

# Impact of grazing management on lamb meat quality

Giuseppe Luciano

## Introduction

In low-input farming systems, particularly in the Mediterranean area, reducing the exploitation of pastures is of interest to farmers. But limiting access to grazing may have a negative impact on the production performance and meat quality of ruminants. Research conducted within the LowInputBreeds project with lambs aimed at determining the impact of pasture management on quality and shelf life of meat, and on lamb performances.



## Background

In the last decades consumers' perception of red meats has been strongly influenced by alarming rumours, mainly related to nutritional implication on human health, leading to an indiscriminate and unjustified avoidance of these products. But, what exactly is meat charged with? Nutritionists claim that well balanced diets should provide a high intake of polyunsaturated fatty acids while limiting that of saturated fat.

### Saturation of fatty acids by micro-organisms in the rumen

It has been commonly reported that red meats from ruminants (e.g. beef and lamb) contain only negligible amounts of polyunsaturated fatty acids. The scarce presence of these compounds in meat from ruminants is attributed to processes in the rumen. Specifically, a wide variety of micro-organisms, which inhabit the rumen, operate a peculiar metabolism known as "biohydrogenation". In biohydrogenation the unsaturated fatty acids are progressively saturated, with the consequence that a higher proportion of saturated fatty acids are transferred to meat and milk.

In the past, this process has been considered inevitable. Therefore, attention has never been placed on the quality of the animal diet. However, in the last years,

research has clearly demonstrated that red meats can contain remarkable amounts of beneficial fatty acids depending on the diet of the animals.

### Positive impact of fresh herbage on meat quality

The occurrence and the content of polyunsaturated fatty acids in meat are strongly and positively linked to diets based on the consumption of fresh herbage at pasture. In other words, the higher the proportion of pasture in the diet, the higher the content of polyunsaturated fatty acids in meat. The noticeable content of polyunsaturated fatty acids in meat from pasture-fed animals is mainly due to the high content of these compounds in fresh forages. For instance, linolenic acid accounts for almost 70 % of the total fatty acids in fresh herbage and, once ingested by the animals, it serves as precursor of all the desirable health-promoting fatty acids in meat.

Fresh herbage is also rich in bioactive compounds, such as natural antioxidants, which can be transferred to the meat, thus increasing its resistance to the oxidative processes that limit its shelf life in terms of colour deterioration and rancidity off-flavours over storage and display.



**Feeding of ruminants with forages at pasture according to their nature consistently improves the nutritional quality of their products. (Photo: Salvatore Bordonaro)**

### Limits and potentials to feeding at pasture in Mediterranean areas

However, in most Mediterranean areas pasture availability is often limited to rather short seasons, which makes it practically impossible to raise livestock exclusively on pasture, especially those which require long production cycles, such as beef cattle.

Conversely, lambs destined to meat production are slaughtered rather early (not later than 60 days of age) and, generally, are raised in autumn and spring when pasture is available. Therefore, extensive pasture-based feeding systems are of special importance for lamb production, especially as the use of concentrates in ruminant feeding is discouraged by the fact that they are often too expensive due to the high cost of grains.

### Impact of grazing management on fatty acid profiles

In the frame of the LowInputBreeds project, the University of Catania evaluated the possibility of limiting the daily access to pasture for growing lambs solely to the morning or afternoon, instead of traditional all-day grazing. This strategy might be of interest in order to limit grazing pressure and to reduce the costs that, in some instances, arise from attending the flock at pasture. The focus of this investigation was to assess the effect of this restriction on some nutritional and technological meat quality traits and evaluate its impact on animal performance.

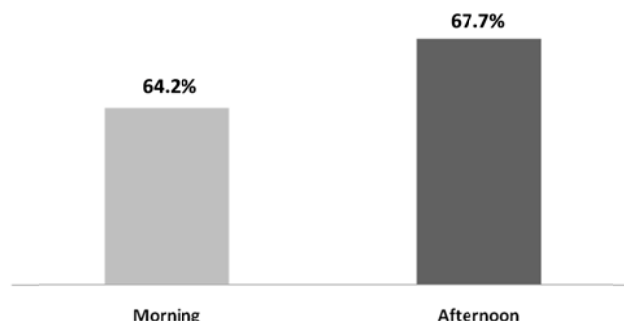
#### Variation of the fatty acid profile in plants

A first study served to choose which time of the day (morning or afternoon) was better in terms of meat fatty acids. Details on the methods and results of this study have been published and we invite to consult the article by Vasta et al. (2012).

In the experiment conducted from March to May 2010 one group of lambs grazed on a ryegrass pasture for 8 hours from morning to the afternoon. Two other groups of lambs grazed other parcels of the same pasture for 4 hours either in the morning or in the afternoon. During the trial, samples of

pasture were collected for chemical analyses. At the end of the trial, the lambs were slaughtered and muscle samples collected for the evaluation of meat quality.

With regard to the fatty acid composition of herbage, the most remarkable difference was the concentration of linolenic acid (LNA n-3), which was higher in the sward grazed in the afternoon than in the morning as shown in figure 1.



**Figure 1: Diurnal variation of linolenic acid (LNA) in pasture**

Although previous studies had shown that chemical composition of herbage does vary throughout the day, there is only scarce information available on changes in the fatty acid profile in plants during the day. Previous studies demonstrated that linolenic acid plays important roles in the photosynthetic metabolism, which might explain the variation in its concentration in leaves during the day.

#### Variation of meat quality

As a consequence of the variation in the fatty acid profile of the herbage through the day, the fatty acid composition of meat is affected by the grazing management. Compared to a morning-grazing only or to a whole day-grazing management, allowing lambs to graze in the afternoon resulted in a meat fatty acid profile richer in the health-promoting fatty acids. In particular, afternoon grazing reduced saturated fatty acids (-8.2 %) and increased the content of polyunsaturated fatty acids (+9.6 %), compared to the conventional system in which animals grazed for 8 hours. Conversely, grazing in the morning only did not appear to change the fatty acid composition compared to the conventional 8-hours grazing. It was concluded that in a Mediterranean environment, during the spring-months March to May, lambs may be kept at pasture only during 4 hours in the afternoon, rather than grazing 8 hours a day, with a positive outcome in terms of meat nutritional quality.

Further studies are needed to understand, how animal circadian rhythms, diurnal rumination patterns and daily changes in herbage chemical composition affect lamb fatty acid metabolism.

### Impact of feeding on shelf life of meat

Apart from nutritional properties, shelf life is an important aspect of meat quality. Proteins and lipids in meat are subject to oxidative processes, which cause deterioration in sensorial and nutritional quality during storage and retail display. As depicted below, these processes lead to the loss of the bright-red colour typical of fresh meat and to the production

of unpleasant rancidity flavours. They therefore represent a major concern in the meat industry.

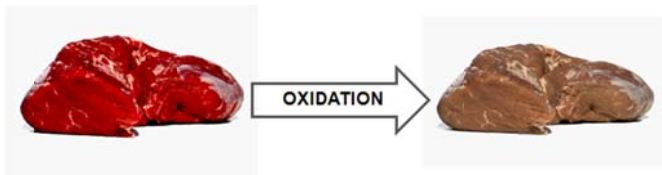


Figure 2. Oxidative deterioration of meat

### Impact of pasture compared to feeding of concentrates

The oxidative deterioration of meat can effectively be delayed by antioxidants in muscle, some of which are of dietary origin.

It was demonstrated that grazing diets result in superior shelf life of meat compared to diets based on concentrate feeds, because fresh herbage contains high levels of antioxidants. However, feeding restrictions may negatively affect the antioxidant defense systems of muscle with a negative impact on meat shelf life. Therefore, in the frame of the LowInputBreeds project, the University of Catania assessed whether a restriction of daily access of lambs to pasture would have detrimental effects on meat shelf life.

Specifically, using the same experiment detailed above, three procedures for feeding of lambs were compared:

- i) Pasture for 8 hours during the day (positive control: expected to produce a meat with a good shelf-life)
- ii) Pasture for 4 hours in the afternoon
- iii) Exclusive feeding of concentrates in stall (negative control: expected to produce a meat with a poor shelf life).

The measurement of the levels of lipid oxidation in meat during a period of simulated retail display of 10 days showed clearly that the meat from lambs fed exclusively concentrates (negative control) had much higher levels of lipid oxidation compared to the meat from the lambs fed at pasture. Interestingly, the levels of lipid oxidation across the 10 days of display were lower in meat from lambs grazing for 8 hours as well as for 4 hours in the afternoon. These results show that a restriction of the daily access to pasture to the sole afternoon does not impair meat shelf life compared to a conventional system, in which lambs grazed for 8 hours during the whole day. For details on this experiment, please consult Luciano et al. (2012).

### Impact of grazing management on lamb growth and production performances

The results of the above experiments suggest that, in the Mediterranean environment, the restriction of the daily access to pasture for lambs does not negatively affect some important meat quality traits. However, such strategy should not have detrimental effects on the animals' growth and production performances.

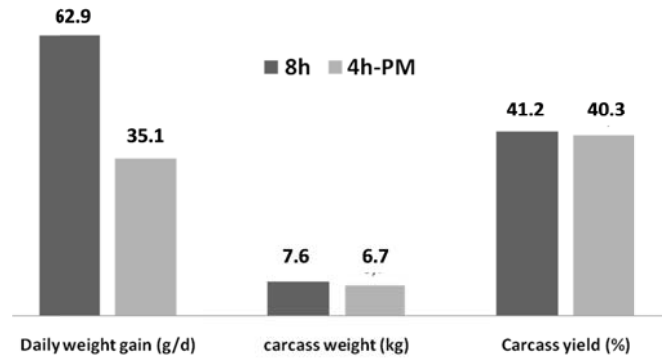


Figure 3: Growth and production performances

As Figure 3 shows, daily weight gain was higher for the lambs allowed to graze for 8 hours compared to those grazing for 4 hours in the afternoon. As a consequence, the live weight at slaughter was higher for the 8 h lambs compared to the 4-hours-PM lambs (18.62 kg vs 16.60 kg, respectively). However, interestingly, there was no difference in the carcass weight and carcass yield between the two groups of lambs. A possible adaptation of the grazing behaviour consequent to the restriction of the time at pasture could have allowed lambs to partially overcome such feeding restriction and to minimize detrimental effects. Indeed, for the 4-hours-PM group, the restriction of the daily grazing duration by 50 % of that allowed to the 8-hours lambs caused a reduction of the herbage intake of only 22.6 %. This, together with the lower physical activity of the 4-hours-PM lambs compared to the 8-hours lambs, might partially explain the comparable carcass weight and yield between the groups. Also, the 8-hour-treatment might have resulted in a higher gut fill and gut development in lambs compared to the restricted 4-hour-grazing management.



Based on the research conducted, grazing in the afternoon is preferable over grazing in the morning from a "meat quality" perspective. (Photo: Salvatore Bordonaro)

Details on the effects of the different grazing managements on lambs' feed intake and performances have been published and may be found in both Vasta et al. (2012) and in Luciano et al. (2012).

## Outlook

In general terms, it can be said that several different situations can induce producers to limit the daily availability of pasture for ruminants. In temperate climate conditions this could be a strategy to extend the grazing season to periods characterized by low herbage availability, such as early spring and late autumn.

In Mediterranean areas vulnerable to over grazing, the possibility of reducing the time spent at grass could help implement pasture management strategies to limit lands and pastures degradation. In this context, lamb meat production appears to fit with such strategies, since small ruminants are typically well adapted to marginal areas and low-input systems. Additionally, in the Mediterranean areas, production of light lambs is often concentrated in the short periods in which pasture can be available. Very few studies have so far been conducted to evaluate the possibility of reducing the time spent at pasture.

Certainly, such strategies should not be detrimental to animal health and productivity although further investigations on how animals react to and compensate for such modulations of grazing management are necessary. Also, the impact of the pasture quality and botanical composition on lamb performance and meat quality and how they might interact with restrictions in grazing duration should be focused on.

In the frame of the LowInputBreeds project, the University of Catania has investigated the effects of reducing the daily grazing availability to the sole morning or afternoon on some main animal performances and meat quality parameters. From this study, it seems that growing lambs can compensate for reduced pasture availability, probably by adapting the grazing behavior, with only minor effects on production performance. Additionally, results suggested grazing in the afternoon gives better meat quality compared to morning grazing, especially with regard to nutritional properties. These results could be likely explained by the diurnal variation of the chemical composition in the plants. In outline, the results of our study highlighted the need for further research to identify and study the main factors to consider in implementing restricted grazing management which maximum profit without compromising animal health and welfare.

## References/Further reading

Articles published providing details on the studies conducted by the University of Catania under the 7<sup>th</sup> FP project LowInputBreeds

Vasta V., Pagano R.I., Luciano G., Scerra M., Caparra P., Foti F., Cilione C., Biondi L., Priolo A., Avondo M. (2012). Effect of morning vs. afternoon grazing on intramuscular fatty acid composition in lamb. *Meat Science*, 90 (1), 93-98

Luciano G., Biondi L., Pagano R.I., Scerra M., Vasta V., López-Andrés P., Valenti B., Lanza M., Priolo A., Avondo M. (2012). The restriction of grazing duration does not compromise lamb meat colour and oxidative stability. *Meat Science*, 92 (1), 30-35

Further suggested readings on the topic "possibility of limitation of grazing duration":

Iason G.R., Mantecon A.R., Sim D.A., Gonzalez J., Foreman E., Bermudez F.F., Elston D.A. (1999). Can grazing sheep compensate for a daily foraging time constraint? *Journal of Animal Ecology*, 68, 87-93

Pérez-Ramírez E., Delgarde R., Delaby L. (2008). Herbage intake and behavioural adaptation of grazing dairy cows by restricting time at pasture under two feeding regimes. *Animal*, 2 (9), 1384-1392

Avondo M., Bonanno A., Pagano R.I., Valenti B., Grigoli A.D., Alicata L.M., Galofaro V., Pennisi P. (2008). Milk quality as affected by grazing time of day in Mediterranean goats. *Journal of Dairy Research*, 75 (1), 48-54

## Imprint

### Author

Dr. Giuseppe Luciano, University of Catania, DISPA, Via Valdisavoia 5, 95123 Catania, Italy; e-mail: giuseppe.luciano@unict.it

### LowInputBreeds

LowInputBreeds is the acronym of the project 'Development of integrated livestock breeding and management strategies to improve animal health, product quality and performance in European organic and 'low input' milk, meat and egg production'. It is funded under the Seventh Framework Programme of the European Community for Research, Technological Development and Demonstration Activities (Contract No. 222623).

### Disclaimer

The contents of this technical note are the sole responsibility of the authors, and they do not represent necessarily the views of the European Commission or its services. Whilst all reasonable effort is made to ensure the accuracy of information contained in this technical note, it is provided without warranty and we accept no responsibility for any use that may be made of the information.

### Layout and editing

Gillian Butler, Newcastle University, UK; Veronika Maurer, Gilles Weidmann and Helga Willer, Research Institute of Organic Agriculture (FiBL), Frick, Switzerland

### Cover picture

Flock of sheep in Sivilly. Photo: Alessandro Priolo, University of Catania

### Publishers

Consortium of the LowInputBreeds project, c/o Newcastle University, UK, and Research Institute of Organic Agriculture (FiBL), Frick, Switzerland

Download: This technical note is available for download at <http://www.lowinputbreeds.org/lib-technical-notes.html>

Contact: [helga.willer@fibl.org](mailto:helga.willer@fibl.org)

© LowInputBreeds Consortium 2014