Organization of milk recording in goats in France: Looking for new recording schemes

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Abstract

In France, milk recording for goats began in the 1960s, with the same method as for cows (the A scheme) but by measuring nitrogen content instead of fat content, in order to adapt breeding goals to the economical context of this species (cheese production exclusively). Since the 1980s, both fat and protein contents have been measured, and somatic cell count since the 1990s.

Since 1992, farmers have choice among several methods other than the A scheme, at first AT, and 10 years ago AZ and CZ have been introduced. Moreover, farmers who are not interested in getting genetic evaluations for their goats can choose another simplified and less expensive method.

However, for few years, MROs, helped by Institut de l'Elevage, have been looking for new schemes, that would simplify their work and that would be more flexible, if possible without any loss of accuracy.

The main issue of the AT procedure is the obligation to get records morning and evening alternately, which is sometimes difficult to implement. Therefore the present work aims at estimating daily milk, fat and protein yields and contents by using Liu's approach, from results obtained during one milking only and from estimated coefficients, according to period between two milkings, stage of lactation and parity.

Regression coefficients were obtained from a training dataset of 28,700 daily results of 5,500 goats, for which morning and evening performances were both available. Then, on an independent validation dataset of 1,700 goats, two approaches were used to estimate performances of each lactation: i) the current AT scheme (which assumes that each milking represents 50% of the daily yield); ii) a new recording scheme (called AC), in which all the records are those obtained either mornings, or evenings, and in which daily performances are estimated by using Liu's coefficients computed with the training dataset. Results show that protein yields and contents are accurate and unbiased in all the situations. The accuracy is lower for fat and the bias is larger, but AT and AC results are comparable. This is why the Liu's approach, applied in recording schemes where only one milking is measured will be proposed for an agreement by ICAR and it will be used by the French MROs in a near future.

A second issue is the acceptable period between two records: until now, severe bounds have been required in France with A4 and A5 schemes. In the near future, these constraints will probably be replaced by a requirement on the average period between records, computed within the first 250 days or within two periods (until the lactation pick and after).

With these changes, the French renewed organization of goat milk recording will be more flexible and thus better fitted to the demand. But performances estimated with the various proposed schemes being not at the same level of accuracy, a study is engaged by MROs and Institut de l'Elevage in order to find the most appropriate way to publish the results and to help farmers to interpret the performances according to their accuracy.

Keywords: Milk recording, goats, alternate testing scheme, Liu's method.

Introduction

The first recording scheme used for goats in France required monthly visits, with measure of both daily milk yields, and a single sample half part for both milkings. The development of the goats' cheese production, and the implementation of a breeding scheme for Alpine and Saanen breeds in the 1980s contributed to increase the demand for goat milk recording: the number of recorded goats trebled within 20 years, and reached 300,000 goats in the 2000s.

Obviously milk recording schemes had to be adapted to the various technical needs of the farmers and to the logistic constraints of the Milk Recording Organizations ("MROs"), due to the large heterogeneity of herd densities and sizes. New procedures were implemented in 1992, with larger accepted periods between two records. The recording scheme was also simplified by measuring one milking only, alternatively mornings or evenings, as it is recommended for AT. In 2006 the AZ method was recognized. With AZ, milk yield of both milkings are measured, but only one sample is taken, alternatively mornings and evenings. The implementation of this new method was motivated by the use of the new milk recording device Lactocorder®. Indeed, MROs have adapted their organization in order to reduce their staff, sometimes with the breeder's involvement (in this case, the scheme is called CZ according to ICAR terminology, Leclerc *et al*., 2004).

The main issue of the AT and AZ procedures is the obligation to get records in the morning and in the evening alternately, which is sometimes difficult to organize: about 3% of

recorded lactations are nullified for this reason. Therefore the present work aims at estimating daily milk, fat and protein yields and contents by using Liu's approach (Liu *et al*., 2000), from results obtained during one milking only and from estimated coefficients. The final objective was first to try to improve the quality (accuracy and reduced bias) of estimated performances with alternate schemes (AT or AZ), but also to look for new schemes in which the performances could be obtained with a non-alternated way (called "AC" in the paper).

Material and methods

Data used were collected on Saanen goats by several MROs, from November 2007 to November 2010, according to an A method with two separate samples for morning and evening milkings. Milk recording was implemented with Lactocorder®, which allowed to collect milking times for each goat.

The data set was split in two parts: a training population of 28,700 test-days records and a validation data set of 11,370 test-day records. Both data sets are described in table 1.

Table 1. Description of the data sets.

	Training population	Validation population
Nb of test-day records	28,700	11,370
Nb of lactations	5,500	1,700
Mean of test-day per lactation	5,2	6,9
Percent of 1st parity	35	33

For each performance (daily yields and contents) and for each combination of parity x lactation stage x milking interval, regression coefficients b0 and b1 were estimated with the training data set by using either morning or evening data, according to the model used in Liu *et al*. (2000):

$$yA4^{[ijkl]} = b_0^{[ijk]} + + b_1^{[ijk]} y_{AT}^{[ijk]} + e^{[ijkl]}$$

where yA4 represents the daily performance of the lth goat (being in parity i, lactation stage j, and the milking's interval k) and $e^{[ijkl]}$ is the residual.

Each of these effects was divided in classes presented in table 2.

Coefficients obtained with the training data set were used to estimate daily production of the validation set, either from morning or from evening data. Coefficients were estimated for milk, fat and protein yields, and fat and protein contents. For contents, an alternative could be to derive the daily contents from the ratio between both estimated daily matter (Fat or Protein) yield and Milk yield. This option has been tested (not presented here), but the results were close to those obtained by using directly the content measured during the AM or PM milking.

Table 2. Definition of classes used in the model.

Effects	Nb of classes	Class definition
Parity	2	1st lactation, 2nd and later lactations
Lactation stage (in months)	10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10 +
Milking interval	5	AM : <12.5h;12.5h-13h;13h-13.5h;13.5h-14h;>14h PM : >11.5h; 11h-11.5h; 10.5h-11h; 10h-10.5h; <10h

Results

Table 3 presents daily production calculated with both milkings (reference) or estimated from data of only one milking (AM or PM). The results obtained without corrective factor for contents are first presented, then results obtained with correction according to Liu's approach.

Liu's approach leads to a reduction of all the biases, especially for fat content, and thus it improves significantly the test-day results delivered to the farmer. The loss of accuracy compared to "A" method ($1-R^2$) are similar when using Liu's coefficients or not. Loss of accuracy is ranged between 5 and 7% for protein content and it is much larger for fat content (17 to 26%, better with the evening data than with the morning ones). However, slopes obtained from the regression between true and estimated performances are much closer to the unit by using Liu's approach than without any correction, which is a very interesting result: it indicates that error does not depend on the performance level of the animal, which is very important for genetic evaluations.

Table 3. Results for daily performances for the validation set.

		Estimated performances		Bias			
		Mean	Std	Mean	Std	Slope	(1-R2)%
Milk yield (kg)	Reference	3.52	1.19				
	AM *2	3.68	1.29	+0.15	0.39	0.88	8.9
	PM *2	3.38	1.21	-0.15	0.39	0.93	10.1
	AM Liu	3.49	1.16	-0.04	0.35	0.98	8.5
	PM Liu	3.53	1.15	0	0.39	0.97	10.4
Fat content (g/kg)	Reference	39.6	7.3				
	AM sample	35.7	8.0	-3.9	3.6	0.81	26.2
	PM sample	43.9	8.2	+4.3	3.8	0.78	17.3
	AM Liu	38.6	6.8	-1.0	3.5	0.94	22.6
	PM Liu	39.0	6.3	0.6	3.3	1.03	17.3
Protein content (g/kg)	Reference	33.6	3.8				
	AM sample	33.2	3.9	-0.4	0.8	0.96	5.6
	PM sample	34.0	3.9	+0.4	0.9	0.94	5.4
	AM Liu	33.4	3.7	-0.2	0.8	1.00	7.4
	PM Liu	33.6	3.7	0.0	0.9	1.00	7.7

Table 4 presents the results obtained at the lactation level; performances were computed for a standard lactation length of 250 days according to Fleischmann method. For AT method we used alternatively mornings or evenings data, and for AC method, the data from the same milking for each test day were used, either morning or evening.

Liu's approach allows to get a similar bias for all methods. Losses of accuracy are always around 1% for milk, 5% for protein contents. For fat contents, the loss of accuracy is important in all the cases: 25 % using "AT" method or "AC" with the morning data, 18% when using "AC" with evening data. However, as for estimated daily performances, slopes are close to 1 (all of them are ranged between 0.90 and 1.12) and they are comparable with both recording schemes.

Table 4. Results for lactation performances (250 days) for the validation set.

		Estimated performances		Bias				
		Mean	Std	Mean	Std	Slope	Correlations	(1-R2)%
Milk yield (kg)	Reference	639.9	389.2					
	AT AM/PM	650.7	394.5	10.8	36.7	0.98	0.996	0.86
	AC AM Liu	629.9	381.3	-10.0	33.6	1.02	0.996	0.72
	AC PM Liu	633.1	377.8	-6.7	41.9	1.02	0.994	1.10
Fat content (g/kg)	Reference	40.1	6.0					
	AT AM/PM	39.3	6.0	-0.8	2.5	0.91	0.911	24.8
	AC AM Liu	39.5	6.0	-0.7	2.6	0.90	0.908	25.7
	AC PM Liu	39.3	5.1	-0.8	2.4	1.07	0.914	18.3
Protein content (g/kg)	Reference	33.0	2.9					
	AT AM/PM	32.9	2.7	-0.1	0.9	0.99	0.950	3.6
	AC AM Liu	32.7	2.6	-0.3	1.0	1.04	0.946	4.1
	PM Liu	33.0	2.4	0	1.0	1.12	0.947	5.1

Discussion and conclusion

These results are different from those obtained with cows performances by Bourrigan *et al.* (2011): in this case, higher accuracies were found for fat and protein contents when using Liu's approach.

The study needs to be completed with additional data before implementation. It is also planned to estimate daily performance for somatic cell count and to adapt the model to AZ method in fitting the milk yield of the other milking as a covariate (Bünger *et al.*, 2010).

However, this work shows that Liu's method leads to a better estimation of daily performances, which are important for herd management. The loss of accuracy on lactation performances is about the same with all simplified methods of dairy recording (with alternate as with non alternate records), and it does not depend on the performance level. Therefore a new recording scheme based on non alternate records and using correction factors estimated with Liu's approach will be proposed in France in a near future. This new recording scheme, which is as accurate as AT (recognized by ICAR), is also proposed for an agreement by ICAR.

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