Methods to Estimate 24-hour Yields for Milk, Fat and Protein in Robotic Milking Herds

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Introduction

Capturing milk, fat and protein yield data is central to the purpose of milk recording and genetic evaluation programs. The Canadian milk recording system is based on a Test Day Model (TDM), which requires the input of actual or estimated 24-hour yields of milk, fat and protein from each milking cow in the herd. Although there are few reports in the published literature, several attempts have been made to address some of these issues and challenges for automated systems (Bloth, 2001; Friggens, 2000; Galesloot, 2000; Reents, 2000). In robot milked herds it is possible to capture each cow's milking times, milk weights and associated time interval between milkings. With the use of specialized sampling equipment (shuttle), it is possible to collect a sample from every milking during a 24-hour test period. However, for cows that visit the milking station infrequently, or if all milk is not evacuated from the udder during one or more of the milkings during the test day, the milk yield estimates can be inaccurate.

The objective of this study is to determine the optimum number of previous milkings, which should be used to most accurately estimate the actual 24-hour milk yield, regardless of the milking interval.

In robotic milked herds while the electronic capture of the milk weights and times is automatic and requires little or no human intervention, the same is not true for the sampling process. Most producers with robotic milking systems would prefer to limit the duration of a robotic milk sampling to a manageable period of time.

The objective of this study was to use data collected to determine the minimal sampling duration to estimate reasonably accurate 24-hour yields of fat and protein

Optimum Number of Previous Milk Weights to Accurately Estimate 24-hour Milk Yield

In order to determine the optimal number of previous milk weights required to accurately measure 24-hour milk yield, milk records were collected on fifteen LELY robotic dairy farms in Germany. The data included records from 1805 cows collected from April, 1998 to March, 2001. For each record milking rates were calculated (kg/hr) as well as: R (reference rate calculated using the current milk record plus 4 records back in time and 4 records forward in time), M (the milk rate for the current record), M1 (milk rate calculated by using the current milk record plus one record back in time), M2 (milk rate calculated by using the current milk record plus two records back in time) and continuing for M3 through M25. For each cow the correlation coefficient was calculated between the following pairs of variables: R and M, R and M1 through to R and M25. The variance was also calculated for the variables M through M25. The correlation and variances were modeled in SAS (1990) using a nested mixed model which included the following covariates; DIM (day in milk class of the animal), LACT (for parity 1, and 3+), LAG (number of milkings between records, 2 to 25) and first order interaction terms. Random effects included herd, and cow nested within herd. Prediction equations for both the correlation and variance were calculated. For each DIM by LACT group the prediction equations were normalized and superimposed. A difference curve was then calculated by taking the difference between the two normalized prediction curves. The maximum value of the difference curve is the LAG value at which the correlation is greatest and the variance is minimized.

The difference curves suggested that the current milking plus the last 12 milk weights with associated intervals or the milk weights and intervals from the last 96 hours (4 days), be used to estimate the test-day milk yield for robotically milked cows

Fat and Protein Yields

In order to determine the minimal sampling duration to estimate reasonably accurate 24-hour yields of fat and protein the previous data set was analyzed. Rate of fat yield (kg/hour) and rate of protein yield (kg/hr) were modeled in SAS (1990) using a repeated nested mixed model with an autoregressive error structure. Covariates included: DIM, LACT, eason of milking (1 = ONDJFMA, 2 = MJJAS), milking interval (hrs) and time of first milking on test day (coded in 2 hour intervals beginning at 0600). Random effects included herd and cow nested within herd. Model equations were calculated based on various test day (TD) lengths. Predicted values for TD lengths were calculated and compared to predicted values based on various TD lengths (6, 8, 10, 12, 14, 16 and 18-hours). Two comparison statistics were used, the absolute deviation (AD) and percent deviation from 24-hour model (PD).

The results indicated a reduction in the accuracy of the 24-hour fat and protein yield estimate as the length of the sampling period decreases from 18 to 12 hours. While a 24-hour sampling period is undesirable from a labour and cost perspective, it would appear that a sampling period of 14 or 16 hours could be practical.

References

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