PE9.43 Can restricted grain supplementation practice under grazing conditions change fatty acid composition in lamb meat? 441.00

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Abstract*— There are significant scientific evidences demonstrating the advantages of consuming meats produced on grass-fed animals compared with those of grain-fed for human health. However, there are a few experimental results related to the restricted use of supplements under grazing conditions on the fatty acid composition in lamb meat compared with those feeding only on pasture. Seventy five castrated male Uruguayan Corriedale purebred or Merino Dohne crossbred lambs were finished into 3 feeding systems, with different proportions of pasture (P) (mainly dominated by a mixture of *Plantago lanceolata* cv. Tonic and *Lotus corniculatus* cv. INIA Draco) and sorghum grain supplementation (C), where: T1, P (4% of liveweight, LW); T2, P (2% LW) plus C (0.8% LW); and T3, P (2% LW) plus C (1.6 % LW). The intramuscular fat content (IMF) of the *Longisimus dorsi* (LD) muscle was not affected by feeding regimes (P>0.05). The IMF meat concentrations of linolenic (18:3 n-3) and EPA (20:5 n-3) were higher for T1 compared with T2 and T3 (P<0.05). The most important fatty acids presented in the IMF were oleic (18:1), palmitic (16:0) and stearic (18:0), which represented between 84.9 and 87.8 % of the total fatty acids evaluated. However, there were not significant differences between treatments (P>0.05) in those fatty acids. There were also no significant differences (P>0.05) in PUFA, MUFA and SFA concentrations between treatments. Similar results were found (P>0.05) for the PUFA/SFA and Ω6:Ω3 ratios, corresponding to 0.22 vs. 0.20 vs. 0.21 and 2.34 vs. 2.53 vs. 2.79 for T1, T2 and T3, respectively. Under the experimental conditions imposed in the present study, the use of restricted amounts of grain supplementation under grazing conditions did not have major influence in the fatty acid composition of IMF in lamb meat compared with those of grass fed lambs.

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***Index Terms*—supplementation, grazing, lamb, fatty acids, human health.**

I. INTRODUCTION

HUMAN nutrition science has demonstrated the importance of food consumption patterns on human health, in particular related to the influence of fat concentration and profile in human diet [1]. In recent years, human health concerns have increased in relation to fat consumption in red meats. Red meat intramuscular fat concentration and fatty acid composition can be manipulated by animal species, breed, age, and feeding system, etc. Animal feeding has a major importance in changing meat fatty acid composition, influencing human health and consumer perceptions about feeding patterns [2]. There are scientific evidence coming from experiments performed around the world which have proven the advantages for human health of consuming meats produced on grass-fed animals compared with those of grain-fed [1]. In Uruguay, restricted grain supplementation on fattening lambs under grazing conditions is one of the technology options available to increase production, the proportion and profitability in particular under high stocking rates or restricted quantity and quality forage conditions [3]. Under restricted pasture conditions, supplementation also improved lamb carcass and meat quality [3]. This technology also contribute to augment the competiveness of lamb production business compared with other agricultural options like cropping, forestry, dairy or beef fattening [4]. In this context and looking for opportunities of improving Uruguayan lamb profitability and meat acceptance with European consumers, the research teams of INIA-Uruguay, INIA-Spain, IRTA- Spain, Zaragoza University-Spain have studied different combinations of pasture:concentrate feeding regimes on meat fatty acid composition, sensory attributes and consumer acceptance and perceptions [1][5]. These studies have shown that the inclusion of certain amounts of concentrates in the diet of grazing lambs on improved pastures, could improve animal performance, carcass and meat quality, sensory attributes, and consumer acceptance without changing the fatty acid composition compared with the grass fed animals [6]. The main objective of this study was to evaluate the influence of restricted grain supplementation use under grazing on lamb meat fatty acid composition and its potential influence on human health.

II. MATERIALS AND METHODS

Animals and treatments

This experiment was conducted at the Experimental Unit "Glencoe", belonging to the INIA Tacuarembó Experimental Station. The experiment lasted for 108 days (24th July-9th November 2008).

Seventy five castrated male Uruguayan Corriedale purebred or Merino Dohne crossbred lambs were finished into 3 feeding systems, with different proportions of pasture (P) (mainly dominated by a mixture of *Plantago lanceolata* cv. Tonic and *Lotus corniculatus cv.* INIA Draco) and sorghum grain supplementation (C), where: $T_{1,}$ P (4% of liveweight, LW); T_2, P (2% LW) plus C (0.8% LW); and T_3, P (2% LW) plus C (1.6 % LW).

Animals were distributed in a balanced manner between treatments according to the lamb initial liveweight (ILW) and body condition score (IBCS), genotype, and sires (6) within each genotype evaluated. The lambs of the present study were part of the crossbreeding genetic project between Corriedale and Merino Dohne breeds [7] .

At the beginning, animal live weight (ILW) was 35.5 ± 4.72 kg. and body condition score (BCS) was 2.93 ± 0.35 units (scale 1-5) [8].

Traits measured

For all the animals, the variables measured, according the procedures described by [3], were: liveweight gain (LWG), final live weight (FLW), carcass tissue depth at GR point (GR), and hot carcass weight (HCW).

Animals were slaughtered at a commercial slaughterhouse. A portion of LD was vacuum-packaged and frozen for subsequent analysis. Samples were submerged in liquid nitrogen (-196 ºC), pulverized and stored at -20 ºC. Total lipid was determined by chloroform-methanol procedure of [9] modified by using a 10:1 ratio of chloroform-methanol for sample. Extract containing approximately 25 mg of lipid was converted to fatty acid methyl esters (FAME) using the method of [10]. The FAME were analyzed using a Konik HRGC 4000B gas chromatograph, and separated using a 100-m SP 2560 capillary column (0.25 mm i.d. and 0.20 µm film thickness, Supelco, Bellefonte, PA). Column oven temperature was programmed at 140 to 165°C at 3°C/min, 165 to 220°C at 5°C/min for 10 min and held at 220°C for 50 min with a split ratio: 0.42. The injector was maintained at 230 °C and detector at 240°C. Nitrogen was the gas carrier at a flow rate of 1 mL/min. Individual fatty acids were identified by comparison of retention times with standards (Sigma, St. Louis, MO; Supelco, Bellefonte, PA; Matreya, Pleasant Gap, PA). Fatty acids are expressed as percentages of the sum of all fatty acids measured.

Statistical analysis

It was applied a completely random experimental design. The analysis of variance was done with Proc GLM (SAS Institute Version 9.1, 2008) with treatment as a fixed effect. Means were compared by the LSMEAS procedure (SAS, 2008)($P<0.05$). All data were initially tested for normality and homogeneity of variance and some variables were normalized previously to be analyzed. Also, some variables were adjusted by co-variates.

III. RESULTS AND DISCUSSION

Table 1 shows the influence of treatment on lamb performance and carcass traits, where T1 and T3 lambs had, in general, higher responses than for T2 lambs. This result could be associated with higher intakes and better nutritive value of diet T1 and T3 lambs pasture compared with those of T2 (Montossi *et al*., unpublished). In Table 2 is presented the fatty acid composition of the intramuscular fat content (IMF) of the LD muscle. The IMF concentration was not affected by the diets, probably due to the marginal differences found between treatments at the end of the experiment in terms of FWL, HCW and GR. The range of IMF values recorded in the present study is similar research carried out in Uruguay with heavy lambs (8-10 months old) fed on different combinations of pasture:concentrate [2]. Independently of the treatment, the most important fatty acids presented in the IMF were oleic (18:1), palmitic (16:0) and stearic (18:0), which represented between 84.9 and 87.8 % of the total fatty acids evaluated. There were no diet influences on those fatty acids. Treatments had a significant influence on myristic (14:0) and arachidic (20:0) fatty acids. There is no clear pattern for 14:0 between diets, while the 20:0 concentration increased with grain supplementation. According to the expectations, linolenic acid (18:3n3) and eicosapentaenoic acid (EPA; 20:5n3-3) were higher for T1 in comparison with T2 and T3. Grass fed lambs produced more proportions of those fatty acids than grain fed lambs [11]. The other fatty acids analyzed were no affected by diet ($P>0.05$). Previous research have proved that the meat of lambs fed on dominated by grass increased long chain PUFA and CLA [2][11]. The percentage of PUFA, MUFA and SFA were similar between treatments. The same tendency was found for the PUFA:SFA and Ω6:Ω3 ratios. Probably, the concentration of sorghum grain in the diet of the supplemented animals was not sufficient to change the fatty acid profile of the IMF of meat produced by T2 and T3 lambs. The UK Department of Health [12] recommends that PUFA:SFA and Ω6:Ω3 ratios should over 0.45 and below 4.0, respectively. In the present investigation, PUFA:SFA ration fell into the range of 0.20 to 0.22, while Ω6:Ω3 ratio was always below 0.4. Similar tendencies were described in a study carried out in Uruguay, where restricted amounts of concentrated were used (0.8 or 1.2% of LW) in Corriedale heavy lambs (8-10 month old) under grazing conditions [11].

IV. CONCLUSION

Lowers contents of SFA and higher contents in MUFA are considered beneficial to human health, but in particular more emphasis is now focused on having a greater content of PUFA, especially of the *n3* series as well as achieving the recommended Ω6:Ω3 ratio. Under our experimental conditions, the use of restricted amounts of grain supplementation in lambs under grazing conditions did not have major influence in the fatty acid composition of the IMF compared with those of grass fed lambs.

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Table 1: Mean values of animal performance characteristics and carcass quality traits.

Variable	T1	T2	T3	P
LWG (g/d)	163 a	134 b	148 ab	**
FLW (kg)	53.0 a	49.8 b	51.5 ab	*
GR (mm) [1]	9.8	8.7	10.0	ns
HCW (kg)	22.9 a	21.7 a	22.7ab	**

References:
ns: not significant (P>0.05), *: P<0.05.
[a, b]: means with different letters among columns are significant different at P<0.05.
[1]: adjusted by HCW.

Table 2: Mean values of intramuscular fat (g/100g muscle) and fatty acid composition (g/100g of FA).

Variable	**TF**	**T1**	**T1**	**T3**	**P**
IMF (g/100g)		3.8	4.2	4.0	ns
Fatty Acid (g/100gFA)					
C14:0	Ln	1.9 b	2.0 a	1.9 b	*
C14:1	-	0.3	0.3	0.3	ns
C16:0	-	24.3	23.7	24.2	ns
C16:1	1/Ln	1.4	1.5	1.5	ns
C18:0	-	18.1	18.4	19.0	ns
C18:1	Ln	43.3	44.5	43.1	ns
C18:2n6	-	4.4	3.8	4.1	ns
C 20:0	Ln	0.10 b	0.13 a	0.12 ab	*
C18:3n6	1/Ln	0.08	0.08	0.09	ns
C18:3n3	-	1.9 a	1.5 b	1.4 b	**
C20:2n9	-	0.25	0.27	0.29	ns
C20:3n3	Ln	0.15	0.13	0.15	ns
C20:3n6	Ln	0.09	0.08	0.09	ns
C20:4n6	Ln	1.26	1.33	1.51	ns
C20:5n3	-	0.82 a	0.68 b	0.70 b	*
C22:5n3	Ln	0.60	0.55	0.57	ns
C22:6n3	Ln	0.25	0.21	0.22	ns
CLA	Ln	0.73	0.71	0.70	ns
SFA		44.4	44.2	45.3	ns
MUFA		45.0	46.3	44.9	ns
PUFA		9.8	8.7	9.1	ns
PUFA/SFA		0.22	0.20	0.21	ns
Ω6: Ω3		2.34	2.53	2.79	ns

References:
ns: not significant (P>0.05), *: P<0.05 and **: P<0.01.
[a, b]: means with different letters among columns are significant different at P<0.05.
TF: Transformation factor.