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Dietary supplementation of garlic and rosemary: effects on colour stability and lipid oxidation in lamb meat

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RIASSUNTO: Integrazione alimentare con aglio e rosmarino: effetti sul colore e sull'ossidazione lipidica della carne di agnello. *Agnelli di razza Gentile di Puglia sono stati alimentati con un mangime di base (Controllo) o integrato con aglio fresco (3,5 g kg⁻¹), estratto di aglio (500 mg kg⁻¹), estratto di rosmarino (500 o 1000 mg kg⁻¹) o con vitamina E (500 mg kg⁻¹ α -tocoferolo acetato). Sono stati costituiti due sottogruppi di agnelli macellati rispettivamente a 80 o 110 giorni. Nei giorni 1, 3, 5 e 7 successivi alla macellazione sono stati valutati il colore e l'ossidazione lipidica mediante TBARS test sul muscolo Longissimus lumborum. Il colore della carne è stato migliorato dagli antiossidanti naturali, ma soprattutto dalla vit. E ($P < 0,05$). Il TBARS test ha evidenziato una diminuzione dell'ossidazione lipidica nei gruppi vit. E e aglio estratto ($P < 0,01$), seguiti dal gruppo rosmarino 1000 ($P < 0,05$). A 110 giorni si sono attenuate le differenze tra i trattamenti alimentari, ma la vit. E e l'aglio estratto hanno confermato il loro effetto antiossidante ($P < 0,05$).*

Key words: natural antioxidants, colour stability, lipid oxidation, lamb meat.

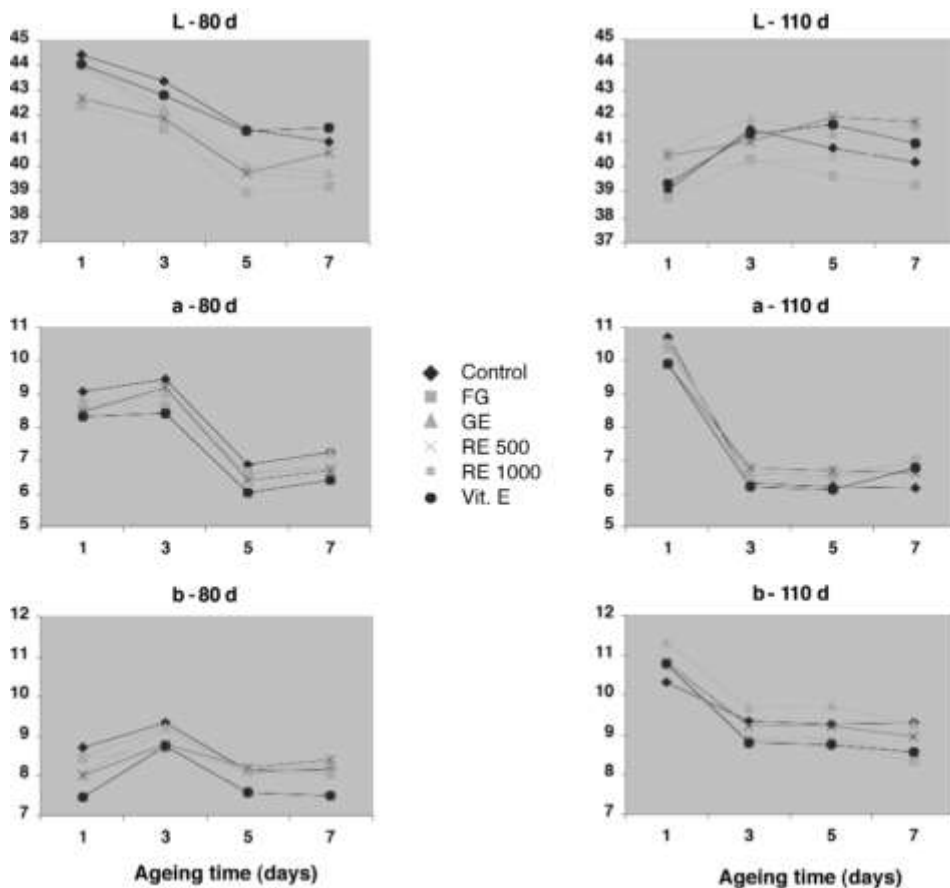
INTRODUCTION – The colour of fresh meat is an important criterion consumers take into consideration when purchasing meat. Meat colour depends on the occurrence of chemical and microbial deterioration processes. The role of vitamin E and other antioxidants on ruminant meat colour stability and prevention of lipid oxidation has been widely investigated (Macit *et al.*, 2003; Realini *et al.*, 2004). Many natural herbs and plant extracts exert antioxidant effects such as garlic (Yin and Cheng, 2003) and rosemary (Sánchez-Escalante *et al.*, 2001). Their use as additives for animal feeding may be a valid alternative to synthetic antioxidants since they show beneficial effects also on animal welfare and other physiological functions (Tedesco, 2001). The aim of this study was to evaluate whether garlic and rosemary dietary supplementation as compared with vitamin E affects lamb meat colour and lipid stability during storage.

MATERIAL AND METHODS – The trial was carried out on 60 Gentile di Puglia male lambs weaned at about 40 days of age. The lambs were then divided into 6 groups (n=10) and fed with a concentrated feed (on DM basis: crude protein 19.10%, crude fibre 13.86%, crude fat 2.70% and ash 9.25%; Control group) alternatively supplemented with fresh garlic (3.5 g kg⁻¹; Group FG), garlic extract (500 mg kg⁻¹; Group GE), rosemary extract, either at the dose of 500 (Group RE 500) or 1000 mg kg⁻¹ (Group RE 1000), and vitamin E (500 mg kg⁻¹ α -tocopherol acetate; Group Vit. E). The lambs were allowed to become adapted to the diet for a week before the beginning of the experiment. Within each feeding treatment two sub-groups of 5 subjects each were formed, slaughtered when lambs were respectively 80 or 110 days old. After 24 hours of refrigeration at 0-4°C, the *Longissimus lumborum* (Ll) muscle was dissected from the right half carcass. Meat was evaluated for

colour and lipid oxidation 1, 3, 5 and 7 days after slaughter. The LI muscle was split into 4 slices which were placed individually on polystyrene trays, overwrapped with a polyethylene film and stored at 0-4°C until the ageing time. Meat samples were processed in duplicate using an OXItek® thiobarbituric acid reactive substances (TBARS) assay kit (ZeptoMetrix Co., Buffalo, NY, USA). Malondialdehyde (MDA) developed from lipid peroxidation was measured by spectrophotometry at 532 nm and expressed as equivalents (nmol ml⁻¹). Meat colour was assessed by the Hunter Lab System using a colorimeter (Miniscan XE, D65/10° illuminant) and recording Lightness (L), redness (a) and yellowness (b). Data were analysed by the GLM procedure of SAS (1999-2000) taking into consideration as main effects diet, slaughtering age, ageing time and their interactions. Means were compared using Student's t test.

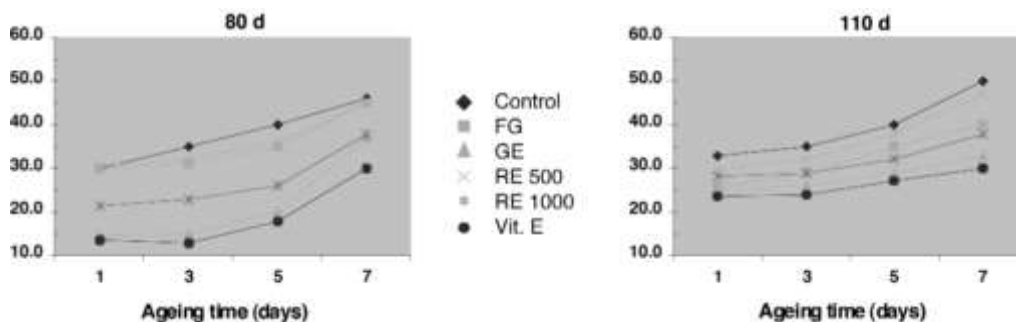
RESULTS AND CONCLUSIONS – The dietary addition of antioxidants positively affected all the meat colour features as compared with the Control group but only vit. E supplementation improved significantly (P<0.05) meat colour stability during storage (Figure 1). Among the natural antioxidants tested, fresh garlic showed to be less effective than garlic extract. Rosemary extract at the higher concentration had better effects on meat colour stability, thus suggesting a dose effect.

Figure 1. Meat colour during storage in lambs slaughtered at 80 or 110 days.



When lambs were slaughtered at 80 days, there was a clear worsening of meat colour at day 5 while when slaughter occurred later meat colour showed to be more susceptible to storage beginning on day 3 as evidenced by a significant ($P<0.01$) decrease of the a and b values. The difference between the diets was evened when lambs were slaughtered at 110 days of age. A similar trend was observed for the oxidative state of meat lipids (Figure 2). The results of the TBARS test referring to the age of 80 days show that dietary addition of vit. E and GE significantly ($P<0.01$) prevented muscle lipid deterioration followed by the RE 1000 diet ($P<0.05$), while FG and RE 500 feeds improved only slightly lipid stability during storage. When lambs were slaughtered at 110 days, the dietary addition of antioxidants still tended to stabilise meat lipid deterioration over time, but at a significant level ($P<0.05$) only for the vit. E and GE groups. In this study vitamin E confirmed its protective effect on meat colour and lipid oxidation, in agreement with previous reports (Macit *et al.*, 2003; Realini *et al.*, 2004). Yin and Cheng (2003) found that the addition of four garlic-derived compounds to ground beef was more effective than α -tocopherol in delaying oxymyoglobin and lipid oxidation. Based on our findings, maybe feed supplementation with 3.5 g kg⁻¹ of fresh garlic was not enough to achieve the same effect displayed by garlic extract. Recent research has focused on the use of rosemary powder, extract and oleoresins as antioxidants in meat and meat products processing. Sánchez-Escalante *et al.* (2001) found that rosemary powder plays a direct antioxidant effect on colour protection. Our results show a dose effect of rosemary extract on both meat colour and lipid oxidation. In conclusion, further research is advisable to identify the optimal dose of administration of natural antioxidants and delivery systems able to improve the bioavailability of the active ingredients for livestock feeding.

Figure 2. MDA (nmol ml⁻¹) during storage in LI muscle of lambs slaughtered at 80 or 110 days.



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