**Application**

Feed into Milk (FiM, 2004) energy rationing models remain valid for rationing modern Holsten dairy cows.

**Introduction**

The FiM energy rationing models for dairy cows were developed over 20 years ago. Since then, dairy production in the UK has undergone considerable changes, with annual milk yields per cow having increased from approximately 6,000 litres in 2000 to 8,133 litres in 2023. The objective of the present study was to evaluate if energy rationing models within FiM remain valid for rationing modern Holsten dairy cows.

**Materials and Methods**

The present dataset was collated from 29 long-term indoor feeding studies (experiment periods ranged from >90 d to whole lactation) conducted between 2006 and 2023 at the Agri-Food and Bioscience Institute (AFBI) in Hillsborough, Northern Ireland. A total of 64 treatments were evaluated with more than 700 individual Holstein dairy cows. Feed intake, milk yield and liveweight of individual cows were recorded daily while milk composition was analysed weekly. Daily liveweight gain was estimated by linear regression of liveweight over time. All cows were offered grass silage-based diets, while maize silage and wheat straw were included in some rations. A total of 37,831 weekly mean data of individual cows were used in the present validation. Total daily ME intake (corrected for the effect of feeding level) was calculated from forage and concentrate DM intakes multiplied respectively by forage and concentrate ME concentrations. The ME concentrations of grass and maize silage were predicted using NIRS while ME concentrations of concentrates and straw were taken from the FiM database. Total ME requirement was calculated using FiM models as a sum of ME requirements for maintenance and milk production, liveweight gain, activity allowance and pregnancy. The validation was carried out by comparing total ME intake (actual intake) with total ME requirement (predicted intake).

**Results**

The data used in the present validation are presented in Table 1. The database represents a large range of dairy production conditions in terms of lactation No (1 to 10), days in gestation (0 to 236), weeks in milk (1 to 44), liveweight (370 to 853 kg), DM intake (10.0 to 40.0 kg/d) and milk yield (5.2 to 76.6 kg/d). Average ME requirement predicted using FiM energy rationing models is 256 MJ/d, which is only 1 MJ/d lower than the actual ME intake (corrected for the effect of level of feeding). The output shows a minor underprediction of 0.1% and a small mean prediction error (MPE) of 0.142. Most of the mean square prediction error (MSPE) was derived from the random factor (78.7%), with 21.3% from the line error, and 0% from the bias (difference between predicted and actual ME intake). A further evaluation using the linear regression of the prediction bias (difference between predicted and actual ME intake divided by actual ME intake, y) against liveweight (x) or milk yield (x) found that neither liveweight nor milk yield had a significant relationship with the prediction error.

Table 1. Data used in the present validation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|   | Mean | s.d. | Min | Max |
| Lactation No | 2.5 | 1.42 | 1 | 10 |
| Day in gestation | 67 | 56.0 | 0 | 236 |
| Week in milk | 15 | 10.0 | 1 | 44 |
| Liveweight (kg) | 606 | 72.6 | 370 | 853 |
| DM intake (kg/d) | 21.7 | 4.19 | 10.0 | 40.0 |
| Milk yield (kg/d) | 34.2 | 8.78 | 5.2 | 76.6 |
| Actual MEI (MJ/d) | 257 | 49.3 | 101 | 458 |
| Predicted MEI (MJ/d) | 256 | 54.1 | 73 | 482 |



Fig. 1 Actual vs. predicted ME intake (MJ/d)

**Conclusions**

The output of the present evaluation demonstrates that FiM energy rationing models developed over 20 years ago can accurately predict total ME requirements of the modern Holstein cow. The prediction accuracy remains similar across a large range of liveweights and milk yields.

**Acknowledgments**

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**References**

Feed into Milk. Edited by Thomas, C. (2024). Nottingham University Press.