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Innovation in feeding practices to improve the sustainability of local and traditional sheep production

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Abstract. Small ruminants have played for centuries a key role for the livelihoods of people in the Mediterranean basin. In particular, the importance of dairy sheep systems is evident in relation to landscape configuration, diversity of products, cultural heritage, etc. However, the sustainability of many of these systems is seriously endangered nowadays. Therefore, they will have to face adaptation strategies to fit to the current social, economic and environmental conditions. In particular, feeding practices are related to many of the negative environmental impacts that livestock farming is usually blamed for: methane emissions, landscape degradation and erosion, competition with humans for edible resources, etc. Because of that, the Department of Animal Production of Neiker-Tecnalia is carrying out several research activities relative to the Latxa dairy sheep production system aiming to: (i) innovate in the grazing management practices to enhance the potential of grasslands to fix carbon and improve the fertility of soils, productivity and biodiversity (LIFE REGEN FARMING project); (ii) add value to a range of residues (becoming into co-products) coming from the agro-food industry (dry whey, cold-pressed cakes obtained by the extraction of oil from sunflower, rapeseed and olives) by including them in the ration and decrease the utilisation of soybean, cereals, etc. (LIFE SEED-CAPITAL and VALORLACT projects); and, (iii) improve the nutritive quality and healthy features of added value food products. The rationale behind these activities and some results will be presented.

Keywords. Innovation – Management – Dairy – Sheep – Livestock – Systems.

L'innovation dans des pratiques d'alimentation pour améliorer la durabilité de la production ovine locale et traditionnelle

Résumé. *Les petits ruminants ont joué pendant des siècles un rôle clé pour la subsistance des populations dans le Bassin Méditerranéen. En particulier, l'importance des systèmes des ovins laitiers est évident par rapport à la configuration du paysage, les produits, l'héritage culturel, etc. Cependant, la viabilité de beaucoup de ces systèmes est sérieusement mise en danger de nos jours. Donc, ils devront faire face aux stratégies d'adaptation pour répondre aux conditions sociales, économiques et environnementales actuelles. En particulier, les pratiques d'alimentation sont liées à de nombreux impacts négatifs sur l'environnement qui sont d'habitude blâmées à l'élevage : les émissions de méthane, la dégradation du paysage, la concurrence avec l'homme pour les ressources comestibles, etc. À cause de cela, le Département de Production Animale de Neiker-Tecnalia a mené plusieurs activités de recherche relatives au système laitière de la Latxa visant à: (i) innover dans le gestion des pâturages pour améliorer le potentiel des prairies pour fixer carbone et améliorer la fertilité, la productivité et la biodiversité (LIFE REGEN AGRICULTURE projet); (ii) ajouter de la valeur à une gamme de résidus (coproduits) provenant de l'industrie agro-alimentaire (lactosérum sec, tourteaux pressées à froid obtenus par l'extraction de l'huile de colza) en les incluant dans la ration et de diminuer l'utilisation de soja, céréales, etc. (projets LIFE : SEEDCAPITAL et VALORLACT); et (iii) améliorer la qualité nutritive et les caractéristiques saines de produits alimentaires. Le raisonnement derrière ces activités et des résultats seront présentés.*

Mots-clés. *Innovation – Gestion – Produits laitiers – Ovins – Élevage – Systèmes.*

I – Introduction

The sustainability of many sheep farming systems is seriously compromised by a diversity of factors related to the technical viability, economic profitability, environmental impact and social acceptance. Under these circumstances, it is crucial to design management practices suitable to cope with the existing challenges, specially taking into account the importance of dairy sheep systems for landscape configuration and cultural heritage within the Mediterranean basin (Ruiz *et al*., 2009).

First, the utilisation of the grazing resources available is usually suboptimal, sometimes generating under-grazing and the degradation of pastures, with the subsequent turning to scrub and decreasing nutritive value (Mandaluniz *et al*., 2009), or overgrazing and erosion of soils. In fact, despite permanent pastures have a huge capacity for soil generation and carbon fixation (Teague *et al*., 2011), little attention has been devoted to grazing practices during the last decades, and the beneficial impact on soil has been disregarded. Moreover, soil carbon plays a vital role to provide essential ecosystem services, such as soil fertility, climate change regulation, water supplies, biodiversity. Therefore, many farmers require knowledge transfer and advise to improve the utilisation of grasslands and forage resources, and at the same time, improve the fertility of soils.

Then, the generation of a diversity of residues from innovative activities of the food industry or biodiesel production (Amores *et al.,* 2014; Benhissi *et al., 2014*) open new opportunities for raw materials to be used in livestock feeding. However, these products need to be tested first in order to assess the technical viability and then the potential impact on the animal welfare, food quality and the economic output of the livestock activity. Moreover, the innovation in the diet formulation of ruminants is necessary to decrease the emissions of enteric methane under the current global change scenario. The implementation of R+D activities through participatory approaches is an interesting tool for effective knowledge transfer.

To a great extent, the sustainability of the Latxa dairy sheep production in the Basque Country (Spain) is based on part-time grazing in spring, although feeding is usually supplemented indoors with concentrates and even forages to meet energy and protein requirements. The Department of Animal Production of NEIKER-Tecnalia is carrying out several research activities aiming to improve the grazing and feeding practices within the Latxa system. This is being achieved through the implementation of the following LIFE projects; (i) LIFE REGEN FARMING (*www.regenfarming.com*) tries to innovate in the grazing management practices to enhance the potential of grasslands to fix carbon and improve pastures' fertility, productivity and biodiversity, and finally livestock sustainability; (ii) LIFE SEEDCAPITAL (*www.lifeseedcapital.com*) and (iii) VALORLACT (*www.valorlact.com*) try to add value to a range of residues (becoming into co-products) coming from the agro-food industry (dry whey, cold-pressed cakes obtained by the extraction of oil from rapeseed) by including them in the ration and decrease the utilisation of human edible resources such as soybean, palm oil or cereals.

II – Material and methods

All experiments are being conducted within the Latxa sheep of the experimental dairy flock of NEIKER-Tecnalia in Vitoria-Gasteiz (Basque Country, Spain). Each project fixes the experimental design to reach their objectives. (i) LIFE SEEDCAPITAL carried out an assay with 36 sheep in early lactation to assess the effect on milk production and quality, of cold-pressed cakes obtained by the extraction of oil from rapeseed in the concentrate formulation. One group received a concentrate based on cold-pressed rapeseed meal (RPS), the second group received cold-pressed sunflower meal (SUN) and the last one soybean meal (CTR). (ii) VALORLACT carried out an assay with 40 ewes at early lactation to assess the effect on milk parameters of dry whey included in the concentrate. Two groups received an experimental concentrate that contained either 0% (control) or 16% dry whey formulated to provide equal amounts of energy (1 UFL/kg), crude protein (17%) and fat (2.5%). (iii) LIFE REGEN FARMING carried out an assay during spring 2014 to assess the ef-

fect of the grazing regime on pasture and animal parameters. All the flock was blocked into two homogeneous and randomly assigned to free (FG) or rotational (RG) grazing regimes. The RG group of ewes grazed 2-3 days/plot and each plot had a 24 ± 2 days resting time between grazing periods. The FG group of ewes grazed 6-10 days/plot, with 15 ± 3 resting days.

Data and sample collection started after 10-14 days of adaptation to treatments and the frequency of collection and duration of the assays depended on the specific objectives of each project. As the studies were carried out with dairy sheep, the assays always collected data about individual daily milk yield (DMY) and milk composition (crude fat and crude protein). Daily milk yield usually was corrected to standard DMY (DMYs) as described by Bocquier and Caja (1993). Moreover, individual live weight (LW) and body condition score (BCS) were determined. As specific observations, indoor assays (LIFE SEEDCAPITAL AND VALORLACT) monitored intake, and outdoor assays (LIFE REGEN FARMING) measured herbage biomass and nutritive value (crude protein (CP, neutral detergent fibre (NDF) and acid detergent fibre (ADF).

III – Results and discussion

The utilisation of sunflower cold pressed cakes in the sheep nutrition reduced DMYs by 14.9% and fat content by 21.0%, on average, in comparison with either cold-pressed rapeseed meal or soybean meal (Table 1). Cold pressed SUN increased total polyunsaturated fatty acid (PUFA) proportion by 44.7% and 38.7% compared to CTR and RPS, respectively. Cold pressed SUN also increased milk conjugated linoleic acid (CLA) concentration by 71.4% and 167% compared to RPS and CTR. RPS compared to CTR increased CLA concentration by 55.6% (Table 1).

Table 1. Intake, milk yield, composition and fatty acid profile as affected by treatment (concentrate formulated with cold pressed rapeseed-RPS, cold pressed sunflower-SUN and soybean meal-CTR)

Variables / treatment	CTR	RPS	SUN	P value
Intake, kg DM/d	2.70	2.64	2.68	0.612
DMY, g/d	2001	1940	1918	0.792
DMYs, g/d	1900^{a}	1865^{a}	1616^{b}	0.038
Crude fat, %	6.2^{a}	6.1^{a}	4.9^{b}	<0.001
Crude protein, %	4.5	4.4	4.3	0.414
Fatty acid, g/100 g of total fatty acid				
9c,11t CLA	0.9^{c}	1.4^{b}	2.4^{a}	<0.001
Polyunsaturated	4.7^{b}	4.9^{b}	6.8^{a}	<0.001

$^{a, b, c}$ Values within a row with different superscripts differ significantly. DMY: Daily Milk yield; DMYs: Daily Milk yield standard; CLA: conjugated linoleic acid.

Feeding a concentrate formulated with dry whey resulted in an increase of 2.8% of milk crude and true protein concentrations, but non-significant differences were found in terms of milk fat or fat and protein corrected milk (Table 2). Total dry matter intake and milk yield were not affected by experimental concentrate.

Regarding the impact of the grazing regime, there was no difference in the herbage mass or dairy production variables between the two regimes (summary at Table 3, more details in Mandaluniz *et al*., 2015) but the RG resulted in a 14% higher amount of forage harvested for conservation. This regenerative practice promotes permanent pastures and increases herbage production which improves forage autonomy of farms. Moreover, the longer resting time of RG paddocks reduces carbon footprint and could benefit soil restoration and increase carbon fixation on pasture (Teague *et al*., 2011).

Table 2. Effect of dry whey on dry matter (DM) intake, and milk yield (DMY) and composition

Variables / treatment	Control	Whey	P value
Intake,kg DM/d	2.41	2.44	0.233
DMY, kg/d	1.96	1.88	0.450
Crude fat, %	5.00	6.33	0.157
Crude protein, %	4,61[b]	4,74[a]	0.021
True protein, %	4.53[b]	4.66[a]	0.013
Fat and protein corrected milk, kg/d	1.79	1.74	0.411

[a, b, c] Values within a row with different superscripts differ significantly. DMY: Daily Milk yield.

Table 3. Effect of the treatment "grazing regime" (free-FG and rotational-RG) on pasture and livestock parameters

Variables / treatment	FG	RG	P value
Grass, kg DM/ha	1290 ± 234	1291 ± 207	0.99
CP, g/kg DM	164 ± 31	156 ± 25	0.26
ADF, g/kg DM	250 ± 66	246 ± 30	0.73
NDF, g/kg DM	480 ± 90	480 ± 60	0.85
DMY (mL d^{-1})	1346 ± 420	1343 ± 453	0.99
DMYs (mL d^{-1})	1193 ± 351	1218 ± 382	0.39
Crude fat (%)	6.63 ± 0.87	6.50 ± 1.05	0.12
LW (kg)	60.8 ± 7.63	61.7 ± 8.78	0.19

DM: dry matter; CP: crude protein; ADF: acid detergent fibre; NDF: neutral detergent fibre; DMY: dry matter ingestion; and LW: live weight.

IV – Conclusions

There are opportunities for the sheep farming systems to face the existing challenges and to improve the sustainability of the sector through the introduction of innovative approaches in nutrition and management of grazing resources. The valuation of certain residues generated in other activities or the adoption of changes in the grazing management can contribute to reduce the costs of feeding and to enhance the forage autonomy and the economic profitability of the farm, to improve the nutritive quality and healthy features of milk, .

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