Challenge and problems of forage conservation in mountainous regions of Austria

Pötsch E.M.[1], Resch R.[1], Wiedner G.[2] and Buchgraber K.[1]
[1] *Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein, 8952 Irdning, Austria*
[2] *Feed stuff Laboratory Rosenau, 3252 Petzenkirchen, Austria*
Corresponding author: erich.poetsch@raumberg-gumpenstein.at

Abstract

A comprehensive silage monitoring project has been carried out in the years 2003, 2005, 2007 and 2009 in Austria. More than 3,670 grass silage samples from different Austrian sites were collected and analysed for dry matter content, nutrients, minerals, energy concentration and fermentation quality. Important management data were recorded by means of questionnaires and interviews. Apart from unfavourable natural weather conditions in mountainous areas the main reasons for unsatisfactory silage quality are obvious in management mistakes. Late harvest times resulting in high content of crude fibre, low concentration of easy fermentable sugar and difficulties with the compaction of such bulky material are still the main problems in practice. Forage contamination causing an increased risk of clostridia, respectively butyric acid in the fermentation process, is another serious problem that has to be faced. The results show that there is a considerable potential in Austria to improve silage quality in practice. Strong efforts have to be undertaken therefore to advise farmers specifically how to improve the ensiling procedure and to increase silage quality.

Keywords: forage conservation, silage quality, forage contamination, clostridia, butyric acid

Introduction

Grassland covers up to 95% of agriculturally used areas in mountainous regions of Austria. In these disadvantaged areas grassland and dairy farming represent the main source of agricultural production, which is characterised by harsh conditions of climate, topography and infrastructure. Due to the short vegetation and grazing period, forage has to be conserved in sufficient amounts for indoor feeding periods which last up to 7 months. Since forage conservation results in high costs, it is of great economic interest to obtain high quality of hay, aftermath hay and silage, which account for nearly 40% of the total grassland yield in Austria. Beside numerous experiments on silage quality covering a wide range of different aspects, a silage monitoring project was initiated by AREC Raumberg-Gumpenstein to i) record the status quo of silage quality in practice, ii) point out the possible reasons for fermentation problems and iii) offer specific advice to improve silage quality.

Materials and methods

The Austrian silage monitoring project started first in 2003 and was repeated in the years 2005, 2007 and 2009 in cooperation with the regional agricultural chambers. Seven of the nine Federal provinces of Austria participated in this project with 3,670 silage samples in total. In addition to the silage sampling a comprehensive collection of management data (e.g. farming system, grassland type, harvesting time, silage and mowing system, chopping length, charging procedure, use of silage additives) was done by means of questionnaires. Silage samples were analysed for dry matter content, crude nutrients, minerals and fermentation quality according standardized methods, whereas energy concentration was estimated by equations. Statistical

data analyses were done by using Statgraphics-Plus (Version XV.1) for General Linear Model - procedures respectively PASW Statistics (Version 17.0) for descriptive analysis.

Results and discussion

Data analyses showed a high proportion of well pre-wilted silages with an average content of 374 g DM kg^{-1} FM. Nearly 60% of the samples met the given target range of 300 to 400 g DM kg^{-1} FM, 13% were below it. The three prior-determining factors of the multivariate analyses for the DM-content were weather conditions at harvest, year and growth (Table 1). The average content of 262 g crude fibre and 148 g crude protein kg DM^{-1} indicate that most of the forage was harvested early enough at the time of ear and panicle emergence of the main grasses. But there is still a remarkable proportion of samples (38%) with a high content of crude fibre

Table 1. Impact of fixed effects and quantitative factors on nutrient content (CP = crude protein, CF = crude fibre), ash, energy concentration and fermentation properties of silages

parameter	**DM**	**CP**	**CF**	**ash**	**energy**	**pH-value**	**lactic acid**	**acetic acid**	**butyric acid**
unit	(g kg^{-1} FM)	(g kg^{-1} DM)			(MJ NEL kg^{-1} DM)		g kg^{-1} DM		
mean value	**374.3**	**148.3**	**262.2**	**103.6**	**5.96**	**4.5**	**43.8**	**11.6**	**10.9**
standard deviation	74.1	19.6	26.7	21.6	0.34	0.35	24.4	7.1	9.6
R^2 in %	16.8	37.4	39.1	19.3	85.9	23.1	14.3	14.6	38.5
fixed effects	significant if p-value < 0,05								
farming system	0.227	0.000	0.000	0.000	0.327	0.070	0.013	0.012	0.019
year	0.000	0.000	0.000	0.000	0.099	0.000	0.000	0.000	0.033
growth	0.000	0.000	0.000	0.000	0.000	0.001	0.168	0.101	0.000
grassland type	0.006	0.000	0.000	0.000	0.000	0.006	0.001	0.000	0.001
mowing system	0.014	0.000	0.000	0.000					
cutting height			0.339	0.000	0.003	0.094	0.007	0.912	0.043
tedding frequency	0.028	0.159	0.025	0.008					
cutting time	0.000					0.369	0.596	0.043	0.044
weather conditions	0.000	0.248	0.004	0.137	0.819				
silo system		0.345	0.014	0.891	0.778	0.000	0.000	0.269	0.000
harvesting technique	0.000			0.068					
chopping length	0.535		0.732	0.645	0.246	0.001	0.046	0.000	0.000
compaction level					0.036	0.006	0.004	0.532	0.027
silage additives					0.329	0.000	0.004	0.000	0.000
sample packaging						0.000	0.410	0.634	0.024
quantitative factors	significant if p-value < 0,05								
dry matter		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
crude protein			0.000		0.000				
crude fibre	0.543	0.000		0.000	0.000	0.000	0.000	0.165	0.000
crude ash		0.000	0.000		0.000	0.000	0.000	0.516	0.000
prior-determining factors									

that causes serious problems in the fermentation process and leads to lower digestibility and energy concentration in forage (Pötsch *et al*., 2010).

There was a significant impact of the cutting height on the content of ash in silages, which on average was at 104 g kg DM^{-1} with a standard deviation of 22 g. The results show that the ash content in practice is still too high and some farmers seem not to be aware of mistakes in management. Two-thirds of the silage samples had an energy concentration between 5.6 and 6.3 MJ NEL kg DM^{-1}. Nearly 70% fulfilled the requirements of > 5.8 MJ NEL kg DM^{-1} which can be seen as a good basis for sufficient milk or fattening performance from forage. Energy

concentration was mainly determined by crude fibre and ash content but also by the number of growth, where the first growth reached more than 6.0 MJ NEL kg DM^{-1} on average.
The overall average pH-value of 4.5 corresponded well with the critical pH-value for silages pre-wilted between 30-40% DM (Weissbach, 2002). Beside the package system of the samples the content of crude fibre (= vegetation stage) and ash (= contamination) were the strongest significant factors that influenced the pH-value. Whereas the content of dry matter had an unexpected slight impact on the pH-value of the silages, the time between baling and wrapping showed a significant and strong influence. Two-thirds of all samples met the recommended range of the concentration of lactic acid and acetic acid which were strongly determined by the pre-wilting level and by the year of investigation (Resch, 2010). A significant effect of silage additives could be found for the concentration of fermentation acids. Silages conserved with bacteria products had a higher content of lactic acid (+6.2 g kg DM^{-1}) and lower concentration of butyric acid. Only 25% of all samples were below the given limit of 3 g kg DM^{-1} of butyric acid, which was strongly determined by the pre-wilting level as well as by crude fibre and ash content.

35% of all analysed forage samples were harvested well-timed (< 270 g crude fibre kg DM^{-1}) and pre-wilted between the recommended range of 300-400g DM (represented by the intersection area in Figure 1). Adding the criteria of forage contamination (ash content >100g kg DM^{-1}) as an important issue, the percentage of optimal grass silages is reduced to 14%! Probably the used classification system is too strict but we must not forget that the silage samples of this project are representing the premium third. No farmer would provide silages of bad quality for a monitoring project which is at the same time a silage competition.

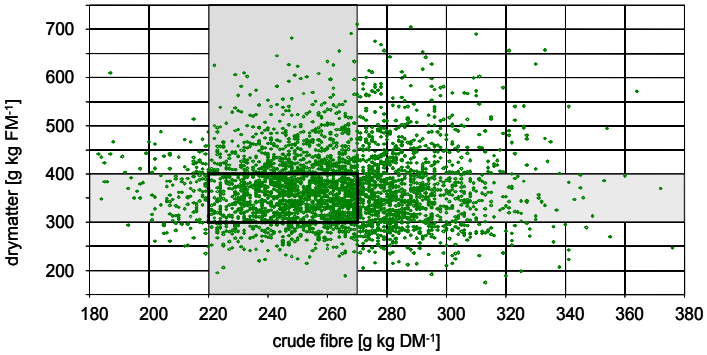

Figure 1. Distribution of grass silages concerning pre-wilting level and crude fibre content expressing stage of vegetation (data of the Austrian silage monitoring project, 2003-2009)

Conclusions

The results of the Austrian silage monitoring project clearly indicate a high potential of improvement concerning forage and silage quality in practice. Many of the analysed silages showed a disappointing high content of crude ash and concentration of butyric acid - so farmers have to be specifically advised to avoid management mistakes in forage conservation.

References

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