

QUALITY AND NUTRITIONAL VALUE OF SILAGE MADE OF MEADOW GRASS MOWED WITH AND WITHOUT CONDITIONERS

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Abstract. The research was carried out in 2011-2013 in a farm producing meadow grass silage in the form of cylindrical bales. The objective of the research was to determine the quality and value of the nutritional values of silage depending on drying ensiled meadow grass influenced by the use of a tine-type conditioner and a roller mill. Three variants of mowing were assumed: without conditioner, with a tine-type conditioner and with a roller mill. A basic chemical composition was marked in silage with a standard method and the content of organic acids with the use of gas chromatograph. Nutritional value of silage was assessed in Flieg-Zimmer scale. It was found out that mowing green forage with the use of a conditioner favourably influences the quality of silage. Silage obtained from green forage, which was mowed with the use of a tine-type conditioner had the highest content of dry mass ($415.7 \text{ g}\cdot\text{kg}^{-1}$), a slightly lower content of dry mass was reported upon the use of a roller mill ($365.6 \text{ g}\cdot\text{kg}^{-1}$), and the lowest for green forage silage mowed without a conditioner ($274.2 \text{ g}\cdot\text{kg}^{-1}$). Appropriate degree of drying was an essential element influencing the course of the ensilaging process and the silage quality.

Key words: silage, conditioner, mill, quality, nutritional value

Introduction

In farms, which keep dairy cows, ensilaging in the form of big cylindrical bales wrapped up with stretch foil has been in recent years a very popular method of preserving green forage of meadow grass (Gach and Korpysz, 2011; Nowak, 1997; Radkowski and Kuboń, 2006a). The quality of prepared silage depends on many factors, inter alia: botanical composition of meadow grass, initial drying, compression of formed bales and airtightness of packaging. Content of dry mass in the preserved fodder is one of the most important factors which affect the quality and nutritional value of silage in the initial process of preparation (Nowak, 2000; Nowak and Šařec, 2001, Radkowski and Kuboń, 2006b; Rad-

kowski and Kuboń, 2007). Therefore, ensilaging dry green forage is a dominating technique of preparing silage (Wróbel, 2012). Fast drying of plants is not always possible due to weather. In order to speed up this process, mechanical treatments are applied, which in the professional literature are called conditioners (Gach and Pintara, 2000). The use of conditioners partially or fully eliminates tedding treatments which allows limitation of the loss of nutrients formed as a result of the effect of working elements of the applied machines. Obtaining faster drying results not only from loosening of the plant mass of windrow but, mainly from damage of the external (wax) layer of plants. Numerous scientific research show that the fermentation process during ensilaging is worse if the ensiled material is moist (Gudmundsson, 2001; Dawson et al., 1999). Ensilaging of too moist material, which does not exceed $200 \text{ g}\cdot\text{kg}^{-1}$ of dry mass, results in the effluent of ensilage juice along with valuable nutrients. Too moist green forage ferments too strong and the obtained silage are too acid. Then, the increased content of dry mass as a result of longer drying as a rule results in the increase pH of silage, decrease of total acids content at favourable relation of the amount of lactic acid to the remaining acids and decrease of fermentation losses (Han et al., 2006; Mikołajczak, 1997). Moreover, difficulties with compression of too dry raw material occur. Optimal content of dry mass, which should occur in the green forage of meadow grass designated for ensilaging is 35-40%. In production conditions, 1 day at sunny weather, or 2 days should be designated to obtain such value (Jankowska-Huflejt et al., 1996). The objective of the presented research was to assess the impact of the tine-type conditioner and a roller mill during mowing of meadow grass on the quality and the nutritious value of the obtained silage.

Material and methods

The research was carried out in 2011-2013 in production conditions in a farm specializing in milk production, located on the territory of Śląskie voivodeship. Tests were carried out on silage prepared from the first windrow. Meadow grass of the following botanic composition constituted raw material for ensilaging: high grass 55%, low grass 20%, papilionaceous 15% and herbs 10%. Meadow fescue (*Festuca pratensis* Huds.), timothy grass (*Phleum pratense* L.), perennial rye grass (*Lolium perenne* L.), meadowgrass (*Poa pratensis* L.) and cocksfoot (*Dactylis glomerata* L.) prevailed among grasses. Among papilionaceous: red clover (*Trifolium pratense* L.) and white clover (*Trifolium repens* L.). Among herbs: ribwort (*Plantago lanceolata* L.), dandelion (*Taraxacum officinale* F. H. Wigg.) and yarrow (*Achillea millefolium* L.). Plants were mowed in the phase of initial heading. Mowing of meadow grass was performed with a disc mower KT 301 Samasz in three variants:

- variant 1 – without a conditioner,
- variant 2 – with a mounted tine-type conditioner,
- variant 3 – with a mounted roller mill.

Surface area of each object was $2,000 \text{ m}^2$. Plant material from all variants, after 7 hours of drying was raked with a swath rake belt turner Z-226 in rolls half an hour before harvesting and then collected with a rolling press CLAAS ROLLANT 44S. Weather conditions during drying were favourable, it was sunny and windy. Bales were transported to the

storing place, were they were wrapped up with the use of a wrapping device PRONAR Z-235. Average time from forming a bale to its complete securing with foil did not exceed 4 hours. Bales were wrapped with four layers of stretch foil (polyethylene) 0.025-0.030 mm thick and 500 mm wide. The wrapped up bales were transported with the use of a gripper mounted on the front loader to the place of storing.

After 6 weeks before feeding on silage, samples were collected for chemical analysis (4 from 4 variants), where the content of basic components was determined with Vienna method, pH on the pH-meter, and the ammonium level with Conway method. The content of organic acids was determined with the use of a gas chromatograph Varian 3400. Nutritional value was valued in the units of INRA system with the use of Winwar system, version 1.6. by DJG company. Tabular coefficients of fodder decomposition in a rumen and bowels were used for valuation of silage. The obtained results were subject to the analysis of variance and the significance of differences was assessed with Duncan test at $\alpha=0.05$. Presentation of results was limited to stating mean values from the researched years.

Results and a discussion

Data concerning the chemical composition of the obtained silage and their quality was presented in table 1. The research results indicate that in variants where a tine-type conditioner and a roller mill were used during mowing, silage had higher content of dry mass.

Silage obtained from green forage subjected to initial mechanical treatment was characterised with a significantly higher content of total protein, raw fat and water-soluble sugars in comparison to silage of plants mowed with a mower without conditioner. When analysing N-NH₃ in the total nitrogen, its considerable amount in silage made of plants mowed without conditioner of windrow was reported. It shows that during ensilaging plants of considerable water content (variant 1) a considerable decomposition of protein takes place. Amount of this fraction of nitrogen was 12.6% of total nitrogen. This number exceeded the level recognized as correct, which in good quality silage should not exceed 10% (Podkówka and Potkański, 1993). The content of organic acids is a significant index which decides on the quality of silage and their usefulness in feeding animals. Lactic acid content, the most desirable in silage, was the highest in fodder obtained from green forage subjected to mechanical treatment with a tine-type conditioner (variant 2). Butyric acid, which lowered the final assessment of fodder, occurred in slight amounts only silage from variant 1 of the experiment, here additional mechanical treatments were not used (conditioning). Despite that, silage obtained a good assessment according to Flieg-Zimmer scale. Drying green forage results in the increase of the water-soluble sugars and osmotic pressure increases in cells, which limits development of butyric acid bacteria (Wróbel et al. 2000). In order to increase chemical and nutritious quality of silage of meadow grass, the use of conditioner of windrows is purposeful. Positive impact of conditioners of windrows during drying was proved in numerous papers (Gach and Pintara, 2000; Wróbel, 2012). The results obtained during research presented in this paper prove that the use of a conditioner (variant 2 and 3) ensured a correct course of fermentation and guaranteed a very good quality of silage. Moreover, the increase in the energy and protein value in these variants was reported. When comparing variants of both conditioners, the use of roller mill during mowing meadow grass ensured a higher nutritional value of silage. The use of a conditioner during mowing can be justified in two ways. The content of dry mass and

water-soluble carbohydrates increases in short time. Brzóska et al. (1998) carried out research, which show that the degree of drying green forage before ensilaging is a factor that significantly decreases the degree of proteolysis of proteins in silage. Higher level of dry mass in the fermented green forage limits development of proteolytic bacteria and deaminating fractions of soluble nitrogen. Concluding, one may state that the use of a conditioner in order to speed up drying, considerably improves chemical composition and the quality of silage. Such silage may enrich the base of volumetric fodders for ruminants for the period of winter feeding.

Table 1.
Chemical composition and indexes and the quality of silage of meadow grass of the 1st windrow

Specification	Mower		
	No conditioner (variant 1)	Tine-type conditioner (variant 2)	Roller mill (variant 3)
Dry mass (g·kg ⁻¹)	274.2a	415.7c	365.6b
pH	4.44	4.36	4.31
Total protein (g·kg ⁻¹ dry mass)	134.5a	164.5b	182.1b
Raw fat (g·kg ⁻¹ dry mass)	26.2a	27.1ab	36.7b
Water-soluble sugars (g·kg ⁻¹ dry mass)	23.5a	37.5b	57.1b
Raw ash (g·kg ⁻¹ dry mass)	88.1a	75.6a	106.8b
Raw fibre (g·kg ⁻¹ dry mass)	300.2b	259.1a	243.9a
ADF(g·kg ⁻¹ dry mass)	340.7b	274.1a	257.1a
NDF (g·kg ⁻¹ dry mass)	557.0b	475.3a	403.4a
Lignin (g·kg ⁻¹ dry mass)	82.1b	81.7b	57.6a
Lactic acid (g·kg ⁻¹ dry mass)	64.7a	106.3b	101.5b
Acetic acid (g·kg ⁻¹ dry mass)	13.7a	30.8b	21.6b
Butyric acid (g·kg ⁻¹ dry mass)	2.7	0.0	0.0
Content of N-NH ₃ (% N total)	12.6b	7.5a	6.0a
Assessment of silage:			
– points	68.0	96.0	98.0
– quality	good	very good	very good
UFL (kg ⁻¹ dry mass)	0.50	0.56	0.77
UFV (kg ⁻¹ dry mass)	0.48	0.45	0.68
PDIE (g·kg ⁻¹ dry mass)	83	98	106
PDIN (g·kg ⁻¹ dry mass)	56	64	76

Conclusions

1. Silage made of plants, for mowing of which, mowers equipped with windrow conditioners were used, were characterised with good quality (pH within 4.31 to 4.26 and no butyric acid). This silage also contained more desirable organic components.

2. In order to obtain silage which meets determined nutritious requirements for highly-production animals, the use of a tine-type conditioner or a roller mill is justifiable during mowing of plants.
3. Mowers equipped with conditioners, which affect the increase of the speed of drying green forage and limit the losses of nutritional elements should be used in a wider scope for production of silage.

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JAKOŚĆ I WARTOŚĆ POKARMOWA KISZONEK Z RUNI ŁĄKOWEJ KOSZONEJ Z UŻYCIEM I BEZ KONDYCJONERÓW

Streszczenie. Badania prowadzono w latach 2011-2013 w gospodarstwie produkującym kiszonkę z runi łąkowej w postaci bel cylindrycznych. Celem badań było określenie jakości i wartości pokarmowej kiszonek w zależności od podsuszenia zakiszanej runi łąkowej pod wpływem zastosowania spulchniacza palcowego i zgniatacza walcowego. W badaniach założono trzy warianty koszenia: bez kondycjonera, ze spulchniaczem palcowym i ze zgniataczem walcowym. W kiszonkach oznaczono podstawowy skład chemiczny metodą standardową, a zawartość kwasów organicznych za pomocą chromatografu gazowego. Wartość pokarmową kiszonek oceniono w skali Fliega-Zimmera. Stwierdzono, że koszenie zielonki z użyciem kondycjonera korzystnie wpływa na jakość kiszonek. Kiszonki uzyskane z zielonki, którą skoszono z użyciem spulchniacza palcowego, miały największą zawartość suchej masy (415,7 g·kg⁻¹), nieco mniejszą zawartość suchej masy odnotowano po zastosowaniu zgniatacza walcowego (365,6 g·kg⁻¹), a najmniejszą ilość miały kiszonki z zielonki koszonej bez kondycjonera (274,2 g·kg⁻¹). Odpowiedni stopień podsuszenia był istotnym elementem wpływającym na przebieg procesu zakiszania oraz jakość kiszonki.

Słowa kluczowe: kiszonka, spulchniacz, zgniatacz, jakość, wartość pokarmowa.

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