Feed restriction in ewes affects milk performances and decreases milk lipolysis

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Feed restriction in ewes affects milk performances and milk lipolysis

Introduction

Milk lipolysis is defined as the hydrolysis of triglycerides, the main component of milk fat. As a consequence, the release of free fatty acids in milk is responsible for milk flavor defects together with alterations of foaming and creaming abilities of milk. Milk lipolysis represents an important criterion to assess the quality of milk. Feed restriction was used as a model for studying milk lipolysis and its mechanisms in 3 ruminant species within the frame of the LIPOMEC project (ANR-19-CE21-0010). Indeed, whereas feed restriction is known to increase and decrease milk lipolysis in dairy cows (Vanbergue et al., 2018) and goats (Chilliard et al., 2014) respectively, no data were available so far in dairy ewes. **The aim of our experiment was to study the effect of feed restriction on milk performances in dairy ewes and to characterize its effects on milk spontaneous lipolysis in relation with the associated milk composition**.

Material and methods

- 2 X 2 cross-over design of 15 days, with two groups of 24 Lacaune ewes (102 ± 2.0 days in milk)
- 2 dietary treatments of 72% forage (half grass silage and half alfalfa hay) and 28% concentrate on a DM basis delivered at 2 levels of intake

P1 = 1wk	P2 = 1wk
UR	R
R	UR

UR = unrestricted : 100% of the dry matter intake (DMI) ad libitum;

R = restricted :
65% of the DMI ad libitum

- Sampling and analysis

✓ **Feedstuffs**
Daily control of ingestion and once per period analysis of their composition

✓ **Blood**
Last day of each period, after morning milking : Plasma metabolites measurement

✓ **Milk**
Last day of each period on morning and evening milkings

- Lipolysis analyzed by the copper-soap and by ISO/TS 22113 standard (BDI method).
- Milk fat globule and casein micelles size distributions evaluated by laser light scattering

Results

	Item			Diet effect
	UR	R	SEM	P-value
DMI, kg/d	3,0	2,1	0.060	<0.0001
Live -weight, kg	74.8	69.3	0.63	<0.0001
[1]NEL balance, MJ/ d	-0,57	-2,77	0,184	<0.0001
[2]PDI efficiency	0.72	0.59	0.012	<0.0001
Milk				
Yield l/d	1.92	1.51	0.056	<0.0001
Fat content, g/l	78.6	83,8	1.65	<0.0001
Protein content, g/l	58,7	59,7	0,78	0.0266
Lipolysis (mEq/100g fat)				
Copper salt Morning milking	0.40	0.15	0.048	0.0001
Copper salt Evening milking	0.76	0.30	0.086	<0,0001
BDI Morning milking	0.53	0.26	0.060	0.0018
BDI Evening milking	0.82	0.37	0.110	0.0001
Milk fat globule diameter, µm				
Morning milking	5.30	5.34	0.068	0.459
Evening milking	5.10	5.30	0.071	<0.0001
Casein micelles diameter, nm				
Morning milking	140	149	2.8	<0.0001
Evening milking	146	160	2.7	<0.0001
Milk lLPL activity nmol/min/ml	453	452	1.8	0.5122
Plasma metabolites				
NEFA, µmol/l	184	464	19.1	<.0001
Urea, mg/l	596	504	12.7	<.0001

[1]Net energy balance,% (MJ/d) calculated according to INRA (2018)
[2]PDI (Protein digestible in the intestine efficiency) = PDI supplied for lactation needs (INRA, 2018)

Feed restriction in ewes :

✓ Metabolic status :

- Decrease in live-weight
- Plasma increase in NEFA and decrease in urea

→ Mobilization of body fat

✓ Lipolysis

- Decrease in milk spontaneous lipolysis measured by the copper-soap method (-0.25 and -0.46 Meq / 100 g of fat, respectively for morning and evening milking) or by the BDI method (-0.27 and – 0.45 Meq / 100 g of fat, respectively for the morning and evening milking).
- No effect on milk LPL activity
- These results are the opposite of what is observed in dairy cows under feed restriction

✓ Milk parameters :

- Decrease in milk yield, (-0.41 l/d), increase in milk fat and protein contents (+ 5.2 and +1.0 g/l respectively), no effect on somatic cell count
- Increase in the diameter of milk fat globules at evening milking (+0.2 µm, P<0.0001) and in the diameter of casein micelles (+9 and +14 nm, respectively on morning and evening milkings)

→ Larger fat globules are associated with lower degree of lipolysis contrary to that observed in dairy cows

Conclusions

For the first time, we showed a decrease of more than 50 % in milk lipolysis in dairy ewes in response to feed restriction. This breeding factor may occur in periods of limited food resources due to climatic hazards in particular in the Mediterranean area.
Our perspective is to enrich these zootechnical data with lipidomic, proteomic and transcriptomic data of milk on a set of animals selected for their extreme lipolytic traits

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