Relationship between somatic cell counts and other udder phenotypes in dairy sheep

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Summary

In France, special attention is given to intramammary infections of dairy sheep due to economic consequences especially in PDO cheese sector. The selection for mastitis resistance based on somatic cell counts (SCC) has been implemented in Lacaune breed (since 2002) and Pyrenean breeds (since 2016). In Lacaune, udder morphology has also been included in the global merit index for 12 years. In this context, an in-depth study was carried out in 15 farms (with Lacaune and Red-Face Manech breeds) in 2015, with comprehensive phenotyping on udder morphology, clinical examination of the udder, SCC and milk traits. Data were collected on 7,065 ewes. The flocks were chosen to have a (moderate to) high level of bulk tank SCC, averaging 500,000 cel/ml and 1,050,000 cel/ml, respectively in Lacaune and Red-Face Manech.

The first objective was to evaluate the feasibility of the udder clinical examination on-farm as an additional phenotype of udder health. Five traits were scored during the examinations. Udder asymmetry (caudal evaluation), parenchyma induration, abscesses (number and size) and cysts (number and size) had good levels of concordance, repeatability and reproducibility between trained operators (from 0.7 to 1), compared to less than 0.5 for supra-mammary nodes size assessment. In average, 11% of the ewes showed abscesses, 3% udder induration and 23% of the ewes had at least 2 abnormalities. The log transformation of somatic cell count scores (LSCS) of the ewes with an abnormality was 0.3 to 0.7 higher than healthy ewes. The increase reached 0.8 LSCS for the ewes with 2 or more abnormalities. The udder morphology was also a significant "risk factor" with an increase of the LSCS for the bad shaped udder.

In both breeds we illustrated that the SCS selection was efficient. The SCS of the ewes was closely linked with the SCS index of their father. Dams of proven rams had a better LSCS (-0.7) but also less abscesses. These results reported in a diversity of conditions (breeds, feeding systems, milking conditions) are consistent with those found in an INRA divergent selection study on SCC in Lacaune breed. Taking into account both udder morphology and SCS in the global merit index contributes in improving udder resistance to mastitis. On the field, using clinical examination of the udder is possible for operational purposes but implies trained operators and the selection of the most relevant indicators (udder asymmetry, abscess, pronounced induration). These indicators allow to identify chronic udder infections and thus are complementary to SCC.

Keywords: somatic cell count, udder health, dairy sheep.

Introduction

In France, special attention is given to intramammary infections (IMI) of dairy sheep because of significant economic consequences, especially in PDO cheese sector using raw milk. The control of udder health (in particular subclinical IMI) focused on the control of somatic cell counts (SCC). Such plans of SCC control had been developed, taking into account specificities of dairy sheep production in France (size of the flocks, suckling period, milking routine, drying off period length…). In this context, the selection for mastitis resistance based on SCC has been implemented in Lacaune breed (since 2002) and Pyrenean breeds (since 2016). In Lacaune, udder morphology has also been included in the global merit index for 12 years (ongoing in Pyrenean breeds). The global aim of the French *Mamovicap* project (2013-2016) was to explore new tools for the control of mastitis on farm. These tools are based on the valorization of accessible information or phenotypes available in routine or with easy access as symptoms of the udder and teats or practices of milking and milking speed (automatic milk recording systems). Regarding the clinical examination of the udder, the objective was to evaluate its on-farm feasibility as an additional udder heal phenotype and to study its relationship with the SCC at the flock or individual level.

Main characteristics of the flocks involved in the study

The flocks were chosen to have a (moderate to) high level of bulk tank SCC (bSCC), averaging 500,000 cel/ml and 1,050,000 cel/ml, respectively in Roquefort area (Lacaune breed) and Pyrenean Mountains (Red-Faced Manech breed). The data were collected on 7,065 ewes among 15 flocks in Lacaune breed (N=10) and Red-Faced Manech breed (N=5). All the flocks were in official milk recording and the average milk production was 277 liters in 165 days and 228 liters in 157 days respectively for Lacaune and Manech. Individual SCC were performed monthly for all ewes.

Table 1. Characteristics of the 15 flocks

	Roquefort area	Pyrenean mountains
Breed	Lacaune	Red-Faced Manech
Number of flocks	10	5
Size of the flocks	470	377
Average milk production per ewe (liter)	277	228
Average lactation length (days)	165	157
Bulk tank SCC (cell/ml)	498 000	1 048 000

Feasibility of the udder clinical examination on-farm as an additional phenotype for udder health

Five traits were scored two times during the lactation: udder asymmetry (5 levels), parenchyma induration (6 levels), abscesses (number and size), cysts (number and size) and supra-mammary lymph nodes size assessment (6 levels). The examinations were made by 2 trained operators. Operator dependent reliability of clinical examinations was assessed through kappa concordance coefficient calculation (for repeatability and reproducibility). An udder typology based on the 3 traits scored for udder morphology selection (teat angle, udder depth and udder cleft) was used (Barillet *and al.* 2006). The different udder shapes interpretation were based on the ability (by expert opinion) for both suckling and machine milking.

Udder asymmetry, significant parenchyma induration, abscesses (both number and size) and cysts (both number and size) had good levels of concordance: values ranged from 0.7 to 1

compared to 0.5-0.6 for supra-mammary nodes variables and 0.4-0.5 for parenchyma induration intensity before grouping classes. The clinical examination scoring must be adapted according to the operators (breeder, technicians, vets) and the objectives (culling, dry-off antibiotherapy or phenotyping). Usually, the most reliable and significant (for IMI diagnosis) criteria are udder asymmetry, abscess, marked induration (chronic mastitis).

Relationship between somatic cell count and clinical examination of the udder

In average, 16 % of the ewes were presumed to have an infected udder according to SCC, 11% showed abscesses, 5% udder asymmetry, 3% udder induration and 23% had at least 2 abnormalities.

Table 2. Average percentage (intra-flock) of ewes with abnormalities (standard deviation in brackets)

	All flocks (N=15)	Roquefort area (N=10)	Pyr mountains (N=5)	r with bSCC
% of infected udders (1)	16 (8)	11 (3)	24 (10)	0.86
% of udder asymmetry (2)	5 (3)	4 (3)	7 (2)	0.71
% of udders with abscesses	11 (4)	9 (3)	14 (5)	0.74
% of udders with cysts	22 (8)	19 (7)	26 (7)	0.61
% of udders with induration	3 (2)	3 (1)	3 (2)	0.19
% of udders with reactive nods	31 (9)	29 (9)	36 (9)	0.32
% of udders with at least 2 abnormalities	23 (8)	19 (5)	31 (5)	0.64

(1) ewes considered as infected if at least two SCC individual over 800 000 cells/ml.
(2) % of strong asymmetry

At the flock level, the correlation coefficients between the bulk tank SCC and the percentage of udders showing abnormalities were higher with abscesses and udder asymmetry. We confirmed the relationship between the annual mean of tank bulk SCC and the estimated prevalence of IMI through individual SCC (Berthelot *and al.*, 2006). The raise of the IMI % is 2-3% when bSCC increases by 100,000 cel/ml.

At the individual level, test-day SCC were used after logarithmic transformation and computed in arithmetic lactation mean of somatic cell scores –LSCS (Rupp *and al.* 2003). The effect of an udder abnormality on LSCS was tested according to the following model:

$Y_{ijklmn} = F_i + L_j + S_k + L_l + P_m + (\text{Morpho or Assym or Abc or Indur or Nods})_n + E_{ijklmn}$

where:

y_{ijklmn} = LSCS

F_i = effect of flock i (15 flocks)

NL_j = effect of parity j (5 levels)

S_k = effect of lactation k (8 levels)

L_l = effect of lambs number l (3 levels)

P_m = effect of sires's EBV m (6 levels);

(Morpho, Asymmetry, Abc, Indur, Nod) $_n$ = effect of presence of one of these abnormality or effect of udder shape n

E_{ijklmn} = residual effect.

The LSCS of udders with an abnormality was 0.24 to 0.67 higher than healthy udders (table 3). The increase reached 0.8 LSCS for the ewes with 2 or more abnormalities. The udder morphology was also significantly associated with LSCS mainly in Red-Faced Manech.

An illustration of the efficiency of SCC selection

SCS of the ewes was closely linked with the SCS EBVs of their sire. Daughters of proven rams had a better LSCS (- 0.7 to -0.8) but also less abscesses. The SCC EBVs of the sire of the abscessed ewes were significantly higher (+0.2 point) than ewes without. These results reported in a diversity of conditions (breeds, feeding systems, milking conditions) are consistent with those found in an INRA divergent selection study on SCC in Lacaune breed (Allain et al., 2013). It can be interpreted as an indirect validation of the efficiency of SCC selection in Lacaune and Manech selection schemes.

Table 3. Effect on LSCS of the type of clinical abnormality, udder shape and sire EBVs

	Lacaune	Red-Faced Manech
Presence of reactive lymph nods	0,33 ***	0,56 ***
Presence of udder induration	0,33 ***	NS
Presence of abscesses	0,36 ***	0,26 ***
Udder asymmetry	0,24 ***	0,67 ***
Udder shape (difference between extreme levels)	0,61 ***	0,65 ***
Sire index (difference between extreme levels)	0,8 ***	0,7 ***

Conclusion

In both breeds, we illustrated that the SCS selection was efficient. Taking into account both udder morphology and SCS in the global merit index contributes in improving udder resistance to mastitis. On-farm, using clinical examination of the udder is possible but implies trained operators and the selection of the most relevant indicators (udder asymmetry, abscess, marked induration). For operational purposes, the examination allows detection of chronic IMI for mastitis control, and, potentially, in addition to SCS, a more complete phenotype for selection to mastitis resistance. In dairy sheep in France, acute mastitis are relatively rare (less than 5%) unlike in dairy cattle, moreover as they occurred during the suckling period, most of the ewes have no lactation.

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