DIFFERENT WEANING SYSTEM OF LAMB FATTENING AT PASTURE ON FATTY ACID COMPOSITION

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Background

The time of weaning is of particular importance in grass-based systems, since it affects food consumption and growth of the lambs. Weaning system may affect fatty acid composition deposited in the different fats as Cañeque *et al.* (2001) observed in intramuscular and subcutaneous fat of lambs weaned at different moments. Milk composition and the period consumed conditioned fatty acid composition (Velasco *et al.*, 2001a).
Diet is known to affect the model of ruminal fermentation, which in turn influences the fatty acid composition of the fat depots. The effect of diet with regard to the n-6/n-3 polyunsaturated fatty acid (PUFA) ratio has been noted by Mitchell *et al.* (1991), who have found that forage or grass-based diets contribute to high n-3 PUFA tissue concentrations while concentrate-based diets result in high n-6 PUFA concentrations. The importance of linolenic acid is its capacity to diminish the thrombocytic tendency of blood and the risk of suffering coronary diseases. Linoleic (C18:2) and linolenic (C18:3) acids are wholly derived from the diet and compete for incorporation in tissue lipids (Wood and Enser, 1997).

Objectives

The present study deals with the effect of different weaning systems (early weaned and unweaned) and feeding regimes (commercial feed and whole barley) of lamb fattening, and to study its effect on fatty acid composition of intramuscular and subcutaneous fats. These effects have been assessed in lambs raised at pasture until reaching a slaughter weight of 28 kg.

Methods

A total of 52 Talaverana-breed lambs from single birth were raised at pasture until reaching a slaughter weight of 28 kg. Two rearing systems have been assessed in lambs: with early weaning (45 days of age) and unweaning until slaughter. Both groups were fattened *ad libitum* with whole barley with a protein supplement or with a commercial concentrate diet on a 2 ha plot of oak-wooded pastureland.
After slaughter samples of the *longissimus dorsi* muscle and the associated subcutaneous fat were taken to determine the fatty acid composition of intramuscular and subcutaneous fat. Fat extraction was performed according to the method of Hanson and Olley (1963) and fatty acid methyl esters were prepared using the technique of Morrison and Smith (1964). Chromatographic analysis of the methyl esters was performed using a Perkin-Elmer gas chromatograph with a fused silica capillary column. Chromatograph was equipped with a split-splitless injector and a flame ionisation detector. The mobile phase consisted of helium at a flow of 9 psig. Sigma reference standards were used to identify the fatty acids, and nonadecanoic acid (C19:0) was utilised as the internal standard.
Statistical analyses of the results was carried out using an analysis of variance with refrigerated carcass weight as covariate, and were performed using the GLM procedures of the SAS package.

Results and discussions

The effect of weaning system was observed in both intramuscular and subcutaneous fats (Tables 1 and 2). That of lambs unweaned contained more short-chain fatty acids (C14:0 and C16:0) than that of lambs early weaned mainly due to the composition of the maternal milk, as Velasco *et al.* (2001b) observed in suckling lambs raised at pasture or in drylot. Unweaned lambs also presented less intramuscular fat and lower values of stearic (C18:0) and oleic (C18:1) fatty acids. These results demonstrate that lambs which remained with their dams until slaughter presented the highest proportion of saturated fatty acids (SFA) and the lowest proportion of monounsaturated fatty acids (MUFA), as well as the lowest values for desirable fatty acid (DFA) than lambs early weaned. Subcutaneous and intramuscular fats of unweaned lambs presented a lower and therefore adequate n-6/n-3 PUFA ratio than those observed for the same fats of early weaned lambs. The effect of diet on this ratio suggest that unweaned lambs had a higher grass consumption as grass contains a high level of linolenic fatty acid (C18:3 n-3) (Mitchell *et al.*, 1991).
As can be seen from Table 1, lambs feed with concentrate presented in intramuscular fat a higher proportion of oleic (C18:1) fatty acid and therefore a higher level of MUFA than lambs feed with barley. Consumption of an enriched diet leads to deposition of unsaturated fat (Marsico *et al.*, 1995). However in subcutaneous fat (Table 2), lambs consuming barley (principally unweaned lambs) only presented a higher percentage of short chain fatty acids (C12:0 and C16:0) that lambs consuming concentrate. Consumption of whole barley by lambs fattened at pasture causes ruminal pH to rise, increasing the number of cellulolytic bacteria (Mann and Ørskov, 1975) which, in turn, favours the digestibility of the feed consumed and stimulates greater intake.

Conclusions

Early weaned lambs raised at pasture displayed a higher proportion of monounsaturated fatty acids and fewer saturated ones, although the percentage of desirable fatty acids was greater in weaned lambs than in unweaned animals. Type of feed hardly presented significance difference in the fats studied.

Pertinent literature

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Table 1.- Arithmetic means and mean squares of the error of fatty acid composition (percentage of total fatty acids) of intramuscular fat (m. *longissimus dorsi*) in accordance with the effects of the weaning system and the type of feed.

	Weaned		Unweaned		Weaning system (W)	Type of feed (T)	WxT	MSE
	Concentrate (n=11)	Barley (n=12)	Concentrate (n=13)	Barley (n=8)	Sig	Sig	Sig	
Fat	3.99	3.63	2.82	2.77	*	NS	NS	1.11
C12:0	0.93	1.03	0.88	1.87	NS	*	*	0.38
C14:0	3.81	3.68	6.63	6.48	***	NS	NS	0.74
C15:0	0.61	0.95	0.94	0.71	NS	NS	*	0.15
C16:0	24.21	24.93	27.83	26.96	***	NS	NS	2.37
C16:1	3.26	3.20	3.17	3.23	NS	NS	NS	0.08
C17:0	2.03	2.04	1.35	1.61	*	NS	NS	0.26
C17:1	0.32	0.49	0.48	0.21	NS	NS	***	0.04
C18:0	15.63	16.74	14.99	14.02	*	NS	*	2.23
C18:1	32.03	31.32	29.84	27.12	***	**	NS	3.15
C18:2	5.91	5.41	4.59	5.30	NS	NS	*	0.72
C18:3	3.17	2.27	2.24	3.74	NS	NS	***	0.61
C20:0	3.49	2.18	1.80	2.60	NS	NS	***	0.92
C20:4	3.88	4.59	3.73	4.45	NS	*	NS	1.14
C22:0	0.72	1.16	1.54	1.71	NS	NS	NS	0.66
Odd	2.96	3.48	2.76	2.53	NS	NS	*	0.36
SFA	51.42	52.73	55.96	55.97	***	NS	NS	3.03
MUFA	35.62	35.00	33.48	30.55	***	**	NS	3.85
PUFA	12.96	12.27	10.56	13.48	NS	NS	**	4.28
PUFA/SFA	0.25	0.23	0.19	0.24	NS	NS	**	0.002
DFA	64.21	64.01	59.04	58.05	***	NS	NS	4.73
n-6/n-3	2.14	2.57	1.31	1.34	***	NS	NS	0.33

Sig: Significance; NS (non significance), * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$). MSE: mean square of the error. Odd (fatty acids with an odd number of C-atoms), SFA (saturated fatty acids), MUFA (monounsaturated fatty acids), PUFA (polyunsaturated fatty acids), DFA (desirable fatty acids), n-6/n-3 (C18:2/C18:3)

Table 2.- Arithmetic means and mean squares of the error of fatty acid composition (percentage of total fatty acids) of subcutaneous fat in accordance with the effects of the weaning system and the type of feed.

	Weaned		Unweaned		Weaning system (W)	Type of feed (T)	WxT	MSE
	Concentrate (n=14)	Barley (n=12)	Concentrate (n=14)	Barley (n=12)	Sig	Sig	Sig	
Fat	60.45	59.99	43.68	64.81	NS	**	***	92.14
C12:0	1.04	0.93	3.09	2.49	***	*	NS	0.34
C14:0	4.74	4.66	11.06	10.97	***	NS	NS	1.03
C14:1	0.48	0.86	0.53	0.56	NS	NS	NS	0.13
C15:0	1.22	1.55	2.11	1.68	**	NS	***	0.12
C15:1	0.31	0.43	0.41	0.57	NS	NS	NS	0.21
C16:0	26.16	26.63	28.66	30.23	***	*	NS	2.08
C16:1	3.54	3.64	3.48	4.00	NS	**	*	0.12
C17:0	2.39	3.07	2.38	2.00	**	NS	***	0.15
C17:1	0.54	0.72	0.11	0.22	***	*	NS	0.05
C18:0	16.27	16.94	12.80	13.24	***	NS	NS	2.26
C18:1	35.57	33.79	25.90	26.61	***	NS	NS	5.33
C18:2	2.90	3.07	2.68	2.37	**	NS	NS	0.19
C18:3	1.64	1.52	2.66	2.18	*	NS	NS	0.45
C20:0	3.18	2.18	4.15	2.88	NS	***	NS	0.67
Odd	4.47	5.77	5.01	4.47	NS	*	***	0.38
SFA	55.01	55.96	64.25	63.48	***	NS	NS	4.46
MUFA	40.45	39.44	30.43	31.97	***	NS	NS	6.54
PUFA	4.54	4.59	5.33	4.55	NS	NS	NS	0.92
PUFA/SFA	0.08	0.08	0.08	0.07	NS	NS	NS	0.0002
DFA	61.26	60.98	48.56	49.76	***	NS	NS	4.92
n-6/n-3	1.90	2.05	0.95	0.95	***	NS	NS	0.17

Sig: Significance; NS (non significance), * ($p<0.05$), ** ($p<0.01$), *** ($p<0.001$). MSE: mean square of the error. Odd (fatty acids with an odd number of C-atoms), SFA (saturated fatty acids), MUFA (monounsaturated fatty acids), PUFA (polyunsaturated fatty acids), DFA (desirable fatty acids), n-6/n-3 (C18:2/C18:3)