Alternative modelling of body condition score from Walloon Holstein cows to develop management tools

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The objective of this study was to formulate and test an alternative modelling for body condition score (BCS) in order to develop management tools for dairy farmers based on performance recording data. This modelling allowed the prediction of a BCS value for each day in milk of a given cow and would contribute to the development of decision making indicators, (e.g. the prediction of BCS loss at early stage of lactation). The model especially included two herd effects (a random herd x test-day and a fixed herd x month period effects). Results indicated that the overall fit of the model was good. Moreover, the ability of the model to predict future or missing records was tested and indicated satisfying correlations between observation and prediction (from 0.57 to 0.67) considering the structure of data (two years of recording only). Based on these results the tested model can allow the use of BCS for management purposes and permits the development of decision making indicators for dairy farmers.

Key words: Body condition score, Test-day model, Prediction.

For a few years, the Walloon Breeding Association, in collaboration with the Gembloux Agricultural University, has increased the use of performance recording data for management purposes. For instance, an adaptation of the lactation yield computation method was performed and allowed the development of management tools regarding peak yield, persistency as well as total lactation yields. Usefulness of these developments were also presented in other studies (VanBebber et al., 1999; Koivula et al., 2007) which showed the interest of using predictions or solutions in order to advice dairy farmers.

Moreover, since April 2006, body condition score (BCS) is monthly recorded in 76 dairy herds of the Walloon Region of Belgium. In fact, BCS is a valuable indicator of the stored energy reserves of dairy cows and it is linked to the energy balance.
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status as well as the production, the fertility and the health traits. In addition to the
development of a genetic evaluation for this trait (Bastin et al., 2007), the objective of
this recording is to develop and offer management tools to dairy farmers. Currently,
BCS results are monthly sent to each farmer as a “Herd BCS balance sheet”. It
allows him to point, across time, the groups of cows which are not in the range of
desirable scores according to their parity or lactation stages. Nevertheless, this “Herd
BCS balance sheet” is developed based on observed values. Modelling this data in
a management goal could provide more interpretable information, e.g. predicting
the BCS loss at the early stage of lactation.

The objective of this study was to model BCS for predicting a BCS value for each day
of the lactation in order to develop later decision-making indicators for dairy farmers.

Material and methods

Data used in this study were BCS measurements monthly collected by milk recording
agents between the 1st April 2006 and the 31st March 2008 in the Walloon Region of
Belgium. Records before 5 days in milk (DIM) and after DIM 365 were eliminated for
the estimation of variance components. The data set represented 54,955 BCS values
from 5,123 cows. BCS of dairy cows was evaluated based on a nine-point scale
(with unit increments), with scoring of 1 representing an emaciated cow to 9 for
obese cow.

The model was developed in order to allow the prediction of BCS value for each day
of the lactation of a given cow. To achieve this objective, the classical fixed
herd x test-day effect was replaced by the sum of two herd effects: a fixed
herd x test-month period effect and random herd test-day effect. This approach
allowed to define a herd effect for each day of the lactation and was first presented
by Mayeres et al. (2004) for production traits. Besides these two herd effects, the
single trait multi-lactation test-day model finally used in this study included four
fixed effects: stage of lactation expressed as classes of 5 DIM; milk recorder combined
with classes of 14 DIM; age at calving expressed in months; state of the cow: lactating
or dried. Three random regression effects were also defined: permanent environment
within lactation, permanent environment across lactation and additive genetic effect.

Regression curves were modelled using Legendre polynomials of order two.

Covariance components were obtained using AI-REML (Mizstal, 2007). Solving
was done using adapted BLUPF90 (Mizstal, 2007) programs which provided
prediction errors (PE = prediction – observation). Standard deviation of the prediction
error and correlation between observed and predicted values were computed
considering three different cases. Firstly, the adjustment of the model was studied
by examining data collected from 1st April 2006 to 29th February 2008 and used for
solving the model. Secondly, accuracy of prediction for missing records was
estimated by solving the same model as previously described but considering that
the data collected on March 2007 were missing. Finally, BCS values for March 2008
were predicted and compared with the observed value of BCS in order to assess the
ability of our model to predict future test-day records.

Results and discussion

Regarding the adjustment of the model, Table 1 indicated that the overall fit of the
model was good. The average PE was very close to 0 and the correlation between
predicted and observed BCS ranged from 0.88 to 0.91 for all lactations.

For the prediction of missing or future records, the fit of the model was satisfying
according to the structure of BCS data (only 2 years of recording). The average
PE was negative in both cases, indicating that BCS values were systematically
underestimated. The range of PE standard deviation was limited and lower than one unit of BCS (around 0.95 for prediction of missing values and around 0.80 for future values). Table 1 also indicated that the PE was globally closer to 0 and the correlation was lower for the prediction of missing records than for the prediction of future records. It indicated that the average error is lower for the prediction of missing values but its distribution is larger.

No equivalent studies were found for the prediction of future BCS test-days records. Moreover, for information only, previous researches using test-model to predict fat, protein and milk yields for future test-day records indicated ranges of correlations between observation for the test-day n and prediction for the test-day n+1 from more or less 0.70 to 0.90 according to the study, the trait and the number of the test-day predicted (Macciota et al., 2002, Mayeres et al., 2004; Vasconcelos et al., 2004).

Figure 1 illustrates the purpose of the developed model and gives an example of the BCS values observed and predicted across the lactation for a randomly chosen cow in the 7th parity. In this particular case, the modelling allowed the prediction of the

<table>
<thead>
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<th>Lactation</th>
<th>Average PE</th>
<th>Standard deviation of PE</th>
<th>Correlation</th>
</tr>
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<td>Adjustment on data from 1st April 2006 to 29th February 2008</td>
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<td>0.00</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Figure 1. Prediction of a BCS value for each DIM, example of a given cow in 7th lactation.
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Conclusions and perspectives

BCS value of this cow at the end of its lactation. Currently too fat cows at drying are a recurrent problem in Walloon dairy herds, this prediction could help the farmer to pay attention to such cows before they are dried of.

Acknowledgements

This study was the first step toward the development of management tool for dairy farmers based on BCS data and focused on the definition and the test of an alternative modelling of this data. Even if prediction of future or missing BCS records was not perfect, the adjustment of the model was good. Based on these results, some parameters could be estimated. For example, the loss of BCS at the early stage of lactation could be estimated even if records at this time are not available. BCS values at critical point of the lactation (peak yield, calving, drying) would also be valuable. These preliminary results seem to be encouraging for the use of BCS information for management purposes and the development of decision making indicators for dairy farmers.

List of references

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