stored at 4°C for up to 14 days. ○ , fresh sunflower oil containing 30 mg α-tocopherol/kg feed; □ , fresh sunflower oil containing 200 mg α-tocopheryl/kg feed; ■ , heated sunflower oil containing 30 mg α-tocopheryl acetate/kg feed; ▲ , heated sunflower oil containing 200 mg α-tocopheryl acetate/kg feed.