GRAZING BOTANICALLY DIVERSE PASTURES INFLUENCES TISSUE LONG-CHAIN FATTY ACID PROFILE IN LAMBS

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Introduction

It is well known that feeding factors, particularly the feed fatty acid (FA) profile, affect the FA composition of animal products. The botanical composition of pastures may also influence rumen and intermediary FA metabolism, although less is known in this respect for meat producing ruminants, compared to dairy cattle. However, Ådnøy *et al.*, (2005) reported an increased intramuscular (IM) polyunsaturated FA (PUFA) content in lambs grazing diverse mountain pastures, compared to monocultures of lowland pastures. The objectives of this trial were to study the effect of grazing on 3 botanically different pastures on the FA metabolism and pattern in intramuscular and subcutaneous fat of lambs.

Materials and Methods

Twenty-one male lambs of similar genetic background were assigned to 3 different pastures of 7 lambs each: Botanical diverse pasture (BD), Leguminosa rich pasture (L) and Intensive English ryegrass pasture (IR). Animals started at an average live weight of 22.3 ± 3.1 kg and an age of 86 ± 7 days (not significantly different between groups). Animals grazed the pastures *ad libitum* for 12 weeks, and did not receive supplementary feed. The stocking density was low and on average less than 850 kg live weight ha^{-1} for the BD pasture and less than 1200 kg live weight ha^{-1} for the IR and L pasture. The botanical composition of the 3 pastures (Table 1) was determined on 9 occasions during the trial, according to De Vries (1933).

Table 1: Overview of the botanical composition of the 3 pastures grazed by the animals (n=9).

Plant Family	BD	L	IR
Poaceae	*Agrostis stolonifera* (38%) *Bromus hordeaceus* (18%) *Phleum pratense* (9%)	*Lolium perenne* (19%) *Phleum pratense* (14%)	*Lolium perenne* (69%) *Bromus hordeaceus* (17%) *Lolium multiflorum* (5%)
Asteraceae	*Carduus nutans* (12%) *Taraxacum officinale* (4%)		
Ranunculaceae	*Ranunclus acris* (5%)		
Fabaceae		*Trifolium repens* (41%) *Medicago sativa* (20%)	

During the trial, weekly representative samples of the 3 pastures were taken for FA analysis and DM determination. After collection, the fresh samples were stored immediately in liquid N_2 for 4h, after which the FA extraction was started immediately. After 12 weeks, lambs were slaughtered at an average live weight of 24.8 ± 4.2 kg; 36.4 ± 3.5 kg and 35.6 ± 3.8 kg for the BD, L and IR group, respectively (significantly lower for the BD group compared to the L and IR group). *Longissimus thoracis* (left side of carcass between rib 7 and 8) and subcutaneous (SC) fat samples were taken 24h post-mortem from chilled carcasses (4°C), vacuum packed and stored at -20°C until FA analysis. FA of fresh pasture samples were extracted in triplicate with chloroform/methanol (2/1, v/v), as described by Lourenço and Fievez (2005). Meat and adipose tissue samples were extracted in duplicate as described by Raes *et al.* (2001). Fatty acids methylesters (FAME) were prepared according to Raes *et al.* (2001) and analyzed by GC (Raes *et al.*, 2004). For grass FA the temperature program used was: 150°C for 2 min, followed by an increase at a rate of 1°C/min until 200°C. A one-way ANOVA was used to evaluate the effect of the different pastures on grass, meat and fat FA, with Duncan as post-hoc test (SPSS for windows, version 11.0).

Results and Discussion

Table 2 presents the FA composition of the pastures. It is clear that pasture L had the highest total amount of FA, although the proportions of the sum of C18:2 n-6 and C18:3 n-3 were similar across groups with, however, pasture IR being richer in C18:3 n-3 and pastures BD and L having a higher content of C18:2 n-6.

There were significant effects of the type of pasture on the FA profile of SC and IM fat. The CLA c9t11 content in the SC fat significantly differed between the three pasture groups (BD > IR > L), but was not significantly different in the IM fat.

Table 2: Total fatty acid content (mg/g tissue) and proportions of FA (% of FAME) of pasture samples (n=12), and subcutaneous fat and meat of animals (n=7) according to pasture group.

Sample	Fatty acids	BD	L	IR	SEM	Sign.
Pasture	Total (mg/g DM)	18.5^c	29.8^a	25.5^b	1.23	<0.001
	C18:2 n-6	18.2^a	17.3^a	13.9^b	0.778	0.001
	C18:3 n-3	51.7^b	52.1^b	57.2^a	1.67	0.050
Fat	Total (mg/g fat)	609	669	660	18.8	0.098
	CLA c9t11	1.32^a	0.676^c	1.01^b	0.091	0.001
	C18:2 n-6	1.19^b	2.35^a	0.862^c	0.078	<0.001
	C18:3 n-3	1.30^b	3.53^a	1.50^b	0.166	<0.001
Meat	Total (mg/g meat)	16.0	24.4	19.6	2.58	0.094
	C18:2 n-6	7.06^a	5.28^b	3.37^c	0.564	0.001
	C18:3 n-3	2.64^b	3.99^a	2.59^b	0.235	0.001
	CLA c9t11	0.897	0.738	0.903	0.097	0.415
	C20:4 n-6	4.16^a	1.17^b	1.33^b	0.549	0.002
	C20:5 n-3	2.76^a	1.09^b	1.33^b	0.315	0.003
	C22:5 n-3	2.69^a	1.08^b	1.26^b	0.296	0.002
	C22:6 n-3	0.427	0.293	0.340	0.037	0.059
	Indices of desaturation and elongation					
	C20:4 n-6/C18:2 n-6	0.543^a	0.393^b	0.219^c	0.043	<0.001
	C20:5 n-3/C18:3 n-3	1.02^a	0.518^b	0.273^b	0.103	<0.001
	C22:5 n-3/C18:3 n-3	0.993^a	0.487^b	0.271^b	0.094	<0.001
	C22:6 n-3/C18:3 n-3	0.161^a	0.076^b	0.131^a	0.012	<0.001

The proportions of C18:2 n-6 and C18:3 n-3 in SC fat of animals grazing pasture L were significantly higher than for the other groups. A similar effect was found in IM fat for C18:3 n-3, but not for C18:2 n-6, which significantly differed between the three pasture groups in the order BD > L > IR. Although the differences between tissues cannot be readily explained, the higher C18:3 n-3 content in meat and fat from L pasture lambs might be related to differences in rumen outflow rate. This has been shown to be higher for animals fed clover rich diets (Lee *et al.*, 2003).
Significantly higher proportions of C20:4 n-6, C20:5 n-3 and C22:5 n-3 in IM fat of pasture BD animals were also observed. Yet, no significant differences were found for C22:6 n-3. A confounding effect of the lower IM fat content in this group and thus a higher phospholipid/triglyceride ratio cannot be ruled out. However, after correction for differences in IM fat content, the proportions of long-chain FA remained higher for pasture BD lambs (data not shown). This is also reflected in the higher indices for elongation and desaturation activity, suggesting some stimulation of elongation and desaturation of long-chain FA in muscles of pasture BD animals.

Conclusions

From this study, it is clear that the botanical composition of pastures may affect the CLA c9t11 and the PUFA profile of the subcutaneous and intramuscular fat of exclusively grazing lambs. It seems that other factors than the FA supply interfere in the rumen and/or intermediary FA metabolism.

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