ANTIOXIDANT ACTIVITY OF NATURAL EXTRACTS IN PRE-COOKED PORK MEAT BALLS

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Introduction

Lipid oxidation in meat and meat products reduces nutritional and sensory values, likewise, the formation of potentially toxic compounds compromises quality and reduces shelf life (Cortinas et al., 2005). In the last few years, a range of naturally-occurring antioxidants including carnosine, nutritive antioxidants such as α-tocopherol, β-carotene or vitamin C, have been investigated as potential antioxidants in meat products (Jensen et al., 1998; King et al., 1995; O'Neill et al., 1998). Extracts of herbs and spices have also been studied as natural antioxidants added to meat and meat products or supplemented to animal diets (Botsoglou et al., 2003). The aim of this work is to evaluate the dietary supplementation of essential oils of herbs to weanling pigs on susceptibility of pre-cooked pork meat balls to lipid oxidation during chill storage.

Material and Methods

Essential oils of clove and oregano, and their active compounds (eugenol and carvacrol), respectively, were microencapsulated by a commercial company and fed to 12 weanling pigs from 24 to 59 days of age. Animals were allotted to 12 pens (2 pigs per pen), and randomly assigned to 4 experimental treatments with 3 replications each. Treatments consisted of a basal corn-soy diet (Rostagno et al., 2005) with supplementation of natural extracts, as follows: CONTROL (basal diet); EXTRACT OF CLOVE (EC): basal diet with 420 ppm of extract (210 ppm of essential oil of clove + 210 ppm of active compound eugenol); EXTRACT OF OREGANO (EO): basal diet with 420 ppm of extract (210 ppm of essential oil of oregano + 210 ppm of active compound carvacrol) and EXTRACT OF CLOVE + OREGANO (EC + EO): basal diet with 420 ppm of extract (105 ppm of essential oil of clove + 105 ppm of eugenol and 105 ppm of essential oil of oregano + 105 ppm of carvacrol).

At 59 days of age, 3 pigs of each treatment were slaughtered, *Longissimus dorsi* muscle was separated from carcass, sliced, vacuum packaged and stored frozen (-18 ºC). After 2 months of frozen storage the meat was defrosted, minced and mixed with 0.5% of food grade salt. Meat balls were weighed (20 g ± 0.5), vacuum packed and cooked in boiling water at 100 ºC for 8 min. The bags with meat balls were cooled on ice, repacked in polyethylene bags and stored in the dark in a cold room at 1 ºC (± 0.5) during 7 days. TBARS (Madsen et al., 1998) was determined in 3 meat balls of each treatment in duplicate at 0, 2, 4 and 7 days of storage to assess lipid oxidation. The effects of treatments were tested by ANOVA and averages of TBARS were compared in a completely randomized design using GLM procedures of SAS® (SAS Institute, 2001) and considering the experimental factors: diet (supplementation of natural extracts), days of storage (0, 2, 4 and 7) and the interaction.

Results and Discussion

The effect of dietary treatments on the oxidative stability of pre-cooked meat balls is illustrated in Fig. 1. The treatments did not affect significantly lipid oxidation on days 0, 2 or 4. The extent of lipid oxidation, as measured by MAD formation, differed significantly between treatments only after 7 days of chilled storage since dietary supplementation of EC+EO was less effective ($P < 0.05$) on reducing lipid oxidation when compared with CONTROL and EO. It is well established that natural extracts can also exhibit pro-oxidant activity under certain conditions. A typical feature of antioxidants is effectiveness at very low concentrations; however, if this concentration is exceeded the antioxidant activity is reduced and the pro-oxidant activity can be manifested at even higher concentrations (Frankel, 1998; Honglian, Noriko & Etsuo, 2001). In this work, dietary supplementation of 420 ppm of clove extracts alone (EC) and the combination with oregano (EC+EO) seemed to show pro-oxidant effect compared to CONTROL or to the supplementation of oregano alone (EO).

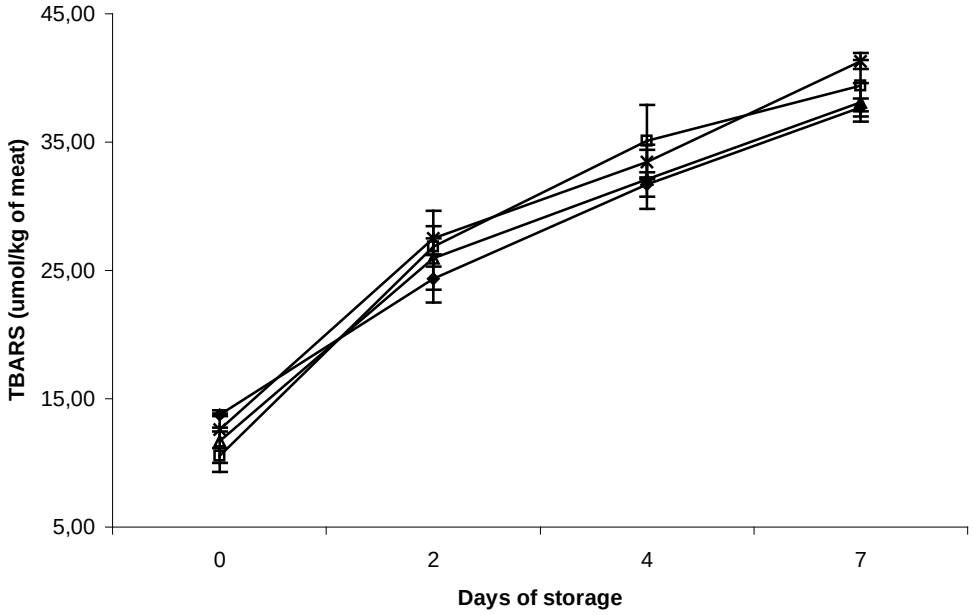

Fig. 1. Effect of dietary supplementation of natural extracts during chilled storage on lipid oxidation of pre-cooked meat balls. All data points represent means of malonaldehydes (MDA) concentration from 3 meat balls analysed in duplicate and their standard deviations. Treatments were: CONTROL (♦): basal diet; EC (□): basal diet with clove; EO (Δ): basal diet with oregano and EC+EO (∗): basal diet with clove + oregano.

Conclusions

The dietary supplementation of 420 ppm of natural extracts of clove and clove + oregano per kg of feed, showed pro-oxidant effect in pre-cooked pork meat balls stored chilled during 7 days. A reduction on the level of supplementation of clove and oregano extracts to weanling pigs seems to be required to improve oxidative stability on pre-cooked meat balls.

References

1. Botsoglou, N.A., Fletouris, D.J., Florou-Paneri, P. Christaki, E., and Spais, A.B. (2003). Inhibition of lipid oxidation in long-term frozen stored chicken meat by dietary oregano essential oil and α-tocopheryl acetate supplementation. *Food Research International* 36, 207-213.
2. Cortinas L., Barroeta A., Villaverde C., Galobart J., Guardiola F. and Baucells M.D. (2005). Influence of the dietary polyunsaturation level on chicken meat quality: Lipid oxidation. *Poultry Science* 84:48-55.
3. Frankel E.N. (1998). Antioxidants. In: *Lipid oxidation* (pp. 129-167). Scotland: The Oil Press Ltd.
4. Honglian S., Noriko N. and Etsuo N. (2001). Introducing natural antioxidants. In: J. Pokorny, N. Yanishlieva and M. Gordon (Eds.), Antioxidants I food-practical applications (pp.147-155). Cambridge, England: Woodhead Publishing Limited.
5. Jensen S.K., Jensen C., Jakobsen K., Engberg R. M., Andersen J.O., Lauriden C., Sorensen P., Skibsted L.H. and Bertelsen G. (1988). Supplementation of broiler diets with retinal acetate, β-carotene or canthaxanthin: effect on vitamin status and oxidative status of broilers in vivo and on meat stability. *Acta Agricultural Scandinavia Science*, 48: 28-37.
6. King A.J., Uijttenboogaart T.G., and De Vries, A.W. (1995). α-Tocopherol, β-carotene and ascorbic acid as antioxidants in stored poultry muscle. *Journal of Food Chemistry*, 60: 1009-1012.
7. Madsen H.L., Sørensen B., Skibsted L.H.; Bertelsen G. (1998). The antioxidative activity of summer savory (*Satureja hortensis* L) and rosemary (*Rosemarinus officinalis* L) in dressing stored exposed to light or in darkness. *Food Chemistry* 63:173-180.
8. O'Neill L.M., Galvin K., Morrissey P.A. and Buckley D.J. (1998). Inhibition of lipid oxidation in chicken by carnosine and dietary α-tocopherol supplementation and its determination by derivative spectrophotometry. *Meat Science*, 50: 479-488.
9. Statistical Analysis System Institute. (2001). SAS user's guide: statistics. Carry, 2001. 155p.
10. Rostagno, H.S. Tabelas brasileiras para aves e suínos: composição de alimentos e exigências nutricionais. 2. ed. Viçosa: UFV, Departamento de Zootecnia, 2005. 186 p.