Prediction of gross feed efficiency in Italian Holstein Friesian bulls

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INTRODUCTION

Improving feed efficiency is a hot topic in dairy cattle breeding. Feed costs are a major proportion of the total costs of the dairy herd and thus reducing feed costs for the same output will improve farm profitability. Another benefit from improving feed efficiency is the reduction of greenhouse gases emissions (Hegarty et al., 2007; Wall et al., 2007; Cassandro et al., 2010, 2013). Several countries have set up projects to record dry matter intake (DMI) data (Veerkamp et al., 2000; de Haas et al., 2012; Pryce et al., 2014), but the recording of large datasets to estimate genetic parameters for feed efficiency is complicated and expensive. One way to obtain estimated breeding values (EBV) for traits difficult to collect at population level is to use genomic selection (Meuwissen et al., 2001), where phenotypes such as DMI are measured in a subset of the population, and genomic predictions are calculated for other animals that have genotypes but not phenotypes (Pryce et al., 2014). Although this approach is appealing, allowing industry-wide selection for improved efficiency, the size of the reference population from which the genomic prediction equations are derived is currently too small within each country to achieve satisfactory levels of accuracy of genomic breeding values (Verbyla et al., 2010). Another way to obtain EBV for feed efficiency is to predict this trait by combining official milk recording data and type traits. The aim of this study was to predict gross feed efficiency of Italian Holstein Friesian bulls selected for production, functional and type traits, and to assess phenotypic correlations of gross feed efficiency with milk yield and composition traits.

MATERIAL AND METHODS

A total of 12,238 bulls, from the official April 2015 genetic evaluation performed by the Italian Holstein Friesian Cattle Breeders Association (ANAFI), were used. Estimated breeding values (EBV) for milk yield (MY, kg/305 d), fat content (FAT, %/305 d), protein content (PRT, %/305 d), stature and body depth were calculated by the bull birth year. Pearson correlations of MY, predicted body weight (pBW) and pFE were calculated using information of MY, FAT and pBW for each bull, as reported by Chase and Sniffen (1985). Daily gross feed efficiency (pFE) was predicted as ratio between MY and pDMI. Phenotypic trends for MY, predicted body weight (pBW) and pFE were calculated using information of MY, FAT and pBW for each bull, as reported by Chase and Sniffen (1985). Daily gross feed efficiency (pFE) was predicted as ratio between MY and pDMI. Phenotypic trend for MY, predicted body weight (pBW) and pFE was calculated by birth year of bulls. The results suggest that pFE can be successfully selected to increase profitability of dairy cattle using the current milk recording system. Direct measurements on DMI should be considered to confirm results of pFE obtained in the present study.
relations and descriptive statistics were computed using SAS software version 9.2.

RESULTS AND DISCUSSION

Descriptive statistics and Pearson correlations for the studied traits are reported in Table 1. Predicted FE and BW averaged 1.47 ± 0.07 and 669.1 ± 4.7 kg, respectively, as well as means for MY, FAT and PRT were 10,144 ± 701 kg/305 d, 3.72 ± 0.22% and 3.39 ± 0.11%, respectively. Unfavourable correlations were estimated between pFE and milk composition traits, whereas favourable relationship was assessed between pFE and MY. All correlations were statistically significant (P < 0.001). Similar results were reported by Connor et al. (2013) and Manzanilla Pech et al. (2014), whereas Vallimont et al. (2011) reported greater estimates of pFE than those obtained in the present work.

Table 1. Descriptive statistics (1) for milk yield (MY), fat content (FAT), protein content (PRT), predicted body weight (pBW) and predicted gross feed efficiency (pFE) of Holstein Friesian bulls (n = 12,238). Pearson correlations (r_p) of MY and pFE with other traits are also provided

<table>
<thead>
<tr>
<th>Trait</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>r_p with MY</th>
<th>r_p with pFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MY, kg/305 d</td>
<td>10,144</td>
<td>701</td>
<td>7,734</td>
<td>12,711</td>
<td>-</td>
<td>0.94</td>
</tr>
<tr>
<td>FAT, %/305 d</td>
<td>3.72</td>
<td>0.22</td>
<td>3.02</td>
<td>4.76</td>
<td>-0.32</td>
<td>-0.61</td>
</tr>
<tr>
<td>PRT, %/305 d</td>
<td>3.39</td>
<td>0.11</td>
<td>2.91</td>
<td>3.93</td>
<td>-0.21</td>
<td>-0.37</td>
</tr>
<tr>
<td>pBW, kg</td>
<td>669.1</td>
<td>4.7</td>
<td>652.85</td>
<td>685.37</td>
<td>0.47</td>
<td>0.33</td>
</tr>
<tr>
<td>pFE</td>
<td>1.47</td>
<td>0.07</td>
<td>1.18</td>
<td>1.70</td>
<td>0.94</td>
<td>-</td>
</tr>
</tbody>
</table>

(1) SD = standard deviation

Trends of MY and pFE by the bulls birth year are depicted in Figure 1. Milk yield increased by 62 kg per year during the last three decades. This result represents the 0.56% of the current phenotypic mean. The pFE followed similar trend with an annual increase of +0.002 kg of MY per kg of DMI. This result represents the 0.19% of the current phenotypic mean. The lower value for pFE compared with MY is the result of the indirect selection strategy used by ANAFI to improve feed efficiency. Figure 2 shows trends for pBW and pFE. Body weight increased by 0.27 kg/year which represents an annual increase of +0.04% of the current mean value of pBW. These findings suggest that feed efficiency can be improved together with milk traits. However, body weight should not increase further.

Figure 1. Trend of milk yield (MY, kg/305 d) and predicted feed efficiency (pFE) for Holstein Friesian bulls evaluated in Italy (ANAFI, April 2015)
CONCLUSION

The results of this explorative study suggest that pFE can be successfully selected to enhance profitability of dairy cattle using current milk recording system. Recent advances in the dry matter intake at individual level using a roughage intake control system or similar tools seem to be very helpful to set up specific selection strategies for feed efficiency. A larger dataset with direct measurements on DMI should be considered to confirm results of the present study.

REFERENCES


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