Small Ruminant Research 116 (2014) 144–152

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Use of dietary rosemary extract in ewe and lamb to extend the shelf life of raw and cooked meat

Rafael Serrano[a], María José Jordán[b], Sancho Bañón[a,*]

[a] Department of Food Science and Technology and Nutrition, Faculty of Veterinary Science, University of Murcia, Espinardo, 30071 Murcia, Spain
[b] Institute of Agricultural and Food Research and Development, La Alberca, 30150 Murcia, Spain

ARTICLE INFO

Article history:
Received 5 April 2013
Received in revised form 5 September 2013
Accepted 29 October 2013
Available online 8 November 2013

Keywords:
Feeding
Sheep diet
Extract
Carnosic acid
Carnosol
Diterpenes
Polyphenols

ABSTRACT

The use of a dietary rosemary extract (DRE) composed of carnosic acid and carnosol at a 2:1 (w/w) ratio is proposed to extend the shelf life of raw and cooked lamb. The sheep diet was supplemented with 600 mg DRE per kg feed during pregnancy and lactation (ewe) and/or fattening (lamb) stages. Meat quality was evaluated in packed raw fillets and cooked patties kept at retail for up to 21 and 4 days, respectively. DRE extended ($P < 0.05$) the shelf life of rawfillets from 9 to 11 days, delaying lipid oxidation and rancidity and, to a lesser extent, colour deterioration and microbial spoilage. By contrast, DRE did not extend the shelf life of cooked patties, because the oxidising status on lamb meat after mincing, heating and retailing exceeded the antioxidant potential of the DRE used. Taking these limitations into account, the treatment with DRE should be limited to fattening lamb alone, which reduces feeding costs, since DRE intake by pregnant and lactating ewes barely extended the shelf life of lamb fillets. Rosemary-based diets can be used as a nutritional strategy for improving lamb quality, although the extract composition should be modified to attempt to increase the degree of meat preservation, in particular, in the cooked meat.

© 2013 Elsevier B.V. All rights reserved.

1. Introduction

Rosemary (*Rosmarinus officinalis*) is a source of dietary polyphenols in sheep nutrition, where it has antioxidant and antimicrobial potential for meat production. Rosemary products include leaf, essential oil, distilled leaf and extracts, whose polyphenol content can vary widely depending on intraspecific variability, climatic conditions and harvest time (Hidalgo et al., 1998; Luis and Johnson, 2005; Sotomayor et al., 2009) as well as the distillation conditions (solvents, temperature, pressure, mechanical separation, *etc.*) (Del Baño et al., 2003). Essential oil is rich in eucalyptol, camphor, α-pinene and other volatile phenols (Sotomayor et al., 2009), mostly destined for the pharmaceutical industry, while distilled leaves, the by-product of essential oil, contain different polyphenols, including acids such as carnosic, rosmarinic, caffeic, ferulic and coumaric, plus carnosol, hesperidin, naringin, luteolin, apigenin and genkwanin (Moñino et al., 2008). Different extracts from these polyphenols can be obtained by consecutive extractions of rosemary-distilled leaves with methanol, acetone and/or water (Del Baño et al., 2003). Among them, extracts rich in carnosic acid and carnosol, the most abundant polyphenols in rosemary, offer greater possibilities for use in sheep feeding because both diterpenes are bioavailable molecules which may be deposited in lamb muscle at sufficiently high levels to act as endogenous preservatives (Moñino et al., 2008).

Several rosemary diets, including distilled leaves (Nieto et al., 2010, 2011) and extracts (Caputi-Jambrenghi et al., 2005; Bañón et al., 2011, 2012a; Morán et al., 2012a,b),

* Corresponding author at: Department of Food Science and Technology and Human Nutrition, Veterinary Faculty, University of Murcia, Campus Espinardo, 30071 Murcia, Spain. Tel.: +34 868 888265; fax: +34 868 884147.
E-mail address: sanchoba@um.es (S. Bañón).

0921-4488/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.smallrumres.2013.10.019

Table 1
Experimental diets given to ewes and lambs.

	Rearing stage	Daily feed intake	Time period	Supplementation with DRE		
				Control	R	RR
Ewe	Gestation and lactating	0.9 kg	240 days	–	–	+
Lamb	Fattening	*Ad libitum*	80 days	–	+	+

have been successfully tested for extending the shelf life of lamb meat. Dietary rosemary was seen to inhibit lipid oxidation, flavour deterioration and rancidity and, to a lesser extent, colour deterioration and microbial spoilage; however, the different levels of meat preservation found by these authors are directly related to the different rosemary sources and the feeding stage when the products were supplied. The supplementation of a ewe diet with distilled leaf offered good results for meat preservation in both raw and cooked lamb kept under retail display conditions (Nieto et al., 2010, 2011), although its efficiency is limited by the heterogeneity of plant material, which makes it difficult to adjust the level of rosemary polyphenols to be included in the sheep diet (Moñino, 2010).

By contrast, the use of dietary rosemary extracts (DREs) allows the dose and type of polyphenols taken by sheep to be adjusted. DREs may be given to ewes during gestation and/or lactation, to lambs during the fattening stage or to both ewes and lambs, although no comparative studies regarding the use of DRE in ewe and lamb diets are available. Of the above possibilities, the supplementation of the fattening lamb diet with DRE may involve less cost for meat production. Doses ranging from 0.5 to 1.2 g per kg feed of different DREs have been used in fattening lambs (around 90 days) (Caputi-Jambrenghi et al., 2005; Morán et al., 2012a,b). The differences in meat preservation observed in these studies suggest that a balanced intake of carnosic acid and carnosol might be more efficient for preserving lamb meat. The extension of DRE intake to pregnant and lactating ewes could improve the level of meat preservation, since rosemary polyphenols, in particular, carnosic acid and carnosol, are transmitted from ewe to lamb during gestation and lactation and subsequently deposited in lamb muscle (Moñino et al., 2008). If so, the higher costs involved in supplementing ewe diets with DRE could be assumed by farmers by offering better quality meat.

The objective of this study was to determine whether the shelf life of raw and cooked meat from lamb supplemented with a DRE (composed of carnosic acid and carnosol) could be increased by extending the supplementation with DRE to pregnant and lactating ewe.

2. Materials and methods

2.1. Experimental design

A DRE composed of carnosic acid and carnosol at 1:2 (w/w) ratio was incorporated (600 mg DRE per kg feed) into two different feeds for ewes and lambs, respectively. The levels of both diterpenes in feed were verified before its use in sheep. Pregnant ewes were randomly assigned to three homogeneous groups (12 ewes per each group) designated as Control, R (basal diet not supplemented with DRE) and RR (basal diet supplemented with DRE during the gestation and lactation stages) (see Table 1). All the ewes were given a basal diet coinciding with their gestation and lactation periods, in order to study the quality of the subsequent lamb meat. All the lambs were weaned and then were fed with fattening pellets supplemented (R and RR groups) or not (Control group) with DRE until they reached the slaughter weight. Finally, the lambs were slaughtered and the carcasses were processed. Meat obtained from 30 lambs (10 lambs per each group) was sampled and analysed. Several physical–chemical, microbial and sensory traits related to meat quality were determined. The shelf life was monitored in both fresh (loin fillets) and cooked lamb (minced meat from different leg muscles). The effects of diet and storage time on lamb quality were determined.

2.2. Rosemary dietary extracts

The DRE was provided by Nutrafur-Furfural Español S.A. (Murcia, Spain). The rosemary extract was obtained by successive stages of extraction, drying and concentration, using different solvents, including water, methanol and acetone, as described by Del Baño et al. (2003). The resultant DRE was a dry powder consisting of 30% rosemary polyphenols (composed of carnosic acid and carnosol at 2:1 (w/w) ratio), which was subsequently incorporated in the feed together with other additives (vitamins, minerals, *etc.*) to manufacture the pellets. After the pelletisation process, the remaining average content of carnosic acid and carnosol was 400 and 200 mg per kg feed, respectively. Rosemary polyphenols were determined by high performance liquid chromatography–mass spectrometry (HPLC–MS), as described Moñino et al. (2008).

2.3. Animals and diets

A total of 36 ewes (Segureña breed) were selected and scanned to assess pregnancy. Sheep were intensively reared on a research farm (CIFEA Lorca, Murcia, Spain). In a first step, the pregnant ewes were randomly assigned to three groups of 12 ewes designated as Control, R and RR. Control and R ewes were given a basal diet consisting of 0.9 kg feed per animal per day for 240 days, coinciding with their gestation and lactation periods, while RR ewes were given the same feed supplemented with 600 mg of DRE per kg feed. Ten lambs from each ewe group were assigned to three groups (Control, R and RR). Following the practices recommended by Segureño farmers, all the lambs were weaned when they reached the weight of 13 ± 1 kg and were then fed *ad libitum* for abound 80 days, coinciding with their fattening stage, until reaching 25 ± 2 kg live weight. The Control diet was not supplemented, while R and RR lamb diets were supplemented with 600 mg of DRE per kg feed. The feed for ewes (Oviunic®) and lambs (Nantacor Cebo Intensivo®) was provided by Nanta Animal Nutrition (Torre Pacheco, Murcia, Spain). Table 2 shows the proximal composition, total energy, ingredients and additives of the different feeds used in ewes and lambs.

2.4. Meat sampling

The lambs were slaughtered in a local abattoir according to European Commission (EC) regulations and the carcasses were chilled at 2 °C for 72 h in a cooling room. For the raw meat study, the *Longissimus dorsi* muscle was removed from both sides of the carcasses and cut into 1.5-cm fillets. The fillets were assigned to a particular day and packaged in B5-37 Aerpackpolystyrene trays (Coopbox Hipania, Lorca, Murcia, Spain) in BB4L bags (Cryovac Packaging, Barcelona, Spain) of low gas permeability (8–12 cm^3 ml^2 per 24 h). The air in the packs was replaced by a modified atmosphere composed of 70% O_2 and 30% CO_2 (EAP20, Carburos Metálicos, Barcelona, Spain) in a discontinuous INELVI VISC 500 packer (Industrial Eléctrica Vilar, Barcelona, Spain). The meat/gas ratio was approximately 0.03 kg meat per l O_2/CO_2. After sealing, the atmosphere inside the bags was checked using an Oxybaby gas metre (WITT Gasetechnik, Witten, Germany). Samples were stored at 2 ± 1 °C for 0, 7, 14 or 21 days in a Climacell 707 display cabinet (MMM Medcenter Einrichtungen, Munich,

Download English Version:

https://daneshyari.com/en/article/2457101

Download Persian Version:

https://daneshyari.com/article/2457101

Daneshyari.com