DIETARY VITAMIN E INHIBITS POULTRY PSE DEVELOPMENT AND IMPROVES MEAT FUNCTIONAL PROPERTIES

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BACKGROUND

Our recent results showed that poultry are susceptible to physical stress originating PSE meat (Olivo et al. 1998). Moreover, by supplementing Vitamin E in the diets, it was possible to slow down the onset of rigor mortis in chicken meat measured by the rate of pH fall avoiding consequently PSE formation (Olivo et. al., 1998). The loss of protein functionality due to extensive protein denaturation was the main factor to be considered for the development of PSE meat characteristics (Bendall & Wismer-Pedersen, 1962; Warris & Brown, 1987). Therefore, the aim of this work was to investigate the effects of vitamin E supplementation on several meat functional properties related to protein denaturation of breast *(Pectoralis major)* meat.

MATERIAL AND METHODS

Chicken and diets: Commercial chicken (n=64) were selected at random and divided into two groups (n=32) and fed control diets containing 150.0 UI (0/21 days), 30.0 UI (22/42 days) and 7.7 UI (43/49 days) and the supplementation diet containing 150.0 UI/(0/21 days) and 200.0 UI/(22/49) days of α-tocopheryl acetate (Roche). **Determination of α-tocopherol**: α-Tocopherol concentration was determined by HPLC following the methodology described in Schuep & Rettenmaier (1994). **Heat Stress:** 32 commercially chickens of 49 days of age were exposed to heat treatment of 42°C for 1h and other 32 birds of the same flock were left on the control pre-slaughtering conditions to be used as control (Froning et al., 1978). **Meat Functional Properties:** Drip loss was measured according to Northcutt et al. (1994). Water Holding Capacity was determined following the technique described by Barbut (1996). Emulsifying Capacity methodology was carried out according to McCurdy et al. (1996) and Protein Denaturation measurement was carried out according to Swatland (1995). **Color Measurement:** The color of intact muscle was evaluated by a Hunter Spectrophotometer (Model UltraScan XE) according to McCurdy et al. (1996). Samples stored during 0,3,6 and 9 days of storage at 3°C under visible light (400 Lux) were analysed. a^*, b^*, and L values were recorded.

RESULTS

α-Tocopherol Concentration. Dietary vitamin E supplementation increased α-tocopherol concentration (μg/g) by 2-3-fold higher in breast muscle (29.31 ± 5.97) than the basal group (10.52 ± 1.09). These results were similar with those recently reported by Morrissey et al. (1997). Table 1 described the effects of physical stress and dietary Vitamin E on functional properties of poultry breast meat:

Protein Denaturation
The supplemented chicken group presented lower percentage of protein denaturation ($p<0.01$) in relation to other groups. Within stressed birds, protein denaturation occurred in lower percentage in meat from supplement group.

Drip Loss
There was a higher drip loss formation in meat from PSE birds. The lowest drip loss occurred in samples from supplemented chicken ($p<0.01$).

Water Holding Capacity
There was no significant difference. These corroborate the results obtained in samples from turkey PSE and control meats (Froning et al., 1978) and chicken meat (Northcutt et al., 1994)

Emulsion Capacity
Meat samples from supplemented and non-stressed chicken presented a higher Emulsion Capacity while meat samples from stressed birds were lower ($p<0.001$).

Meat color evaluation
In Fig. 1, the evolution of packaged breast meat surface color kept at 3°C for nine days was monitored by the ratio a*/b* measured through Hunter colorimeter. The meat samples from supplemented chicken showed higher value in favor of oxymioglobin. Samples analyzed at O day of storage presented approximately 65.0, 16.0 and 73.0 % more oxymioglobin in samples from supplemented birds comparing to basal, supplemented stressed and basal stressed birds, respectively. After nine days of storage, samples from supplemented chicken presented app. 53.0, 20.0, and 76.0 % more oxymioglobin in comparison to samples from basal, supplemented stressed and basal stressed groups, respectively. These results demonstrated dietary vitamin E inhibited chicken PSE formation.

DISCUSSION

Our results demonstrated the beneficial effects of dietary vitamin E. The rapid onset of glycolisis and the formation of lactic acid under higher temperature apparently were the main causes for the poor quality of PSE meat. The decrease of meat functional properties ie. drip loss, protein denaturation, water holding capacity, emulsion capacity and color stability, were directly related to the post-mortem biochemical events. Vitamin E is an antioxidant membrane-associated. According to Cheah et al. (1995), dietary vitamin E inhibits phospholipase A_2 enzimic activity therefore long-chain unsaturated fatty acids are not liberated from the membranes. In our case, consequently, there was a prolonged stability of mitochondria membranes and hindering leakage of Ca^{2+} ions. Release of Ca^{2+} from the sarcoplasmatic reticulum induced the rapid glycolisis and under these conditions the proteins functional properties were impaired.

CONCLUSIONS

Poultry vitamin E supplementation inhibited the onset of PSE promoted by physical stress through the pos-mortem biochemical events contributing to improvement meat functional properties.

ACKNOWLEDGEMENTS

A.L.S. is under CAPES scholarship. E.I.I and M.S. are CNPq Research Fellows.

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Tab. 1. Effects of dietary vitamin E and stress on qualities of poultry breast meat

Group	P. D. (%)	Drip Loss (%)	WHC[1]	Emulsion Capacity[2]
Basal	$22.53^{a,b} \pm 0.24$	$1.70^{c} \pm 0.43$	$2.03^{a} \pm 0.43$	$11.92^{b,c} \pm 0.89$
Supplemented	$12.28^{c} \pm 0.88$	$1.85^{b,c} \pm 0.31$	$2.02^{a} \pm 0.42$	$15.19^{a} \pm 2.52$
Basal Stressed	$24.13^{a} \pm 1.18$	$3.31^{a} \pm 1.21$	$1.97^{a} \pm 0.49$	$11.61^{c} \pm 0.90$
Supplemented Stressed	$20.82^{b} \pm 0.58$	$2.57^{a,b} \pm 0.53$	$1.91^{a} \pm 0.44$	$13.73^{a,b} \pm 1.46$

P.D. Protein Denaturation. WHC Water Holding Capacity. [1]x portion of H_2O:1 portion of sample. [2]1 portion of sample:x portion of ioil.
[a,b,c] Within columns, means having different superscripts are significantly different to at least P<0.001. n: 15

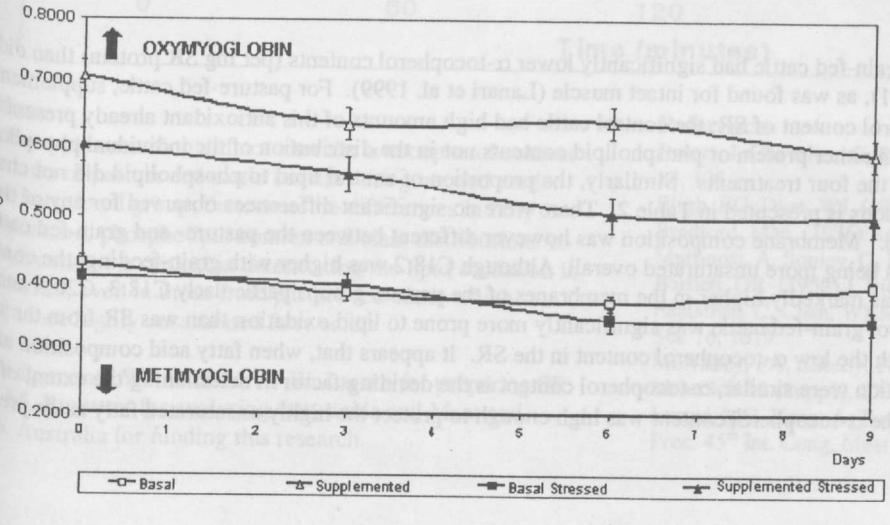

Figure 1: Effect of supplemented vitamin E on PSE breast meat color stability during storage at 4°C.