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ESTIMATION OF THE NUTRITIONAL VALUE OF HAY FROM SELECTED INDIVIDUAL FARMS IN THE REGION OF KRAKOW-CZESTOCHOWA JURA PART I. THE CONTENT OF ORGANIC COMPOUNDS AND NUTRITIONAL VALUE

OCENA JAKOŚCI I WARTOŚCI POKARMOWEJ SIANA Z WYBRANYCH GOSPODARSTW INDYWIDUALNYCH NA TERENIE JURY KRAKOWSKO-CZĘSTOCHOWSKIEJ CZ. I. ZAWARTOŚĆ SKŁADNIKÓW ORGANICZNYCH I WARTOŚĆ POKARMOWA

Abstract: This paper presents an estimation of the chemical composition and forage value of the hay derived from the 12 selected, individual farms specialized in milk production from the region of the Krakow--Czestochowa Jura. The content of the organic compounds was very variable, which can be the result of diversified allotments of grasses and dicotyledonous plants in analyzed hay samples. Only 42 % of all examined hay trials contained optimal dry matter content ie above 820 g · kg^{-1}. When estimating nutritional value of the hay special attention must be paid to the crude protein and crude fiber content. The hay collected with 33 % of samples was characterized with protein content per dry matter below the level assumed as normative. 92 % of samples were characterized with crude fiber content above the optimal level. This fact can be the result of too late time of mowing, especially in the case of first mowing, as well as improper drying method. Among all analyzed components, the greatest diversification was noticed for raw fat content. The weighted mean of this component fluctuated in the range of 13.9–34.5 g · kg^{-1} d.m. The forage characteristics as regards energetic value were as follows: UFL – from 0.68 to 0.81 g · kg^{-1} d.m. and UFV – from 0.59 to 0.71 g · kg^{-1} d.m. The protein value was more diversified and ranged from 55.29 to 122.61 – PDIN and from 73.27 to 97.66 g · kg^{-1} d.m. – PDIE.

Keywords: meadow sward, the content of organic compounds, nutritional value

The preserved forages, including hay, constitute the basic food for cows during the winter period. The nutritional value of hay is in the highest degree affected by the

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floristic composition of the meadow sward, growth stage at which the plants are collected as well as drying and storage method [1–3]. The results of the investigations indicate that the losses resulted from inadequate drying can reach the value of 50 % [4]. Good quality hay provides many basic nutrients to animals as well as fiber essential for ruminants, which determines the proper function of digestive track [5]. Moreover, hay affects the fat content in milk, the higher the share of the bulky forages in the feeding dose, the higher fat concentration. The average daily hay dose for milk cows should amount to 3–4 kg, and the fiber contain should not exceed 25 %. Calves should be fed hay directly after birth because it accelerates the development of rumen and enhances the number of the rumination cycles [6]. The presence of bulky forages, including hay, in a feeding dose is essential, but they should be of the highest quality and feeding value.

Thus, the goal of the present study was to estimate the chemical composition and the forage value of the hay derived from the farms specialized in milk production located in the region of Krakow-Czestochowa Jura.

Materials and methods

The investigations were conducted in the years 2005–2007 under the production conditions in 12 farms specialized in milk production located in the region of Krakow--Czestochowa Jura. The experimental farms were located in the Pilica administrative district (Zawiercie county, Silesia province) 320 m above sea level. The grasslands were located on the brown, acid soils and podsolic soils classified from IVb to VI soil quantity class. The acidity expressed as pH_{KCl} ranged from 4.5 to 5.5 (acidic and very acidic reaction). The soils contained a medium level of assimilable forms of potassium and were poor in phosphorus and magnesium.

During the vegetation period (April–September) the total amounts of rainfall reached the value of 356.8 mm, 338.1 mm and 375.4 mm, respectively for the years 2005, 2006 and 2007. The respective mean temperatures were noticed for the following years: 14.8 ^{o}C, 15.2 ^{o}C and 14.3 ^{o}C.

The experimental hay was derived mostly from the first and second regrowth of grass flora and in a minor amount from the third regrowth. The material was collected at the turn of heading and flowering stages of grasses – the first regrowth and during the heading stage – the second and the third regrowths.

Before feeding the samples of hay were collected (4 from each farm) and subjected to chemical analysis, which comprised: the estimation of essential nutrients by the Weenden method [7]. The feeding value was estimated in the INRA system units using 1.6 Winwar software (DJG). The evaluation of hay was performed using the tabular coefficients of forage distribution in rumen and intestines.

The results in this paper were limited to the mean values for the following years. The obtained results were subjected to the analysis of variance and the significance of differences was estimated using the Duncan test at the significance level of $\alpha = 0.05$.

Table 1

The estimation of the hay feeding value [g · kg^{-1} d.m.]

Item	Examined farm											
	1	2	3	4	5	6	7	8	9	10	11	12
Dry matter	816.4b*	776.0a	808.4ab	833.9bc	768.2a	816.5b	872.2c	807.5ab	822.1bc	864.5c	776.5a	831.6bc
Organic mass	937.2b	907.0a	937.2b	933.1b	926.5ab	944.0bc	937.6b	934.9b	919.4ab	960.2d	956.3c	943.7bc
Crude protein	88.8a	145.7b	147.7b	104.9ab	177.4c	169.1c	174.8c	195.8d	196.9d	104.8ab	174.6c	112.0ab
Crude fiber	282.8ab	286.3ab	257.8a	269.1a	271.9a	309.5b	280.8ab	286.1ab	269.7a	305.6b	275.0a	339.2c
Raw fat	15.3a	24.4b	34.5c	24.0b	19.5ab	20.7ab	19.3ab	19.1ab	18.5ab	17.2a	27.3bc	13.9a
Nitrogen-free extract	550.2d	450.5ab	497.2bc	535.1c	457.6ab	444.7a	462.7ab	433.9a	434.3a	532.6c	479.5b	478.6b
UFL [kg^{-1} d.m.]	0.70a	0.68a	0.71a	0.69a	0.75b	0.81c	0.76b	0.76b	0.75b	0.70a	0.74a	0.69a
UVF [kg^{-1} d.m.]	0.62a	0.59a	0.62a	0.61 a	0.65b	0.71c	0.66b	0.66b	0.65b	0.62a	0.64a	0.60a
PDIN [g · kg^{-1} d.m.]	55.29a	90.74b	91.95b	65.33a	103.93bc	105.30bc	108.86bc	121.89c	122.61c	65.25a	108.72bc	69.70ab
PDIE [g · kg^{-1} d.m.]	73.27a	83.93b	85.18b	75.97a	87.37b	91.84c	92.93c	97.66c	97.09c	78.14ab	93.22c	79.15ab

* Means marked with the same letter are not statistically different following verification with the Duncan test (p = 0.05); UFL – *Feed Unit for Lactation* (1700 kcal EN), UVF – *Meat Production Unit* (1820 kcal EN), PDIE – *protein digested in the small intestine* supplied by rumen-undegraded dietary protein plus protein digested in the small intestine supplied by microbial protein *from rumen-fermented organic matter*, PDIN – protein digested in the small intestine supplied by rumen-undegraded dietary protein plus protein digested in the small intestine supplied by microbial protein *from rumen-degraded protein*.

Results and discussion

The dry matter content in the hay samples was diversified and fluctuated in the range of 768.2 to 872.2 g · kg^{-1} dry matter (Table 1). The data found in literature [7] suggest that hay should contain at least 820 g · kg^{-1} dry matter. Regarding this, it can be stated that only 42 % of the examined high samples met this requirement. When estimating the hay feeding value special attention needs to be paid on the crude protein and crude fiber content. Forage of good quality should contain 140–160 g protein · kg^{-1} d.m., and the optimal level of crude fiber is assumed to be 260 g · kg^{-1} d.m. [8, 9]. 33 % of hay samples were poorer in protein and the crude fiber content exceeded the optimal value in 92 % of the trials. Too high concentration of crude fiber is a worrisome fact, because it significantly decreases the hay feeding value. This phenomenon can be explained by simple negligence of too late time of harvesting, especially in the case of the first regrowth as well as by improper drying method [10]. Among all analyzed components the greatest diversification was found for raw fat content. The weighted mean of this component ranged from 13.9 to 34.5 g · kg^{-1} d.m. The level of nitrogen-free extract fluctuated in the range of 433.9 to 550.2 g · kg^{-1} d.m. The meadow hay of good quality contains on average 30.2 g of raw fat and 462.8 g · kg^{-1} d.m. of nitrogen-free extract [7]. The obtained results revealed that 8 % of the samples were characterized with the proper raw fat content and 58 % contained the required amount of nitrogen-free extract.

The energetic value of the plants collected from the investigated farms were as follows: expressed as Feed Unit for Lactation (UFL) – from 0.68 to 0.81 g · kg^{-1} d.m. and as Meet Production Unit (UFV) – from 0.59 to 0.71 g · kg^{-1} d.m. On the contrary, the study by Zurek et al [11] revealed that in the hay derived from the swamp flora the respective levels were lower and amounted to 0.62 and 0.52. In our investigations higher values for PDIE and PDIN were also observed, which resulted from a higher content of crude nitrogen.

Conclusions

1. Regarding 820 g · kg^{-1} d.m. as the optimal dry matter content it can be stated that only 42 % of hay samples met the feeding requirements. This fact indicates that the drying process was performed improperly in the examined farms.
2. High content of crude fiber in the examined hay indicates that farmers collect plants, especially from the first regrowth, too late.
3. According to the results of domestic investigations it can be stated that the concentration of nutrients in the examined hay samples was sufficient enough to cover the feeding requirements of animals.

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Abstrakt: Praca prezentuje ocenę składu chemicznego i wartości paszowej siana pochodzącego z 12 wybranych gospodarstw indywidualnych, specjalizujących się w produkcji mleka. Gospodarstwa położone są na terenie Jury Krakowsko-Częstochowskiej. Zawartość składników organicznych wykazywała dużą zmienność, co może wynikać ze zróżnicowanego udziału traw i roślin dwuliściennych w badanych próbkach siana. Przyjmując optymalną zawartość suchej masy w sianie na poziomie powyżej 820 g · kg^{-1} s.m. stwierdzono, że tylko siano z 42 % próbek miało odpowiednią zawartość suchej masy. Przy ocenie wartości pokarmowej siana na podstawie analizy chemicznej, szczególną uwagę należy zwracać na zawartość białka ogólnego i włókna surowego. Siano pobrane z 33 % próbek zawierało mniej białka w absolutnie suchej masie niż przewidują normy, a zawartość włókna surowego przekroczyło zawartość optymalną w 92 % próbek. Zjawisko to można tłumaczyć opóźnionym terminem zbioru, zwłaszcza pierwszego pokosu oraz niewłaściwym sposobem suszenia. Spośród analizowanych składników największym zróżnicowaniem cechowała się zawartość tłuszczu surowego. Średnia ważona zawartość tego składnika wahała się w zakresie 13,9–34,5 g · kg^{-1} s.m. Pod względem wartości energetycznej badane pasze zawierały odpowiednio: JPM od 0,68 do 0,81 g · kg^{-1} s.m. i JPŻ od 0,59 do 0,71 g · kg^{-1} s.m. Natomiast wartość białkowa była znacznie zróżnicowana i kształtowała się w zakresie 55,29–122,61 dla BTJN oraz 73,27–97,66 g · kg^{-1} s.m dla BTJE.

Słowa kluczowe: ruń łąkowa, składniki organiczne, wartość pokarmowa