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Organising Committee:
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Rolf Spörndly
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Ensiling of common reed

B.O. Rustas, R. Spörndly, R. Nylund & A. Kiessling
Swedish University of Agricultural Sciences (SLU), Department of Animal Nutrition & Management, Box 7024, 750 07 Uppsala, Sweden.
Correspondence: bengt-ove.rustas@slu.se

Introduction

In Sweden, common reed (*Phragmites australis*) is the dominant vegetation in bays and other sheltered areas. Reed is an important species in aquatic ecosystems but expansion of reed, caused by eutrophication and decreased grazing, may result in too dense and homogeneous reed belts which reduces biodiversity and aquatic ecosystem quality (Pitkänen et al., 2013). Harvesting of reed can be a way of restoring aquatic ecosystems. It also removes nutrients from aquatic environments for recirculation to crop production systems.

Reed is expected to have relatively low digestibility and moderately crude protein content (Spörndly, 2003). It can therefore be a suitable feed for ruminants and horses with low energy demand. Ensiling of reed may be impaired by low content of water-soluble carbohydrates (WSC) and low concentrations of lactic acid bacteria (LAB) on the crop (Asano *et al*., 2018). The aim of this research was to evaluate the effect of additives on ensiling of common reed.

Materials and Methods

Reed was sampled at three sites in June and August 2019. In June, sampling was made on land adjecent to Lake Mälaren, a large fresh water lake close to Uppsala (N 59°48´; E 17°36´) (Sample 1). In august, samples were collected on land at a ditch near Lake Mälaren (Sample 2) and in the water at Gräsö, an island in the Baltic sea with brackish water at the coast of Uppsala county (Sample 3). Sample 3 was cut above the water surface.

Shortly after collection, samples were frozen and, later, after thawing, analysed for content of ash, water soluble carbohudrates (WSC), crude protein (CP), neutral detergent fibre (NDF) and 96-h in vitro organic matter digestibility (IVOMD) and microbial content with routine methods (Table 1). Thawed samples were chopped and 1500-1700 g were ensiled in duplicates in air-tight laboratory scale silos with 1.7-L capacity fitted with waterlocks. The following five treatments were applied: A. no additive (Control), B. 5 g/kg fresh weight (FW) of Promyr (ProMyr NT 570, Perstorp AB, Malmö, Sweden, containing formic acid 35-40%, sodium formate 10-20%, propionic acid 15-25%), C. 50 g/kg FW of molasses, D. 2.1×10^5 cfu/g FW of LAB (Xtrasil bio ultra, Konsil Scandinavia AB, Tvååker, Sweden, containing Lactobacillus Plantarum, Lactobacillus Paracasei, Lactobacillus Brevis) and E. LAB and molasses (LAB+M) at same inclusion rates as treatment 3 and 4. All treatments were supplemented with 36 g water.

Silos were opened after 80 days of storage in room temperature silages analysed for pH, NH_4, volatile fatty acids (VFA) and microbial content with routine methods described by Eriksson and Rustas (2014). Aerobic stability was determined by monitoring the increase of silage temperature during 18 days of aerobic exposure at 20°C ambient temperature. Weight loss was determined when silos were opened.

Data from the ensiling experiment was averaged over silo duplicates and analysed in GLM (Minitab 18.1, 2017) including treatment and crop as fixed factors.

Table 1 Chemical composition and microbial content of reed

	Sample 1	Sample 2	Sample 3
Harvest environment	On land	On land	In water
Harvest time	June	August	August
Dry matter, g/kg fresh weight (FW)	308	420	402
Ash, g/kg DM	84	102	61
WSC, g/kg DM	64	74	54
CP, g/kg DM	166	127	71
NDF, g/kg DM	616	598	693
IVOMD, g/kg OM	637	593	537
LAB, log CFU/g FW	2.0	4.3	3.4
Enterobacter, log CFU/g FW	<1.7	5.8	5.5
Moulds, log CFU/g FW	2.6	3.6	3.7

WSC=water souluble carbohydrates, CP=crude protein, NDF=neutral detergent fibre, IVOMD= in vitro organic matter digestibility, LAB=lactic acid becteria.

Results and Discussion

Content of water soluble carbohydrates (WSC) was below (Sample1), close (Sample 2) and slightly above (Sample 3) the suggested lower level of 2 % of fresh weight (FW) that should be needed to avoid poor quality silage (Gordon *et al*., 1964). Likewise, content of LAB did not reach up to to the minum level (≥5 log CFU/g FW) that is required to produce good quality silage, according to McDonald *et al*. (1991). As the samples in this study were frozen before microbial analyses the results might not be relevant to fresh crop.

pH tended (P<0.1) to be affected by treatment with Control treatment being higher than the threshold of 4.2, under which activity of unwanted bacteria and fungi is limited (McDonald *et al*., 1973) (Table 2). Lactic acid concentration was higher (P<0.05) for LAB and LAB+M than for Promyr, reflecting restricted fermentation with acid treatment. Acetic acid concentration was greater (P<0.05) in Control, molasses, LAB+M treatments compared to the Promyr treatment. Aerobic stability, days until silage temperature increased ≥3°C, tended to be affected by treatment with LAB and LAB+M being stable for longest time.

Molasses was used as an additive because of low WSC content in the crops. Asano *et al*. (2018) used glucose for the same reason but, unlike our results, the glucose additive did not results in good silage quality. Similarly, LAB, as the only additive, was not sufficient in the study buy Asano et al. (2018) to support a good ensiling process, contrary to our results. One reason why all additives promoting fermentation in this study resulted in acceptable silage quality could be related to the relatively high DM content. Another reason could be the composition of LAB on the crop. Asano et al. (2018) conlcluded that not only the amount of LAB is important for for the ensiling process, they should also be of the right species. As little information exist on what number and species of LAB that inhabit common reed, future investigations are encouraged to include those analyses.

Conclusions

Results from this this study indicate that ensiling of reed can result in acceptable silage quality, even without the use of additives. Ensiling additives may improve silage quality.

Table 2 Chemical characteristics and microbial content of reed silage produced with different additives

	Control	Promyr	Molasses	LAB	LAB+M	SED	*P*-value
pH	4.5	4.4	4.1	3.9	3.8	0.26	0.097
NH_4, g/kg DM	2.3	0.7	1.2	1.5	0.8	0.61	0.17
Lactic acid, g/kg DM	18.4	9.1	34.9	40.4	45.8	8.25	0.01
Acetic acid, g/kg DM	9.3	2.6	10.8	7.5	10.2	1.43	0.003
Butyric acid, g/kg DM	2.2	0.2	0.2	0.2	0.2	1.24	0.46
Ethanol, g/kg DM	7.8	3.8	6.8	6.2	5.8	2.75	0.68
Yeast, log CFU/g FW	2.5	1.3	2.7	0.9	2.6	0.78	0.13
Moulds, log CFU/g FW	1.0	1.0	0.9	1.2	0.9	0.27	0.71
Aerobic stability, days until + 3°C	6.8	7.9	7.9	10.0	10.1	1.17	0.086
Weight loss, g/kg DM	28.9	11.1	18.8	16.2	14.5	7.83	0.29

LAB= lactic acid bacteria, M= molasses.

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