Prediction of energy content of grass silages depending on grass and ensiling conditions

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Abstract

A model that predicts energy concentration of grass silages was tested on 16 farms for the years 2002 and 2004. The model is based on grass energy concentration and the ensiling conditions. Estimates of ensiling conditions depend on ensiling capacity, silo compaction, silo temperature and use of silage additives. Factors that reduced energy concentration were determined and used to derive the expected energy content of grass silage. The model was able to predict the energy content of the grass silages with a difference of 0.1 MJ NEL kg DM⁻¹ and a coefficient of variation of 2.22 and 1.09%, in 2002 and 2004, respectively. For planning silage supply for different cattle groups of a holding the model delivered quality data as early as possible. In the case of farms with several silos with different silage quality characteristics, silages can be stocked best according to the special requirements of the herds. By referring the analyses to areas where the grasses originate, farmers gain valuable information for grass sward management of a particular field or pasture.

Keywords: model, sward management, feed planning

Introduction

In large agricultural farms with grassland of different sward compositions, the quality of the silages usually varies among the different silos. Knowing the grass quality, particularly the energy concentration, is a precondition for planning the effective use of the different silages according to the requirements of the different herds of a holding. In cases where there are of quality problems, a successful analysis is impossible without detailed reporting of the ensiling process.

Normally the farmer gets forage quality data that are needed for planning from the forage quality analysis of the silages. Sampling takes place by drilling and taking cores or by sampling the silo opened for feeding. Particularly in large silos, sampling of drilled cores is inefficient and does not very often supply representative results. By sampling the opened silo, results are available just at the time of feeding. There is very often a great difference in time between ensiling and feeding. Particularly in larger silos, it is nearly impossible to refer the silage analyses results to certain fields or pastures.

Materials and methods

A model named ‘Normative Silokartei’ was developed particularly for large agricultural enterprises at the former Institut für Futterproduktion Paulinenaue (East Germany) in the 1980s. The model predicts dry matter (DM) losses and changes in different quality parameters during the ensiling process (Weise and Rambusch, 1983). The prediction is based on forage quality analysis, evaluation of the ensilability of the ensiled grass, and on the ensiling techniques by the farmer. The model was already introduced to farmers before 1989 (Knabe et al., 1986; Weise and Rambusch, 1988), but its use stopped due to the structural changes in the agricultural advisory system and, after 1989, the Northeast German farms themselves. As part of their actual grassland advisory activities the authors made use of the model in several farms since 2000 (Weise and Hertwig, 2011). In 2002 and 2004 the silage quality tool of the model was tested again under the actual practical conditions, in 5 and 9 farms respectively.
In the model, the forage quality of silage is based on the analysis of the grass forage value at time of ensiling (Figure 1).

![Figure 1. Structure of the model, part: prediction of silage energy content](image)

The sampling of the grass to be ensiled and of the feed silage was carried out by the farmer throughout the entire filling and feeding time of the silo. The data used for the original model parametrization were based on the chemical analysis of forage value of the grass and the grass silage from 23 large clamp silos based on the methods and the tables from the DDR-Futterbewertungssystem (Beyer et al., 1971), which provided values for crude protein (XP), crude fibre (XF), crude ash (XA) and energy concentration (EC). In the 2002 and 2004 test, forage value was estimated by near infrared (NIR)-spectroscopy (VDLUFA, 2012). Therefore the EC is given as ‘Energetische Futtereinheit Rind’ (EFr) per kg DM in the results of the original model in 1983 and as ‘Mega Joule Net Energy Lactation’ (MJ NEL) per kg DM in the test of 2002 and 2004. The ‘ensiling conditions’ are characterized by the ‘ensilability’ of the grass and the ‘ensiling technique’, both described by three levels: ‘good’, ‘medium’ or ‘bad’. The ensilability mainly depends on the grass sward composition, the DM content at ensiling and the use of silage additives. For describing the ‘ensiling technique’ the silo filling und compaction process were evaluated. On the basis of a five level scale ‘ensiling conditions’ factors were derived to reduce grass EC ranging between 3 and 10%.

**Results and discussion**

In the original 1983 model the silages contained 92% of the grass EC (Table 1).

<table>
<thead>
<tr>
<th>year</th>
<th>energy concentration 1</th>
<th>silage/grass, %</th>
<th>silage/prediction, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>grass</td>
<td>prediction</td>
<td>silage</td>
</tr>
<tr>
<td>1983</td>
<td>513</td>
<td>484</td>
<td>475</td>
</tr>
<tr>
<td>2002</td>
<td>6.3</td>
<td>6.0</td>
<td>6.1</td>
</tr>
<tr>
<td>2004</td>
<td>6.4</td>
<td>6.1</td>
<td>6.2</td>
</tr>
</tbody>
</table>

1 1983: EFr kg DM⁻¹, 2002 and 2004: MJ NEL kg DM⁻¹
2 Coefficient of Variation

With a coefficient of variation of 4.82%, the silage EC met the predicted EC on average by 98%. In the trials of 2002 and 2004, the silages had on average 96 and 97% of the EC of the grass respectively. The coefficient of variation was 2.22% in 2002 and 1.09% in 2004, while the difference between predicted and measured silage EC was 0.1 MJ NEL kg DM⁻¹.
Conclusions

From a practical point of view, the model successfully predicted EC of the grass silages. The important information of energy content of the silage was available early enough for planning the feeding period. Different silos, with different grass silage energy contents, could be opened and fed to the herds according to the animal requirements.

The places of origin for the different grass materials were available for the model. When the mineral content, i.e. P and K, of the samples are also available as well as the sward species composition, then the farmer has all the essential information for an effective sward management, such as fertilization, herbicide use or grass and legume reseeding (not reported).

References