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Forage resources and ecosystem services provided by Mountain and Mediterranean grasslands and rangelands

Zaragoza : CIHEAM / INRA / FAO / VetAgro Sup Clermont-Ferrand / Montpellier SupAgro  
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 109

2014  
pages 301-305

Article available on line / Article disponible en ligne à l'adresse :

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To cite this article / Pour citer cet article

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# Influence of grazing on meat oxidation in light lamb

L. González-Calvo\*, M. Blanco, G. Ripoll, F. Molino, J. H. Calvo and M. Joy

Centro de Investigación y Tecnología Agroalimentaria de Aragón,  
Avda. Montañana 930, 50059-Zaragoza (Spain)

\*e-mail: mjoy@aragon.es

**Abstract.** Oxidation is one of the primary reasons for meat deterioration, decreasing freshness and consumer acceptance. Vitamin E in the diet reduces these oxidative processes. The objective was to assess the effect of grazing alfalfa on plasmatic  $\alpha$ -tocopherol concentration and meat oxidation. Twenty single reared male lambs of Rasa Aragonesa breed were used. Twelve weaned lambs (49 days old) were fed a commercial concentrate indoors, and eight unweaned lambs of  $29.5 \pm 0.95$  days old grazed continuously with their dams. Lambs were slaughtered when they reached 22 to 24 kg live weight. *Longissimus thoracis* muscle was extracted to determine  $\alpha$ -tocopherol concentration and lipid oxidation after 0, 2, 5 and 7 days of display. Plasmatic  $\alpha$ -tocopherol concentration in concentrate-fed lambs remained steady throughout the experimental period ( $P > 0.05$ ;  $0.24$  to  $0.47 \mu\text{g } \alpha\text{-tocopherol/ml}$ ). Plasmatic  $\alpha$ -tocopherol concentration of grazing lambs ( $0.78$  to  $1.53 \mu\text{g } \alpha\text{-tocopherol/ml}$ ) was approximately 3-fold higher than that of concentrate-fed lambs. Lipid oxidation on day 0 and 2 of display did not differ between grazing and concentrate-fed lambs. In longer display periods, lipid oxidation increased significantly in both treatments ( $P < 0.05$ ). In grazing lambs, lipid oxidation decreased as the grazing period was extended, showing that a grazing period longer than 58 days was enough to reduce the lipid oxidation below  $0.6 \text{ mg MDA/kg muscle}$ . Grazing resulted in an improvement of meat oxidative stability compared to feeding a concentrate-based diet without  $\alpha$ -tocopherol supplementation.

**Keywords.** Alfa-tocopherol – Alfalfa – Plasma.

## *Influence du pâturage sur l'oxydation de la viande des agneaux légers*

**Résumé.** L'oxydation détériore la qualité de la viande, diminuant la fraîcheur et l'acceptation par les consommateurs. Le teneur en vitamine E dans le régime alimentaire diminue les processus oxydatifs. L'objectif de cette étude était d'évaluer l'effet du pâturage de la luzerne sur la concentration plasmatique en  $\alpha$ -tocopherol et l'oxydation de la viande. Vingt agneaux mâles provenant d'une naissance simple de race Rasa Aragonesa ont été utilisés. Douze agneaux sevrés ( $49 \pm 0,2$  jours vieux) ont été alimentés avec un concentré commercial (concentré) et 8 agneaux non sevrés ( $29,5 \pm 0,95$  jours) ont pâturé continuellement avec leurs mères (pâturage) jusqu'à l'abattage à 22-24 kg. La concentration plasmatique en  $\alpha$ -tocopherol des agneaux «concentré» est resté stable pendant la période expérimentale ( $P > 0,05$ ;  $0,24$ - $0,47 \mu\text{g } \alpha\text{-tocopherol/ml}$ ). Les agneaux «pâturage», ont eu une concentration du  $\alpha$ -tocopherol ( $0,78$ - $1,53 \mu\text{g } \alpha\text{-tocopherol/ml}$ ) trois fois plus élevée que les agneaux «concentré». L'oxydation lipidique à 0 et 2 jours de présentation a été similaire pour les deux traitements. Dans des périodes de présentation plus longues, l'oxydation lipidique a augmenté dans les deux traitements ( $P < 0,05$ ). Chez les agneaux «pâturage», l'oxydation lipidique a diminué avec l'allongement de la période de pâturage, montrant que le pâturage pendant 58 jours a réduit l'oxydation lipidique au-dessous de  $0,6 \text{ mg MDA/kg muscle}$ . Le pâturage a amélioré la stabilité oxydative de la viande comparée à l'alimentation à base de concentré sans supplément de  $\alpha$ -tocopherol.

**Mots-clés.** Oxydation de la viande –  $\alpha$ -tocopherol – Luzerne – Plasma.

## I – Introduction

Oxidation is one of the primary reasons for quality deterioration in meat products. In Mediterranean countries, light lamb meat is commonly consumed and the appearance of freshness is the

most important intrinsic quality attribute for the consumers (Bernués *et al.*, 2012). The addition of vitamin E in the animal diet reduces the oxidative processes in meat products (Jensen *et al.*, 1998). However the high cost of  $\alpha$ -tocopherol requires accurate feeding and quantity of  $\alpha$ -tocopherol must be adjusted to reduce the cost of the diet. Grazing can increase the intake of  $\alpha$ -tocopherol cheaply. Numerous studies have shown that lambs finished on pasture had higher  $\alpha$ -tocopherol content in meat than those fed high concentrate diets (Turner *et al.*, 2002). The objective of the present study was to assess the effect of alfalfa grazing on plasmatic  $\alpha$ -tocopherol concentration and meat oxidation in light lambs.

## II – Materials and methods

Twenty single reared male lambs of Rasa Aragonesa breed were used. Twelve weaned lambs ( $49 \pm 0.2$  days old), were indoors fed a commercial concentrate (185 g crude protein/kg dry matter, DM; 190 Neutral detergent fiber/kg DM; and 13.22 MJ/kg DM, 30 mg  $\alpha$ -tocopheryl acetate/kg of concentrate) (C). Eight unweaned lambs ( $29.9 \pm 0.95$  days old) grazed continuously on alfalfa pasture with their dams (Gr), and had free access to the same commercial concentrate. In C treatment dams and lambs during lactation were indoors concentrated-fed, while in Gr treatment, ewes and lambs grazed alfalfa since one week after lambing. When the lambs reached 22 to 24 kg of live weight, they were slaughtered, at weekly intervals. The experimental period lasted  $33.7 \pm 2.90$  d in C and  $36.0 \pm 1.87$  in Gr treatments. The age of lambs at slaughtering was  $74.9 \pm 3.17$  d and  $65.9 \pm 2.47$  d in C and Gr treatments, respectively.

Lambs were bled weekly throughout the experimental period to determine  $\alpha$ -tocopherol concentrations, which were analyzed following Lyan *et al.* (2001) method by HPLC. After slaughter (24 h at 4°C), the *Longissimus thoracis* (LT) muscle was extracted from the left half of the carcass and sliced to determine oxidation and  $\alpha$ -tocopherol content. Samples were displayed for 0, 2, 5 and 7 days in darkness at 4°C. Muscle lipid oxidation (TBARS) was analyzed according to Pfalzgraf *et al.* (1995). Muscle  $\alpha$ -tocopherol content was determined using the methods described in Prates *et al.* (2006).

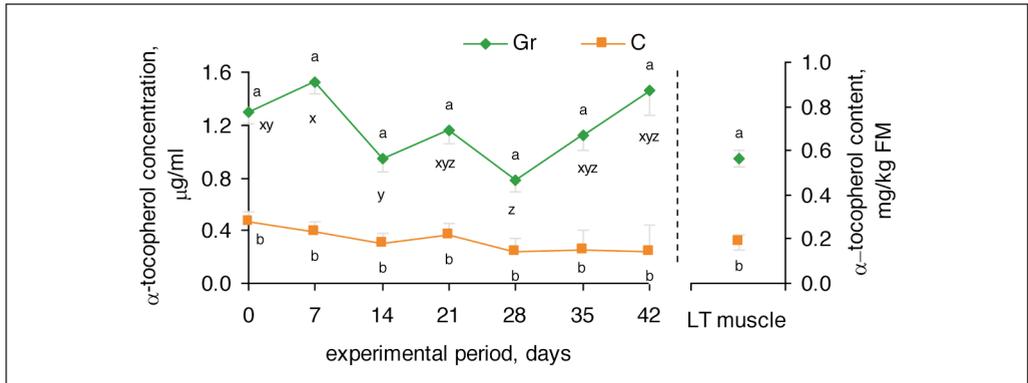
## III – Results and discussion

### 1. $\alpha$ -tocopherol content in plasma and muscle

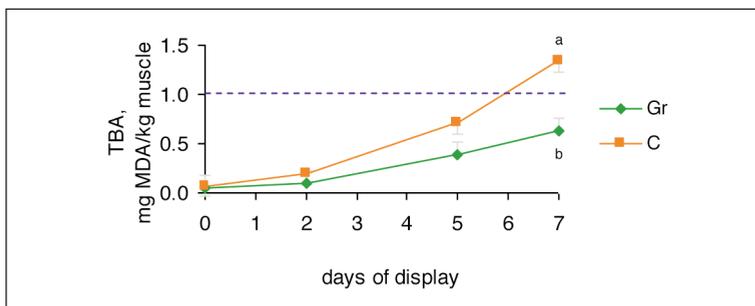
The average concentrate fed during the experimental period was 24.3 and 7.4 kg per lamb, in C and Gr treatments, respectively. Lambs grazing alfalfa had levels of  $\alpha$ -tocopherol in the plasma higher than those of C treatment at the beginning of the study (0 days) as a result of grazing and then, to milk suckled ( $P < 0.001$ ; Fig. 1). Calderón *et al.* (2007) observed a rapid increase of  $\alpha$ -tocopherol during the first week of eating fresh forage. Plasmatic  $\alpha$ -tocopherol concentration in concentrate-fed lambs remained steady throughout the experimental period ( $P > 0.05$ ;  $0.24$  to  $0.47$   $\mu\text{g}$   $\alpha$ -tocopherol/ml), whereas in Gr lambs ( $0.78$  to  $1.53$   $\mu\text{g}$   $\alpha$ -tocopherol/ml) concentration was approximately 3-fold higher than that of concentrate-fed lambs ( $P < 0.001$ ). Guidera *et al.* (1997) found that  $\alpha$ -tocopherol supplemented ewes had greater concentration  $\alpha$ -tocopherol in serum and milk than control ewes just after a week on the experimental diets. In Gr lambs, the plasmatic  $\alpha$ -tocopherol changed during the grazing period ( $P < 0.001$ ), although, there was not a clear effect of the length of the grazing period. In agreement to that,  $\alpha$ -tocopherol concentration in LT muscle was greater in Gr ( $P < 0.001$ ). D'Alessandro *et al.* (2012) found suckling lambs whose dams grazed had greater  $\alpha$ -tocopherol content in muscle than suckling lambs whose dams were fed hay and concentrates.

## 2. Lipid oxidation of *Longissimus thoracis* muscle

Lipid oxidation was affected by the interaction between treatment and days of display ( $P < 0.05$ ; Figure 2). Grazing and concentrate-fed lambs had similar lipid oxidation at 0, 2 and 5 days of display ( $P > 0.05$ ) but Gr lambs had lower lipid oxidation at 7 days of display ( $P < 0.05$ ). Similar results were reported by Luciano *et al.* (2009) in lambs fed fresh forage or concentrates. Lipid oxidation at 7 days of display was correlated with  $\alpha$ -tocopherol content in meat ( $r = 0.67$ ,  $P < 0.001$ ).

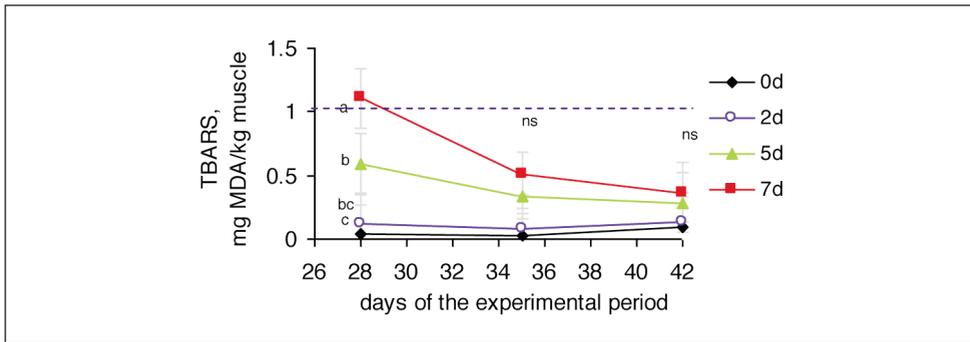


**Fig. 1.** Evolution of  $\alpha$ -tocopherol in plasma throughout the experimental period and  $\alpha$ -tocopherol content in LT muscle of unweaned lambs grazing in alfalfa (Gr) or weaned concentrate-fed lambs (C). Differences within a treatment between days are shown as x, y, z ( $P < 0.05$ ). Differences within a day between treatments are shown as a, b ( $P < 0.05$ ).



**Fig. 2.** Evolution of lipid oxidation of *Longissimus* muscle of grazing (Gr) and concentrate (C) fed lambs with days of display. Differences between treatments are shown as a, b ( $P < 0.05$ ).

In Gr lambs, lipid oxidation decreased as the grazing period was extended (Fig. 3), being highest at 28 days of the experimental period and at 7 days of display. At this moment, lipid oxidation achieved values of 1.1 mg MDA/kg muscle. The limiting threshold for oxidized meat acceptability, according to Ripoll *et al.* (2011), is 1.0 mg MDA/kg muscle in light lamb meat. To ensure levels below 1.0 mg MDA/kg of meat at 7 days of display in Gr treatment, unweaned lambs must be older than 58 days (29.9 d old at starting experimental trial plus 28 d of experimental trial) and grazing since one week age. Sixty-five days grazing time reduced the lipid oxidation below 0.6 mg MDA/kg muscle, regardless of the time of display.



**Fig. 3.** Lipid oxidation (TBARS) of *Longissimus thoracis* from alfalfa grazing lambs according to the length of the experimental period and the days of meat display (0, 2, 5 and 7 days). Different letters within a day mean significant differences among days of display ( $P < 0.05$ ).

## IV – Conclusions

The results of the present study showed that alfalfa grazing increased  $\alpha$ -tocopherol concentrations in serum and in LT muscle compared to concentrate feeding in light lambs. Grazing resulted in a general improvement of meat oxidative stability compared to feeding a concentrate-based diet without  $\alpha$ -tocopherol supplementation. Alfalfa grazing in light lambs is also a feasible alternative for increasing the shelf-life of meat. To reduce the lipid oxidation below 0.6 mg MDA/kg muscle, it was necessary a grazing period longer than 58 d.

## Acknowledgments

This study was funded by the Ministry of Education and Science of Spain and the European Union Regional Development funds (INIA-RTA 2009-0091-C02-01 and RZ2010-0002). L. González-Calvo is supported by doctoral grant from INIA.

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