Silage qualities in the mountain area – a field survey

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Abstract

In mountain areas of Switzerland, economically and environmentally sound dairy production strongly depends on conserved forages of high quality. Due to the lower proportion of high quality grasses and the greater proportion of forbs in mountain grasslands, the ensilability of the forage may be affected. To investigate the silage quality on dairy farms in mountain areas, 31 samples of ensiled forage were collected and analysed for nutrient content and fermentation parameters. On average, the silages had a dry matter (DM) content of 389 g kg^{-1} and contained per kg DM 94 g ash, 130 g crude protein, 303 g acid detergent fibre (ADF), 456 g neutral detergent fibre (NDF) and 5.5 MJ net energy lactation (NEL). They had an average pH of 4.8 with 45 g lactic acid, 9 g acetic acid and also 9 g butyric acid per kg DM. Quality differences of the silages between individual farms were high. The main reasons for reduced quality were the low pre-wilting degree and the high ash content in some samples, as well as a high fibre and a low NEL-content of the forage at ensiling due to progressing sward maturity. The findings indicate the need for an improved farm advisory service.

Keywords: silage, fermentation quality, nutrient contents, mountain areas

Introduction

Because of the shorter vegetation growing period, dairy farming in the mountain area depends much more on conserved forages. To ensure an economically and environmentally sound milk production primarily based on roughage, high quality silage with a well-balanced nutrient content is essential. However, silage production in mountain area is difficult. The lower proportion of high quality grasses, the higher proportion of forbs and the often unstable weather conditions render the production of high quality silage more difficult. Furthermore, difficult terrain conditions may be a source of contamination with soil. The aim of the present study was to survey the silage quality on dairy farms in mountain areas and to identify the main factors which influence the quality.

Materials and methods

The study was carried out on 31 commercial dairy farms in the region Ybrig-Einsiedeln in Switzerland, located between 900 and 1,220 m a.s.l. The silages were produced during summer 2014. Between March and April 2015, samples were taken and nutrient contents and different fermentation parameters were analysed. Seventeen samples were from the first cut and 14 samples from the second and third cut, respectively. The samples were collected from silage stored in bales (15 samples), tower silos (14 samples) or bunker silos (two samples). Only for seven silages had additives been used. Additional data on the silage production practices of the farms was collected with a questionnaire. The quality of the silages was judged together with the farmers using an official Swiss scoring system (Agridea, 2009).

Results and discussion

On average, the silages had a dry matter (DM) content of 389 g kg^{-1}. The variation between the farms was high (Table 1). On average, the silages contained 94 g kg^{-1} DM ash. Four of the samples exceeded the critical value of 110 g kg^{-1} DM. Due to the lower mineral content of the plant material during the

Table 1. Nutrient contents and fermentation parameters of silages from farms in the mountain area.[1]

		All samples				First cut	Second and third cut
		Mean	Standard deviation	Min	Max	Mean	Mean
Number of samples		31				17	14
DM content	g kg^{-1}	389	112	214	641	401	374
Ash	g kg^{-1} DM	94	13	77	138	90	100
Crude protein	g kg^{-1} DM	130	18	99	175	126	134
ADF	g kg^{-1} DM	303	39	247	406	315	289
NDF	g kg^{-1} DM	456	56	377	589	473	435
Sugar	g kg^{-1} DM	80	44	13	171	82	77
NEL	MJ kg^{-1} DM	5.5	0.4	4.3	6.1	5.4	5.6
pH		4.8	0.4	4.1	5.6	4.8	4.8
Lactic acid	g kg^{-1} DM	45	32	3	119	44	47
Acetic acid	g kg^{-1} DM	9	7	1	25	9	9
Butyric acid	g kg^{-1} DM	9	10	0	33	8	11
Ethanol	g kg^{-1} DM	6	3	0	13	6	5
NH_3-N/N total	%	6.1	2.1	2.5	12.3	5.9	6.5
DLG points		70	27	18	100	72	67

[1] ADF = acid detergent fibre; NDF = neutral detergent fibre; NEL = Net Energy Lactation; NH_3-N/N total = ammonia-N proportion.

generative growth cycle, silages prepared from the first cut contained generally lower ash contents (Daccord *et al.*, 2001).

The fibre, crude protein and sugar contents of the silages varied considerably among farms. Samples of the first cut showed higher fibre and lower crude protein contents compared to the second and third cuts. This observation corresponds to the remarks of the farmers in the survey, where many of them stated that the forage of the first cut was ensiled at a rather late maturity stages towards the end of heading and flowering. Consequently, the calculated average NEL content (Net Energy Lactation) of the silages of 5.5 MJ kg^{-1} DM was rather low and varied considerably from 4.3 to 6.1 MJ kg^{-1} DM among farms. Results from the official silage quality analysis 'Raufutterenquête 2014' from all over Switzerland indicated slightly higher average values of 5.7 MJ kg^{-1} DM (Guldimann and Bracher, 2015). The higher NEL content of the silages from the 'Raufutterenquête' may be explained by the fact, that these data predominantly contain samples from the lowlands.

Silages from bales had higher DM contents (430 g kg^{-1}) than silages from tower silos (360 g kg^{-1}). Samples from farms below 1000 m a.s.l. showed higher average DM contents (420 g kg^{-1}) compared to silages from farms above 1000 m a.s.l. (350 g kg^{-1}). However, nutrient and NEL contents were very similar.

The pH ranged between 4.1 and 5.6 (Table 1). In 21 samples, the target pH in relation to the DM content for high quality silage (Nussbaum, 2001) was not reached, most likely due to the low lactic acid production. On average, the silages contained 45 g lactic acid, 9 g acetic acid and 9 g butyric acid per kg DM. A positive correlation between the ash and the butyric acid content was found (r=0.48). This may indicate the importance of contamination with soil.

Classification of the silage quality with the DLG scoring scheme (DLG, 2006) ranged from 18 to 100 points. Out of the 31 analysed samples, 18 samples were classified as good and very good. Six samples had

to be classified as defective and seven as bad and very bad. According to the information from the survey, avoiding soil contamination at ensiling was a major challenge. Not only the soil contamination, but also the pre-wiling degree influenced the fermentation quality. Butyric acid was mainly found in silages with low DM contents. A correlation between the DM and butyric acid content was found (r=0.54). A great discrepancy was found between the ranking obtained by the farmers using the official Swiss scoring system and the DLG scoring (Figure 1). None of the farmers classified his own silage as bad or very bad. However, even very good silages were not classified as such by the farmers.

Conclusions

The investigation showed that the quality and the nutrient contents of the silages from mountain areas varied strongly between farms. Harvesting at the optimum maturity stage, avoiding soil contamination and an optimal pre-wiling are the decisive factors for good quality and high nutrient contents. Silage quality can easily be checked with different scoring systems. However, to obtain reliable results experience and practice are needed. The findings indicate the need for an improved farm advisory service.

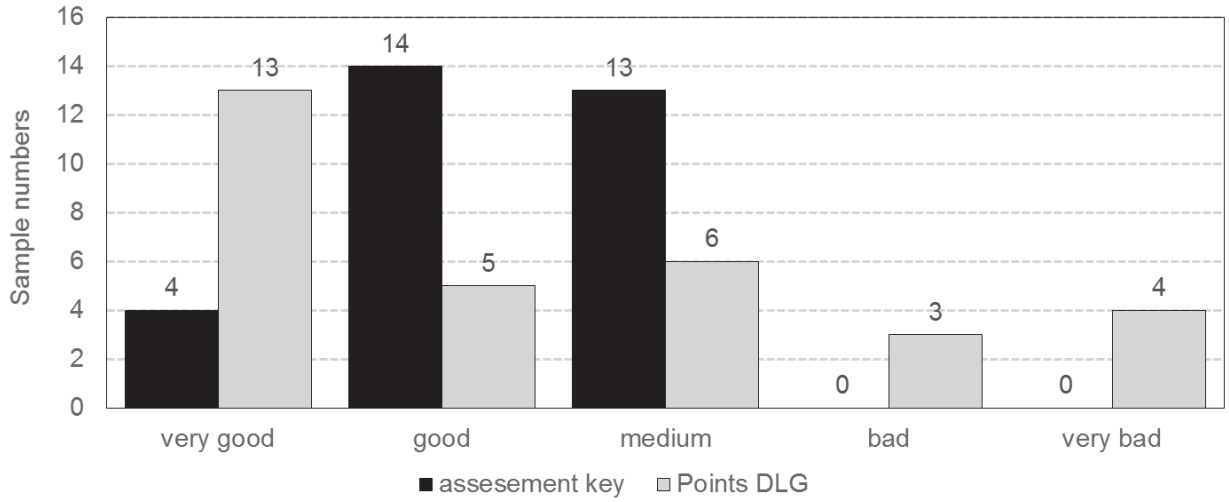

Figure 1. Comparison of the silage quality judged by the farmers with the official Swiss scoring system of Agridea (Agridea, 2009) and the DLG scoring (DLG, 2002).

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