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

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Summary

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.*

Introduction

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

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 1. Adjustment and predictive ability of the model for missing and future records.

	Lactation	Average PE	Standard deviation of PE	Correlation
Adjustment on data	1	0.00	0.47	0.88
from 1st April 2006 to	2	0.00	0.46	0.91
29th February 2008	?3	0.00	0.49	0.91
Predictability for	1	-0.34	0.78	0.64
missing records from	2	-0.42	0.84	0.58
March 2007	?3	-0.41	0.81	0.67
Predictability for future	1	-0.13	0.92	0.57
records of March 2008	2	-0.06	0.98	0.54
	?3	-0.10	0.92	0.67

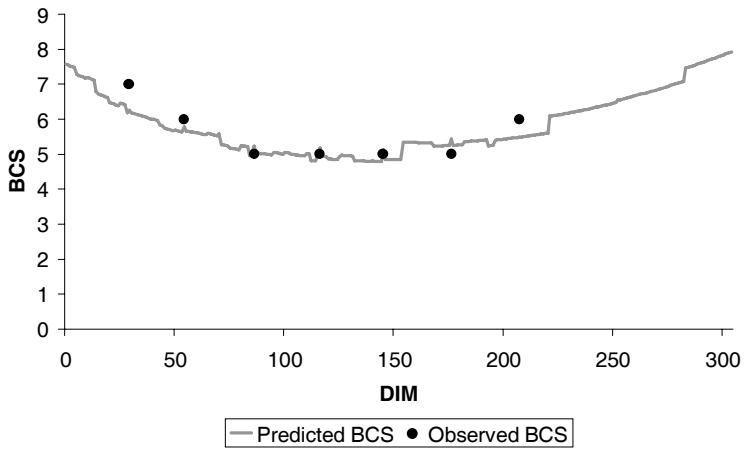

Figure 1. Prediction of a BCS value for each DIM, example of a given cow in 7th lactation.

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.

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.

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