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Fatty acid composition of lambs suckling ewes fed with different vegetable oils

T. Manso*, R. Bodas, C. Vieira***, T. Castro**** and A.R. Mantecón****

*ETS Ingenierías Agrarias, Universidad de Valladolid, 34004 Palencia (Spain)
**Instituto de Ganadería de Montaña (CSIC-ULE), 24346 Grulleros, León (Spain)
***Estación Tecnológica de la Carne (ITACYL), 37770 Guijuelo, Salamanca (Spain)
**** Dpto. Producción Animal, UCM, 28040 Madrid (Spain)

Abstract. Forty eight Churra ewes were used to study the effects of supplementing diets with 3% of different vegetable oils (linseed oil, Lin; soya oil, Soy; olive oil, Oli) or hydrogenated palm oil (Control, Con) on fatty acid composition of suckling lambs covered by the protected geographical indication (PGI) "Lechazo de Castilla y León". The lambs were suckled by their dams and slaughtered when they reached 11 kg body weight. Samples from intramuscular and subcutaneous fat were taken. Regardless the depot, fat from lambs on groups Lin, Soy and Oli presented lower proportion of saturated fatty acids (SFA). Moreover, Oli lambs showed greater proportions of monounsaturated fatty acids (MUFA). Soya oil produced an increase in n6/n3 ratio in both depots, and increased PUFA and PUFA/SFA ratio in subcutaneous fat. Linseed oil reduced n6/n3 ratio in both depots, whereas also PUFA and PUFA/SFA ratio were greater in subcutaneous fat. Lipid composition of "Lechazo de Castilla y León" suckling lambs can be modified by supplementing their dams with different oils.

Keywords. Meat fatty acids – Suckling lamb – Vegetable oil – Supplementation.

Composition des acides gras des agneaux allaitant du lait de brebis nourries à base d'huiles végétales variées

Résumé. *Nous avons eu recours à quarante-huit brebis de race Churra afin d'étudier les effets de l'apport dans l'alimentation de 3% d'huiles végétales variées (huile de lin, L; huile de soja, S; huile d'olive, O) ou huile hydrogénée de palme (Control, C) sur la composition d'acides gras d'agneaux de lait d'appellation d'origine contrôlée "Lechazo de Castilla y León". Les agneaux ont été allaités par leurs mères jusqu'à l'abattage (11 kg poids en vie). Des prélèvements d'échantillon de gras intramusculaire et sous-cutané ont été effectués systématiquement. Indépendamment du dépôt de gras, le gras des agneaux des groupes L, S et O ont montré une moindre proportion d'acides gras saturés (SFA). De plus, les agneaux du groupe O ont montré des proportions plus importantes d'acides gras mono-insaturés (MUFA). L'huile de soja a produit une augmentation dans la relation n3/n6 dans chaque dépôt de gras, et a augmenté le contenu en acides gras poly-insaturés (PUFA) et la relation PUFA/SFA dans le gras sous-cutané. L'huile de lin a fait diminuer la relation n6/n3 dans chaque dépôt tandis que le PUFA et la relation PUFA/SFA ont été plus grands dans le gras sous-cutané. La composition des acides gras des agneaux de lait "Lechazo de Castilla y León" peut être modifiée par l'apport pour leurs mères d'huiles variées.*

Mots-clés. *Acides gras de la viande – Agneaux de lait – Huile végétale – Supplémentation.*

I – Introduction

Suckling lambs is one of the traditional rearing systems in the European Mediterranean region. More specifically, in the Spanish autonomous community of "Castille and Leon", lambs from Churra breed are usually exclusively reared on dam's milk and slaughtered 30-45 days after birth. The meat from these animals is then marketed under the Protected Geographical Indication "Lechazo de Castilla y León", which is demanded by consumers, especially in specific periods (Christmas, Easter) and reaches high market prices.

One of the key factors affecting meat and milk fatty acid composition is the fatty acid profile of the diet. Thus, supplementing dairy sheep with different lipid sources modifies the fatty acid profile of milk (Nudda *et al*., 2008). Moreover, it has been demonstrated that, since suckling lambs are functional non ruminants, fatty acids are not biohydrogenated before reaching the intestine. As a consequence, changes in milk fatty acid composition (due to ewes feeding system or the use of milk replacers) can induce differences in fat composition of suckling lambs meat or fat, as previous studies have reported (Lanza *et al*., 2006; Osorio *et al*., 2007). Like wise, some studies have shown that changing ewes or goats diet fatty acid profile by supplementing with oils or calcium soaps can alter their suckling offspring meat fatty acid composition (Sanz-Sampelayo *et al*., 2006; Nudda *et al*., 2008).

On the basis of these studies, and taking into account the economic relevance of the "Lechazo de Castilla y León" market, the aim of this work is to study the effects of the inclusion of different vegetable oils (linseed, soya, and olive oils) in the diet of ewes on the fatty acid composition of their suckling lambs.

II – Material and methods

Seventy two suckling lambs covered by the protected geographical indication (PGI) “Lechazo de Castilla y León” were used in the present experiment. Two days after parturition, the ewes were divided into four groups. All the ewes received 2.1 kg of a TMR diet comprised of lucerne (40%), maize (15%), barley (17%), soybean (12%), sugar beet pulp (9%), molasses (4%) and vitamin mineral premix (1%). Moreover, each group received a 3% of the corresponding oil added daily to the TMR: hydrogenated palm oil (group control, Con), linseed oil (group Lin), soya oil (group Soy) or olive oil (group Oli). TMR was supplied twice a day and barley straw and fresh water were always available.

The newborn lambs remained with the ewes all day long and fed exclusively by suckling from their respective mothers. Animals were weighted twice a week and when the lambs reached the intended body weight (11 kg) they were taken to the abattoir, stunned and slaughter by section of the jugular vein in the neck. After slaughter, the skin and all internal organs were removed and a sample of muscular (*Longissimus dorsi*) and subcutaneous tissues were taken and frozen at -80ºC until analyses. The fatty acid composition of fat depots were determined by the transesterification *in situ* technique described by Carrapiso *et al*. (2000), using a Hewlett Packard 6890 Series GC System chromatograph provided with a HP-88 capillary column.

The current work summarizes the results of fatty acid composition as the sum of saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids, as well as their ratios. These data were subjected to analysis of variance using the GLM procedure of SAS package (SAS, 1999).

III – Results and discussion

The effects of the diet of the ewes on the meat and fat fatty acid composition of their suckling lambs are presented in Table 1. Regarding the effects on intramuscular fat, the SFA were higher in the meat from lambs in the Con group ($P<0.05$). MUFA proportion was significantly higher for Oli lambs, whereas no differences between groups were observed in PUFA and PUFA/SFA ratio ($P>0.10$). Despite this, the UFA/SFA ratio was significantly higher in Soy and Oli lambs ($P<0.05$). As for the n6/n3 ratio, Lin lambs presented the lowest values and Soy lambs the highest, Con and Oli animals showing intermediate values ($P<0.001$).

As for the subcutaneous fat, the effects were similar than those observed for the intramuscular fat, but the differences became accentuated. Thus, SFA were higher in Control lambs ($P<0.05$) and Oli animals showed the highest MUFA proportions ($P<0.01$). Likewise, Soy lambs presented the highest proportion of PUFA and PUFA/SFA ratio, whereas those animals in Con and Oli groups showed the lowest values (P<0.001). The UFA/SFA ratio was affected by the treatments, Con lambs showing the lowest values (P<0.01). The n6/n3 ratio was found to be higher for those animals in the Soy group, Lin lambs presenting the lowest n6/n3 ratio (P<0.05).

Table 1. Fatty acid composition (SFA, MUFA and PUFA are saturated, monounsaturated, polyunsaturated fatty acids, respectively, expressed in % of total fatty acids) of the intramuscular and subcutaneous fat in lambs suckling from their dams fed with different vegetable oils in the diet

	Group					
	Con	Lin	Soy	Oli	rsd	P-value
Intramuscular						
SFA	41.26^{a}	39.66^{ab}	38.82^{b}	39.37^{b}	2.539	0.026
MUFA	32.99^{b}	33.78^{b}	35.32^{ab}	36.72^{a}	3.547	0.009
PUFA	25.75	26.56	25.86	23.91	3.520	0.145
PUFA/SFA	0.63	0.68	0.67	0.61	0.113	0.256
UFA/SFA	1.44^{b}	1.53^{ab}	1.58^{a}	1.55^{a}	0.161	0.038
n6/n3	8.63^{b}	5.55^{c}	10.26^{a}	9.03^{ab}	1.930	<0.001
Subcutaneous						
SFA	56.65^{a}	53.89^{b}	52.46^{b}	52.91^{b}	3.268	0.001
MUFA	38.97^{b}	39.94^{b}	40.48^{ab}	42.37^{a}	3.477	0.028
PUFA	4.38^{c}	6.18^{b}	7.07^{a}	4.73^{c}	1.291	<0.001
PUFA/SFA	0.08^{c}	0.11^{b}	0.14^{a}	0.09^{c}	0.025	<0.001
UFA/SFA	0.77^{b}	0.86^{a}	0.91^{a}	0.90^{a}	0.115	0.001
n6/n3	6.86^{a}	3.91^{b}	7.23^{a}	5.61^{ab}	3.381	0.015

It has been reported that intramuscular and subcutaneous fats can show different responses in some individual fatty acids depending on the feeding regime (Osorio *et al*., 2007). However, Osorio *et al*. (2007), also found very similar the SFA, MUFA and PUFA proportions between the subcutaneous and intramuscular fats. According to the results presented by these authors, we found similar response in both fat depots, although differences were more marked in subcutaneous fat.

The differences found in the present trial depend on the different fatty acid profile in the milk of ewes from each group, which is strongly related to the ewe's diet (Lanza *et al*., 2006; Sanz-Sampelayo *et al*., 2006; Scerra *et al*., 2007). Thus, when ewes received olive oil in the diet, their lambs showed an increase in MUFA, since olive oil provides with high amounts of C18:1. Likewise, since soya oil is rich in C18:2, lambs from the Soy group presented a significant increase in PUFA and n6/n3 ratio, which were more accentuated in subcutaneous fat. Moreover, the n6/n3 ratio was found to be lower for Lin lambs because of the higher content of n3 fatty acids in linseed oil.

In a study carried out with kids and goats, Nudda *et al*. (2008) concluded that there is a strong relationship between the concentrations of fatty acids in the muscle of suckling kids and their mother's milk. Therefore, it is possible to modify the fatty acid profile of meat by manipulating the diet of their dams. Likewise, concerning the recommendations made today for the population to consume foods with a healthier fatty acid profile, an improvement can be made by giving the animals oily supplements to meet these requirements. In this sense, in our experiment the value of n6/n3 ratio closer to the recommended range for human health (below 4) was found in the meat and fat from lambs suckling ewes receiving linseed oil in the diet.

IV – Conclusions

The present work demonstrates that lipid composition of "Lechazo de Castilla y León" suckling lambs can be modified by supplementing their dams with different vegetable oils.

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