ILIZATION OF BROILER LIPIDS (INCLUDING CHOLESTEROL) THROUGH DIETARY SUPPLEMENTATION WITH SPICE EXTRACTS

LOPEZ-BOTE[1], E.A. GOMAA, J.I. GRAY and C.J. FLEGAL

rtment of Food Science and Human Nutrition, Michigan State University, East Lansing, MI 48824, U.S.A.

sent address: Facultad de Veterinaria. Universidad de Extremadura. 10071 Caceres. Spain.

MARY

The effect of dietary administration of natural antioxidants on lipid stability in chicken breast meat studied. After 9 days of refrigerated storage, the thiobarbituric acid-reactive substances (TBARS) of meat broilers fed the control, oleoresin rosemary (500 mg/kg feed), oleoresin sage (500 mg/kg) and vitamin E 0 IU/kg) diets were 0.51, 0.30, 0.35 and 0.25, respectively. The antioxidant effects were also evident in ked samples but were less marked. The concentrations of cholesterol oxidation products (COPS) in the cooked t of broilers fed the sage and rosemary extracts were 44 and 42% smaller relative to the control samples, le dietary vitamin E reduced COPS by 58%.

RODUCTION

Spontaneous reaction of oxygen with lipids causes deleterious organoleptic changes in meat systems in a atively short time. Raw poultry meat is more susceptible than red meat to the development of rancidity during rage. In addition, cooked poultry meat will develop warmed over flavors more rapidly than cooked red meat ing storage, mainly because of the greater degree of unsaturation of the fatty acids of the phospholipids AY and PEARSON, 1987). There is also increased scientific attention to the possible health risks associated h the consumption of lipid oxidation products, particularly cholesterol oxides in fresh and processed meats E et al., 1991).

Among the practices used to delay the deterioration of food containing lipids, the incorporation of tioxidants is one of the most utilized. Natural antioxidants such as vitamin E, spice extracts and plant rols appear to be reasonable alternatives to synthetic phenolic compounds, e.g. butylated hydroxyanisole HA) or butylated hydroxytoluene (BHT) whose use is questioned because of the possible toxic effects of these pounds.

Dietary supplementation of vitamin E for the subsequent benefit of increased lipid stability, including lesterol, in animal food products has been extensively reported for poultry, pigs and veal calves (ASHGAR al., 1989; ENGESETH, 1990; MONAHAN et al., 1992). However, there is little information on the effects of er natural antioxidants on lipid oxidation in muscle systems when administered through the diet.

The objective of this study was to compare the effects of dietary vitamin E, oleoresin rosemary and oresin sage on the oxidative stability of broiler lipids in raw and cooked broiler breast meat.

TERIALS AND METHODS

Ninety-six male broilers fed on a starter ration for two weeks were randomly divided into 4 groups and en put on a finisher ration for another 4 weeks. The finisher ration was identical for all groups except for e antioxidant added: vitamin E (200 IU/kg feed), oleoresin rosemary (500 mg/kg feed) and oleoresin sage (500 g/kg feed). One ration was not supplemented with antioxidants and this dietary treatment served as the control oup of broilers.

After slaughter, cutting and deboning, representative portions of the breast meat were placed on olystyrene traps, wrapped in an oxygen-permeable PVC stretch overwrap and kept at 4°C under fluorescent light. pid oxidation was assessed at 0, 3, 6 and 9 days by the 2-thiobarbituric acid procedure (KE et al., 1977). e remaining breast meat was vacuum packaged and stored at -20°C for further analysis.

Broiler breast samples were ground, put in Zip-Lok plastic bags, and cooked in a waterbath maintained at 70°C for 30 minutes. The cooked samples were stored at 4°C under fluorescent light and lipid oxidation was monitored immediately after cooking, and after 2 and 4 days.

Cholesterol oxidation products (COPS) in the cooked samples were also determined after 4 days of refrigerated storage. Total lipid extracts were prepared from 5g muscle tissue by the method of MARMER and MAXWELL (1981). An internal standard, 6-keto-cholesterol, was added to the meat sample before lipid extraction. Cholesterol oxides were separated from cholesterol and other muscle lipids following the sample clean-up procedure of PARK and ADDIS (1987) and were quantified by capillary gas chromatography using a fused silica DB-1 capillary column (15m x 0.25mm id) with temperature programming from 170 to 255°C (MONAHAN et al., 1992).

Statistical analysis of the data was performed using a factorial randomized design. Duncan's multiple comparisons test was applied to determine the significance of differences between groups. Analyses of variance were performed using the MSTAT-C microcomputer statistical program (Michigan State University, MI, USA)

RESULTS AND DISCUSSION

The effects of dietary treatment on thiobarbituric acid-reactive substances (TBARS) development in raw meat during refrigerated storage is shown in Figure 1A. Both spice extracts considerably reduced lipid oxidation. After 9, days TBARS values of breast meat from the broilers fed the control and vitamin E diets were 0.51 and 0.25, respectively. Meat from broilers fed the rosemary or sage oleoresins had intermediate TBARS values, being closer to the vitamin E group than to the control group.

Similar effects were observed in the cooked samples (Figure 1B), with the rate of oxidation being greater in these samples compare to the raw counterparts. This observation is consistent with literature reports (GRAY and PEARSON, 1987) and is explained by the harsh conditions of cooking which lead to the disruption of the membranes and subsequent exposure of the lipid substrate to oxidative catalysts. In cooked samples, the lipid enhancing stability of the spice extracts was not as pronounced as in the raw breast meat. Results reported in this paper show an important benefit that may be of interest to the meat industry. Although the spice extracts were not as effective as vitamin E in controlling oxidation, the results obtained were satisfactory, especially if we consider that the level of vitamin E in this feeding trial was much higher than levels used in the experiments previously cited.

Cholesterol oxidation in broiler breast meat was also influenced by the dietary regimen (Figure 2). Broilers fed the sage and rosemary extracts showed decreases in total COPS concentrations of 44 and 42%, respectively. Dietary vitamin E reduced the COPS concentration by 58%.

Cholesterol functions as an integral part of the lipid bilayer cell membrane and is closely associated with membranal phospholipids. The intermolecular free radical processes in the membrane may promote cholesterol oxidation (SMITH, 1981). The partial stabilization of cholesterol with dietary spice extracts and vitamin E may be due to the general decrease in lipid oxidation, and in some cases also to the specific localization of the antioxidant into the cell structures. Dietary vitamin E supplementation has been shown to significantly increase the tocopherol content of broiler muscle mitochondrial and microsomal fractions (ASHGAR et al., 1989) and this localization is thought to be responsible for retarding lipid and cholesterol oxidation. A similar view was expressed by MONAHAN et al. (1992) who demonstrated that dietary vitamin E suppressed cholesterol oxidation in cooked pork during storage and also increased the concentrations of α-tocopherol in the membranes. Little information exists regarding the deposition of the spice antioxidant components in meat, although it was observed that both spice extracts considerably reduced the amount of cholesterol oxidation in the cooked meat.

In addition, methodology was developed to determine the presence of the antioxidant components of sage and rosemary oleoresin (rosemariquinone and carnosol) in the meat products by high performance liquid

romatography. Analyses indicate the presence of detectable quantities of these compounds in meat samples from imals receiving spice extracts in the diet. These data may explain the enhanced lipid stability of the broiler eat relative to that of the control samples. Further details of these analyses will be presented and discussed ewhere.

NCLUSIONS

Dietary administration of antioxidants from spice extracts enhanced lipid oxidative stability in raw and oked breast chicken meat and reduced cholesterol oxidation in cooked meat. The availability of these and other tural antioxidants and their possible synergistic effects suggest an interesting way of improving meat bility.

NOWLEDGEMENTS

This study was supported in part by a grant to Dr. C. Lopez-Bote from the Ministerio de Educacion y encia (Spain) (Movilidad del personal Investigador), and by the Michigan Agricultural Experiment Station.

FERENCES

GAR, A., LIN, C.F., GRAY, J.I., BUCKLEY, D.J., BOOREN, A.M., CRACKEL, R. AND FLEGAL, C.J., 1989. Influence of oxidized dietary oil and antioxidant supplementation on membrane-bound lipid stability in broiler meat. Br. Poultry Sci. 30:815-823

ESETH, N.J., 1990. Membranal muscle oxidation in muscle tissue-mechanism and prevention. Ph.D. Dissertation. Michigan State University. USA

Y, J.I. AND PEARSON, A.M., 1987. Rancidity and warmed-over flavor. Adv. Meat Res. 3:221-269

, P.J., ACKMAN, R.G., LINKE, B.H. AND NASH, D.M., 1977 Differential lipid oxidation in various part of frozen mackerel. J. Food Technol. 12:37-47

RMER, W.N. AND MAXWELL, R.J., 1981. Dry column method for the quantitative extraction and simultaneous class separation of lipids from muscle tissue. Lipids 16: 365-371

AHAN, F.J., GRAY, J.I., BOOREN, A.M., MILLER, E.R., BUCKLEY, D.J., MORRISSEY, P.A. AND GOMAA, E.A., 1992. Influence of dietary treatment on cholesterol oxidation in pork. J. Agric. Food Chem (in press)

RK, S.W. AND ADDIS, P.B., 1987. Cholesterol oxidation products in some muscle foods. J. Food Sci. 52:1500-1503

E, J.E., SPAHIS, K. AND SEILLAN, C., 1991. Cholesterol oxidation in meat products during cooking and frozen storage. J. Agric. Food Chem. 39:250-254

ITH, L.L., 1981. "Cholesterol Autoxidation," Plenum Press: New York

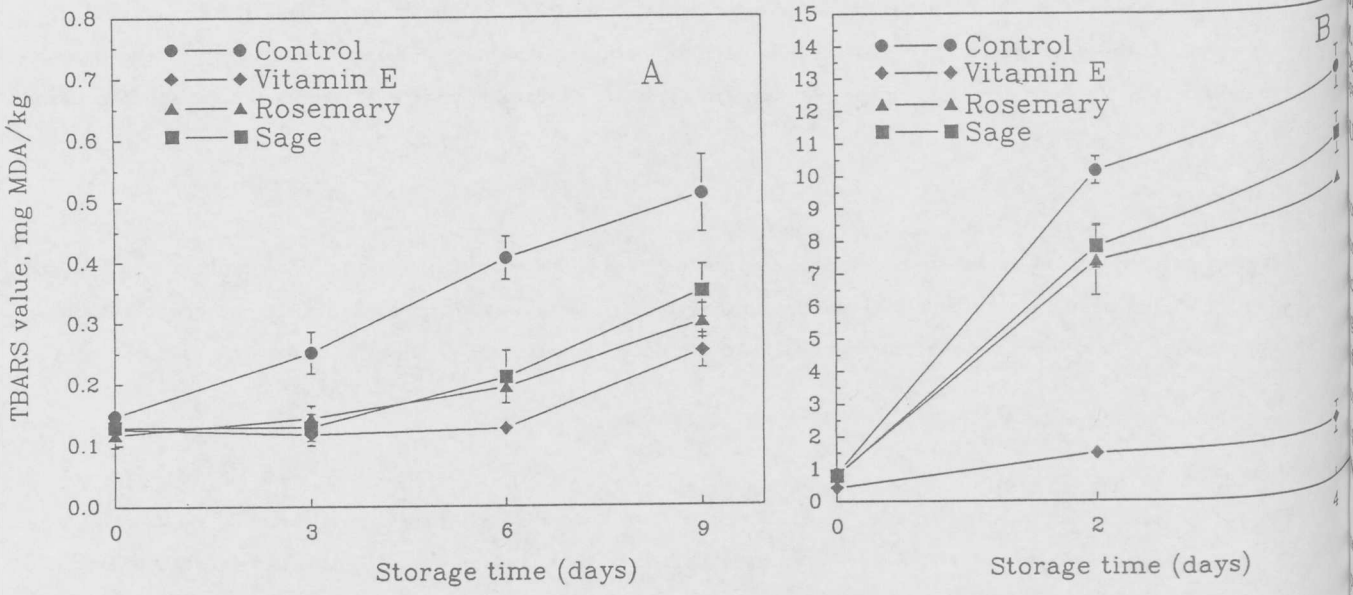

Figure 1.- Effect of dietary spice extracts and vitamin E supplementation on the TBARS values (mg malonaldehyde/kg meat) of (A) raw broiler breast meat stored at 4°C for nine days and (B) cooked broiler breast meat stored at 4°C for four days.

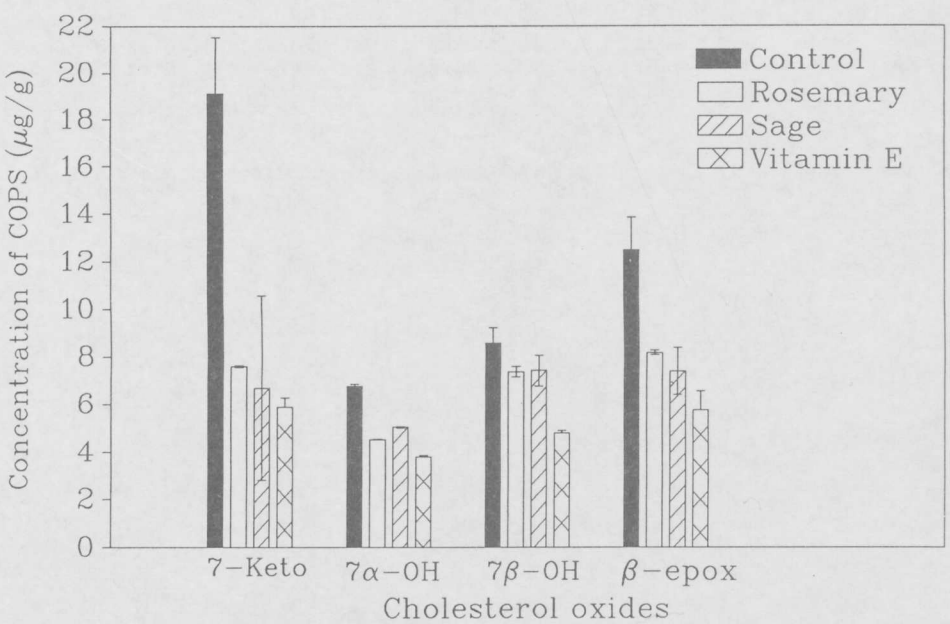

Figure 2.- Cholesterol oxide concentrations (μg/g) in cooked broiler breast meat stored at 4°C for four days.