# How much milk is produced from pasture? Comparison of two calculation methods

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## Abstract

The sustainable use of grassland resources is a good way to produce cheap fodder of adequate quality with usually short transportation pathways. However, many farmers do not know how much fodder they produce on grassland and how much milk is produced from this fodder, especially on pastures. The commonly used calculation method attributes milk production mainly to the energy taken up in the stable and only the remainder (plus the complete energy expenditure for maintenance) to pasture, probably leading to an underestimation of the contribution from pasture. Here, we compared this conventional method to another one attributing the energy expenditure for maintenance and milk according to the energy contributed by each fodder type. As a database, six years of data from a pasture trial carried out at House Riswick, Germany, have been used, with three years of full grazing and three years of half-day grazing plus silage and concentrates provided in the stable. In contrast to the alternative method, the conventional method underestimated pasture performance, especially at small shares of pasture in the ration. Adapting the alternative method in extension services may lead to a better appraisal of grass as a basis for milk production.

**Keywords:** pasture production, roughage, full grazing, concentrates, energy corrected milk

## Introduction

For a sound judgement of the competitiveness of dairy farms, a proper estimation of milk performance is needed. Lately, this estimation has tended to shift from performance per animal to performance per area (Thomet and Reidy, 2013). To judge the latter, it is essential to have a good idea of the milk production from grassland. Especially for pastures, this is complex as the quantity and quality of fodder taken up by the animals is often unknown. In Germany, the common calculation method for milk production per pasture area therefore subtracts the amount of milk produced from fodder taken up in the stable (concentrates and silage) from the total amount of milk. Any fodder taken up on pastures then covers the remainder of the milk plus the energy needed for maintenance. According to a new method suggested by Leisen *et al.* (2013), the milk production from pasture can also be calculated by multiplying the total amount of milk produced with the share of energy supplied by pasture, thus splitting the energy needed for maintenance over all fodder types according to their share in the ration. In this paper, we compared both methods using data from two grazing systems of an experimental farm. This is the first comparison of the methods with real farm data. We hypothesized that the new method gives better results for pasture performance, and that the difference between the methods would be larger the smaller the share of pasture grass in the ration. Furthermore, we hypothesized that there is no difference in pasture performance calculated per hectare between a full and a half-day grazing system if the area is adapted according to the uptake of the animals.

## Materials and methods

Grazing experiments were carried out at House Riswick, Chamber of Agriculture, Germany, between 2009 and 2014. In the first three years, full grazing was practised to a compressed sward height (CSH) of

5-6 cm (short-lawn pasture). The animals were managed in two herds where one was fed on pasture but received concentrates according to performance in 2009 while the other received supplementary silage (in 2009 only) and/or concentrates (fixed amounts in 2010; according to performance in 2009 and 2011). From 2012 to 2014, all animals were on pasture for half a day (6-7 cm CSH) and received a mixture of concentrates and silage in the stable and additional concentrates according to milk performance. No mineral fertilizer was used during the duration of the pasture trial with the exception of 450 kg kainite $ha^{-1}$ applied in spring 2011 on some of the areas. Slurry was only applied in spring on areas used for cutting.

Data on the composition and amount (dry mass) of stable fodder as well as its energy content (literature data for wheat, grain maize) were collected on a daily basis. This was used to calculate the net energy lactation (NEL) provided by the stable fodder. Two times per month, data from milk inspection on the amount and quality of milk were received. This yielded the NEL needed for milk production (based on energy corrected milk). The average live weight of the herd was measured once a month to calculate energy needs (in NEL) for maintenance. Energy requirements for growth or activity were not taken into account. The NEL from stable fodder divided by the NEL needed for milk production and maintenance gave the contribution of stable fodder, or – by subtracting this number from one – that of pasture to the NEL of the total ration.

Calculation of pasture performance was done as follows:

- Method 1 (conventional method): Milk from pasture = total milk – milk from stable fodder
- Method 2 (Leisen *et al.*, 2013): Milk from pasture = total milk × contribution of pasture to NEL of ration

Statistical evaluation of the results was done using SPSS 20.0. The three years per grazing method were considered as replicates and data were analysed with ANOVA after testing for normality and homogeneity of variances.

## Results and discussion

Table 1 shows the average pasture productivity per grazing system calculated using the two different methods. As expected, Method 1 led to significantly smaller values than Method 2. The difference was much larger for the half-day grazing system than for full grazing. This can be attributed to the energy expenditure for maintenance that remains similar for full and part-time grazing but takes a larger share of a smaller pasture uptake if assumed to be derived fully from pasture (Method 1). Table 1 also indicates that there are large and significant differences calculated in the milk yield per hectare with Method 1, but not with Method 2. As the available pasture area was adapted to the animals' requirements, we hypothesized that the outcome per area should be similar. Thus, Method 2 seems to deliver more realistic results under the tested circumstances. A difference in outcome would only be expected if pasture was managed less efficiently, if animals differed in selectivity between systems, or if the quality of the herbage on offer

Table 1. Pasture productivity (energy-corrected milk, kg ECM $ha^{-1}$ $a^{-1}$) in a full grazing and a half-day grazing system with additional feeding, evaluated by two methods.[1]

| | Method 1 | Method 2 | *P*-value between methods |
|---|---|---|---|
| Full grazing | 7,754 (651) | 9,337 (340) | 0.020 |
| Half-day grazing | 1,921 (550) | 8,438 (1,638) | 0.003 |
| *P*-value between grazing systems | <0.001 | 0.405 | |

[1] Methods are explained in the text. Shown are means and standard deviations (within brackets) of values collected over three years. *P*-values are the result of an ANOVA analysis.

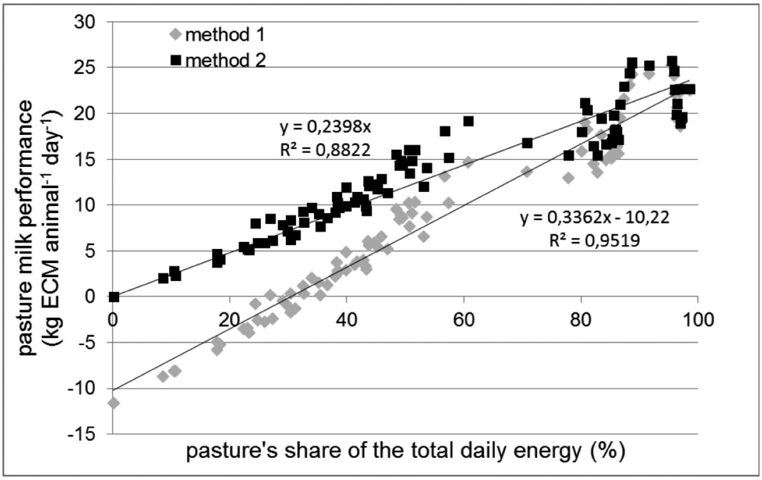


Figure 1. Pasture performance in terms of kg energy corrected milk (ECM) animal$^{-1}$ day$^{-1}$ versus the share of the total daily energy provided by pasture fodder.

differed. Larger standard deviations for the half-day grazing system were due to weather conditions in 2013 causing a shorter grazing period and more supplementary feeding in summer due to drought. If this year was left out of the calculation, the outcome for Method 2 was even more similar.

Figure 1 indicates the influence of pasture's share of the total ration's energy on the calculated pasture milk performance. It clearly shows that the deviation between the calculation methods is larger the smaller the share of pasture grass in the ration. This is in line with our hypothesis.

## Conclusions

The miscalculation of pasture performance following the conventional method increases with a decreasing share of pasture feeding, suggesting even a negative pasture performance at shares below 30%. To enable sustainable and realistic management decisions regarding pastures, it is essential to change the conventional method for calculating pasture performance.

## References

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