An Independent Evaluation of a Lactating Dairy Cow Model: 1. Milk Production and Composition, Body Weight, and Body Condition Score

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Introduction

A comprehensive mechanistic model of the lactating cow has been described by Baldwin and coworkers (Baldwin, 1995). Over the past year, we have undertaken enhancements to that model in an attempt to address deficiencies. Such work has led to significantly better fits to a reference data set (Hanigan *et al*, *J Dairy Sci*, 2001). The work described herein represents a challenge of that model with independent data.

Materials and Methods

Data used for the evaluation were derived from 10 early lactation studies (Week 1 to a maximum of Week 20) conducted at the Purina Mills, Inc. Research Center over the past eight years. Raw data were reduced to treatment means by week. Initial body weight and condition score and weekly dry matter intake (DMI) and diet composition were inputs to the model. Simulations were run by treatment and parity (heifers vs. mature animals) using (ACSL) (Aegis Corp., Huntsville, AL). Body weights, condition scores, milk production and milk composition predicted by the model were compared to the observed weekly means. Results were analyzed using (SAS) (1988). Residual errors were expressed as a root mean square prediction error (RMSPE) and partitioned into mean bias, slope, and residual errors.

Results and Discussion

Results from the simulations are presented in Table 1. All RMSPE were similar to that for the reference data set. Milk, lactose and protein yield were fairly well predicted with fat yield, body weight and body condition score (BCS) less well predicted. Errors in fat yield appear to be associated with factors not considered in the model, as evidenced by the residual error, while BCS errors are likely associated with inappropriate energy partitioning, as evidenced by the slope error. The large proportion of residual errors attributable to the mean bias for BCS and body weight also suggest there may be energy partitioning problems. However, the ability to predict milk, lactose and to a certain extent, protein yield, demonstrate the utility of the model relative to predicting milk income from a given diet. Additional attributes of the model that may be useful from a practitioner's standpoint include predictions of ruminal fill and metabolism, flow of nutrients to the small intestine, blood concentrations of several metabolites including glucose and urea, and ability to predict the temporal patterns of body energy stores.

References

1. Baldwin RL: Modeling ruminant digestion and metabolism. Chapman and Hall, London, UK, 1955.
2. SAS. 1988. SAS/STAT® User's Guide. SAS Inst, Inc, Cary, NC.

Table 1. RMSPE and the partition of that error for predictions of milk, lactose, protein and fat yield, and body weight and condition score.

	Milk Yield	Lactose Yield	Protein Yield	Fat Yield	Body Weight[a]	BCS[b]
RMSPE, kg/d			3.5	0.15	0.18	0.27
39.8 (87.6)	0.67					
Mean Bias, % of MSPE[c]	24.1	2.1	66.5	29.7	66.5 (146.3)	62.0
Slope Error, % of MSPE[d]	4.4	0.4	4.5	9.2	0.4 (0.9)	22.1
Residual Error, % of MSPE	71.4	97.5	29.0	61.1	33.1 (72.8)	15.9

[a]kg (lb); [b]unitless; [c]mean square prediction error; [d]slope of residuals regressed on predicted