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COMMUNICATION

Genetic aspects of milk electrical conductivity in Italian Brown cattle

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ABSTRACT

Electrical conductivity (EC) of milk is defined as an indicator of the udder health. The EC is a low cost and easy recordable information in dairy herds with automatic milking systems. The heritability of EC showed to be higher than somatic cell count and for this reason might be an useful trait for indirect selection for mastitis resistance. The heritability for EC in Italian Brown cattle was equal to 0.23. Therefore, EC could be useful not only for dairy cows management but also for selection of dairy cows. The high correlation between breeding values for SCC and EC is promising in order for improving mastitis resistance and functional ability of dairy cows.

Key words: Dairy cattle, Electrical conductivity, Mastitis, Genetic parameters

Introduction

Electrical conductivity (EC) of milk could be considered a mastitis indicator (Norberg et al., 2004). The EC value depends on the concentration of anions and cations in milk. The concentration of Na^+ and Cl^- increases in milk produced under mastitis disease; therefore, milk from mastitis cows typically shows higher EC when compared to milk from health cows (Kitchen, 1981) and the control of milk EC has been proposed as a tool for monitoring udder health in dairy cows (Norberg *et al.*, 2004). In modern dairy herds automatic systems are spreading for monitoring several traits related to yield, fertility and health status of dairy cows (De Mol *et al.*, 1997). Namely, there are currently some milking automatic systems that allow to collect individual total milking time, milk yield and milk EC, at every milking. Therefore, EC could became a low cost and easy recordable information for several dairy herds; as EC showed in Holstein cows a moderate to high heritability and positive correlation with mastitis (Norberg *et al.*, 2004), it could be useful not only for dairy cows management, but also for selection of dairy cows.

Given these premises, this study aimed to analyse the sources of variation and to investigate genetic parameters of EC collected through automatic milking systems on Italian Brown cows reared in four herds of Trento Province.

Material and methods

This study involved four Italian Brown Swiss dairy herds of Trento Province with a size ranging between 25 and 123 milking cows. Individual total milking time (TMT), milk yield (MY) and the highest EC value per cow were collected at each milking between May 2002 and July 2004 on all milk-

Table 1. Descriptive statistics for total milking time (TMT), logarithm of TMT, electrical conductivity (EC), logarithm of EC and milk yield (MY).

Informatics data	Average	S.D.	Min	Max
TMT	6.6	2.0	2.0	15.0
Ln(TMT)	1.84	0.30	0.69	2.71
EC	494	63	200	800
Ln(EC)	6.20	0.12	5.30	6.69
MY	12.8	3.6	3.0	25.0

ings. Data were collected using the Dairy Plan Software (Westfalia®) and were edited using Microsoft Visual Fox Pro procedure. Only milking session with at least ten records and data relevant to cows with at least 15 records, with days in milk ranging between 5 and 400 days, with TMT values ranging between 2 and 15 minutes, with MY values ranging between 3 and 25 kg, with EC values ranging between 2 and 8 ms/cm and with a milking interval from previous milking of at least 7 hours were retained for analysis. After editing 115,799 milking records involving 429 lactations and 233 cows were available. TMT [Ln(TMT)] and EC [Ln(EC)] were log transformed to normalize the distribution. Analysis of variance was performed for Ln(TMT), Ln(EC) and MY using the SAS package (1990) with a linear model including the following fixed effects: herd (1-4); milking session (1-3.706) nested within herd; stage of lactation (1-15); calving year (1-3); calving month (1-12); parity (1-3); classes of milking interval time (1-5); α linear regression coefficient of Ln(TMT) or Ln(EC) on milk yield per milking session. The variance components were estimated on a reduced data set (93,973 records relative to 362 lactations of 204 cows with all pedigree information available) according to a three-variate test-day animal model analysis using Pest-Vce software (Groenveld, 1998). The EC breeding values were calculated by univariate animal model analysis that included the following effects: milking session, parity, stage of lactation, calving month, the interactions between herd and stage of lactation and parity, permanent environmental effect of cow and additive genetic effect of animal. The EC breeding values were expressed on average 100±12 and compared with SCC-EBV estimates provided by Superbrown Consortium.

Results and conclusions

Descriptive statistics for traits considered are shown in Table 1. The mean value for EC are in agreement with results of Nielen *et al.* (1992) and Mucchetti *et al.* (1994). All the effects considered in the analysis of variance resulted statistically significants. Coefficients of determination (R^2) were 0.45, 0.17 and 0.57 for Ln(TMT), Ln(EC) and MY, respectively.

In Table 2 genetic parameters of traits of concern are given. The h^2 of milkability trait was equal to 0.31 and higher than value (0.13) estimated by Santus and Bagnato (1998) on Italian Brown cows. Heritability estimate for Ln(EC) appeared close to 0.23 and lower than value estimated by Goodling *et al.* (2000), on first lactation Holstein cows. Heritability of MY approached to 0.30. The repeatability values for Ln(TMT), Ln(EC) and MY were 0.69, 0.35 and 0.56, respectively. Linear regression analyses between EC and SCC genetic indexes showed a positive association (0.70), showing the potential rule of EC to predict sub-clinical mastitis.

In conclusion, given the moderate heritability value and the high correlation with SCC, electrical conductivity might be considered an useful trait in selection schemes for Brown Swiss cows with the aim, according to results of Norberg *et al.* (2004), of improving mastitis resistance and functional ability of dairy cows. Further studies based with more dairy herds should be needed to confirm these preliminary results, moreover, the estimation of economic value for EC and genetic correlations between EC with other production, type and

Table 2. Variance components estimates, heritabilities, repeatabilities and genetic correlations (rG) for total milking time (TMT), logarithm of TMT, electrical conductivity (EC), logarithm of EC and milk yield (MY).

	Ln(TMT)	Ln(EC)	MY
Genetic variance	0.019	0.003	2.072
Residual variance	0.019	0.010	2.771
Heritability (h^2)	0.312	0.226	0.331
Standard error of h^2	0.092	0.092	0.001
Repeatability	0.690	0.351	0.557
rG(S.E.) with Ln(TMT)		0.463(0.226)	0.749(0.210)
rG(S.E.) with Ln(EC)			0.552(0.113)

functional traits should be done before to introduce EC trait in an official selection index for Italian Brown cattle.

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