Genetic Evaluation for Casein Contents in Italian Brown Swiss: Preliminary Results

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Introduction

Selection for milk quality and animal functionality is of primary importance for the Italian Brown Swiss dairy breed. The selection index used in Brown Swiss in Italy, the ITE, assigns a relative emphasis of 45% to protein yields and 9% to protein contents. (Rossoni *et al.,* 2006).

The protein content in milk samples, otherwise called total protein, is normally estimated from the total amount of nitrogen (N) scaled by 6.38. The resulting value is on protein equivalent basis includes sources of protein and non-protein nitrogen (NPN). According to Rowlands (1938) the total protein can be fractionated in casein (76.3%), whey proteins (17.9%), and about 5.8% of NPN. Nevertheless the milk NPN content varies from 0.12 to 0.25% of the crude protein, depending primarily on farm management and feeding practises. While NPN has little nutritional value and whey proteins are in cheese production, caseins have a determinant role in milk processing.

Casein content is a much more indicative predictor of cheese yield compared to protein contents (Pecorari *et al.*, 1990).

Casein content can be recorded regularly with existing milk recording system. The first available estimates of genetic parameters for the Italian Brown Swiss were obtained from a small dataset (Ghiroldi *et al.,* 2004). Subsequently a three years project called "BruCa" was funded by a local agency in order to obtain, on a large data set, estimates of genetic parameters for casein's content and its related traits and to evaluate the possibility to select directly on these traits.

The aims of this study were to estimate the genetic gain for casein content according to the actual selection index and to evaluate the effect of a possible inclusion of casein content and yield as selection criteria into the ITE.

Table 1. Genetic (above diagonal) and phenotypic (below diagonal) correlation values for milk, fat and protein yield (kg), fat and protein content (%) and for novel traits casein yield (kg), casein, lactose and urea content (%) and casein index (ratio between casein and protein content).

Genetic / Phenotypic	Milk (kg)	Fat (kg)	Fat (%)	Protein (kg)	Protein (%)	Casein (kg)	Casein (%)	Casein Index	Lactose (%)	Urea (%)
Milk (kg)		0.895	-0.106	0.867	-0.210	0.956	-0.167	0.140	0.137	0.160
Fat (kg)	0.801		0.744	0.864	0.139	0.853	0.190	0.126	0.150	0.104
Fat (%)	-0.830	0.05		0.137	0.714	0.217	0.659	0.202	0.143	0.397
Protein (kg)	0.948	0.796	0.020		0.305	0.996	0.355	0.361	0.134	-0.240
Protein (%)	-0.254	-0.40	0.278	0.105		0.231	0.991	0.390	0.440	0.102
Casein (kg)	0.938	0.753	0.987	0.992	0.970		0.405	0.435	0.189	-0.310
Casein (%)	-0.209	-0.24	0.283	0.140	0.967	0.149		0.610	0.156	0.970
Casein Index	0.135	0.146	0.640	0.147	0.130	0.219	0.251		0.730	-0.102
Lactose (%)	0.175	0.111	-0.260	0.163	-0.820	0.195	0.410	0.526		0.200
Urea (%)	0.040	0.61	0.113	-0.120	0.030	-0.140	-0.050	-0.240	0.890	

Material and methods

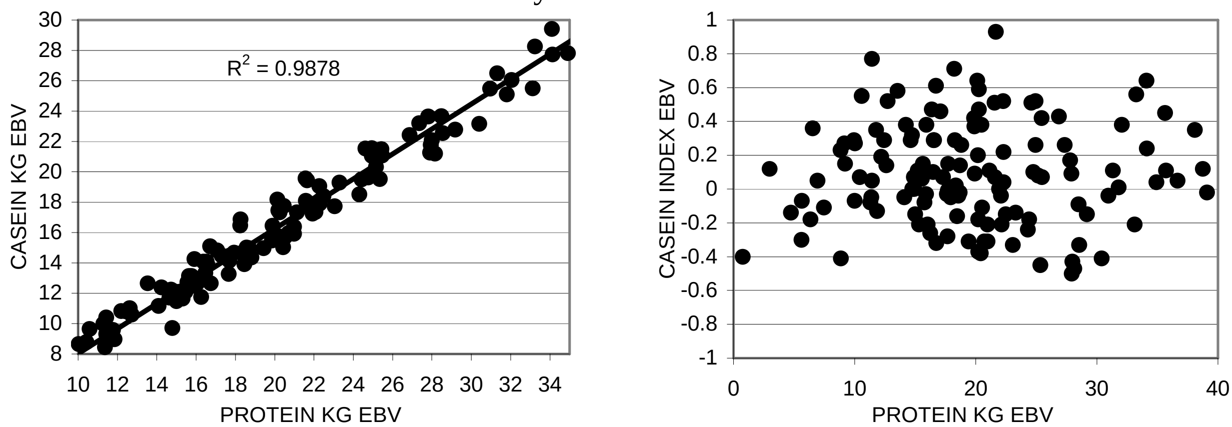
Contents of milk components were obtained analyzing samples collected during routine milk recording by Fourier Transformed Infrared (IR) Spectroscopy with MilkoScan™ FT6000 (Foss Electric, Denmark) since 2005 in Lombardia. Parameters in Table 1 were estimated according to Samorè *et al.* (2007) using an updated data set. The EBV for casein content, casein yield, casein index (ratio between casein and protein content), lactose content were estimated based on a repeatability test-day animal model including more then 500,000 determinations. Factors in the model were the same of the official genetic evaluation procedures for production traits in Italian Brown Swiss (Rossoni *et al.*, 2006). PEST software package was used for EBV estimation (Groeneveld *et al.*, 1990).

According to values in Table 1 genetic gains were estimated according to the following selection indexes:

- The current ITE with protein traits as selection criteria. This estimate provides an estimate of the genetic gain for novel traits (casein yield, casein, urea, lactose content, and casein number) with indirect selection.
- The current ITE but with casein yield and casein content as selection criteria instead of protein traits. This index provides an estimate of genetic gain with direct selection on casein yield and content.

Selection intensity, generation interval, and accuracy are described in Rossoni *et al.* (2006) and are the one derived from the actual selection scheme in the Italian Brown Swiss.

Figure 1. Plots of protein yield, casein content and casein index EBV for sires in artificial insemination in Italy.



Results and discussion

Ranking of individuals for protein yield and casein yield are very similar as was expected given the very high genetic correlation between these two traits (0.996). Nevertheless some difference exists between these two traits for several sires. For example, in Figure 1, sires with an EBV for protein yield of 20 kg, own an EBV for casein yield varying from 15 kg to 18 kg.

The differences across sires is even more detectable comparing protein yield and casein index. Bulls with the same protein yield EBV, can show a large variability for casein index. This is also expected as casein index works strictly on the differences between casein and protein contents. Absolute values of protein and casein contents can be very similar, but it should be possible to base selection on the little differences between these two traits in order to reduce the amount of nitrogen not valuable for cheese production.

Selection response for novel traits is shown in Table 2. Genetic gain for casein yield is in the same range as genetic progress for protein yield, due to the very high genetic correlation between these two traits (0.996). Nevertheless genetic progress for casein percentage is 0.91 standard deviations in 10 years, 30% higher if compared with genetic progress of protein contents (Rossoni *et al.*, 2006). This is due to the correlation between protein and casein contents (0.35) greater then the one between protein yield and protein content (0.30).

The selection criteria in the current ITE seems to have little impact on urea and lactose traits, but shows a strong effect on casein index, as expected because genetic correlation of casein index with protein yield and protein content are positive (0.36,0.39 respectively).

Table 2. Expected genetic gain in 10 years for novel traits with the current ITE.

Traits	Genetic progress	
	Absolute	in St. Dev.
Casein (%)	0.11	0.91
Casein (kg)	21.93	1.47
Urea (%)	-0.01	0.00
Lactose (%)	0.03	0.26
Casein Index	0.38	0.78

The changes in genetic gain using casein instead of protein as selection criteria are reported in Table 3. Genetic progress increased for all traditional traits, except for protein contents, where the genetic gain decreased 0.06 St. Dev. in 10 years. Genetic progress for casein content increased 0.11 St. Dev. in the same period of time.

Table 3. Difference (genetic St. Dev.) in expected genetic gain (10 years) between ITE with casein as selection criteria and current ITE.

Trait	Difference (St. Dev)
Milk (kg)	0.20
Fat (kg)	0.08
Fat (%)	0.10
Protein (kg)	0.10
Protein (%)	-0.06
Casein (kg)	0.16
Casein (%)	0.11
Casein index	-0.01
Urea (%)	-0.01
Lactose (%)	0.13

Conclusion

At Present ITE provides substantial genetic progress also for casein yield, casein content and casein index. Nevertheless when evaluation for casein traits will be available all over the Italian population it will be possible to move from protein to casein in the ITE selection criteria to maximize breeders' efforts oriented to improve cheese making properties of milk.

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