

**Statistical properties of proportional residual energy intake as a new measure
of energetic efficiency**

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Proportional residual energy intake

Summary

Traditional ratio measures of efficiency, including feed conversion ratio (FCR), gross milk efficiency (GME), gross energy efficiency (GEE) and net energy efficiency (NEE) are likely to have some statistical problems including high correlations with milk yield. Residual energy intake (REI) is another criterion, proposed to overcome the problems attributed to the traditional ratio criteria, but it does not account for production or intake levels. For example, a same value of REI could be noticeable for a low producing cow and negligible for high producing cows. This study was conducted to propose a new measure of efficiency to overcome the problems attributed to previous criteria. A total of 1478 monthly records of 268 lactating Holstein cows were used for this study. In addition to FCR, GME, GEE, NEE and REI, a new criterion called proportional residual energy intake (PREI) was calculated as the ratio of REI to net energy intake and defined as proportion of net energy intake lost as REI. The PREI had an average of -0.02 and range of -0.36 to 0.27, meaning that the least efficient cow lost 0.27 of her net energy intake as REI, while the most efficient animal saved 0.36 of her net energy intake as less REI. Traditional ratio criteria (FCR, GME, GEE and NEE) had high correlations with milk yield and fat corrected milk yield (absolute values 0.469 to 0.816), while the REI and PREI had low correlations (0.000 to 0.069) with milk production. The results showed that the traditional ratio criteria (FCR, GME, GEE and NEE) are highly influenced by production traits, while the REI and PREI are independent of production level. Moreover, the PREI adjusts the REI for intake level. It seems that the PREI could be considered as a worthwhile measure of efficiency for more studies in the future.