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VARIATION IN CRUDE PROTEIN AND CRUDE FIBER CONTENT OF MAIZE SILAGE AND ALFALFA HAY USED IN CATTLE FEEDING

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Abstract

Feed quality is an important component of nutritional management in cattle, while crude protein and crude fiber are relevant indicators for assessing the nutritive value of forages. The aim of this study was to evaluate the monthly and annual variation in crude protein and crude fiber content of maize silage and alfalfa hay used in cattle feeding. The study was conducted during 2022–2023 using forage samples collected from a livestock farm in the Moldavia region of Romania. Samples were analyzed using standardized methods for the determination of crude protein and crude fiber, and the results were expressed as mean ± standard deviation. Maize silage showed annual mean crude protein values of 7.75 ± 0.53% and 7.71 ± 0.61% and crude fiber values of 24.37 ± 1.56% and 24.39 ± 1.48% in 2022 and 2023, respectively. For alfalfa hay, mean crude protein content was 12.75 ± 0.79% in 2022 and 12.75 ± 0.71% in 2023, while crude fiber content was 27.50 ± 1.71% and 27.41 ± 1.58%, respectively. No statistically significant differences were observed between 2022 and 2023 for any of the analyzed parameters at the annual level ($p > 0.05$). However, the monthly analysis revealed statistically significant variations for certain parameters and periods. Overall, the results indicate relatively consistent forage composition between the two study years, alongside monthly variation in crude protein and crude fiber content. Periodic monitoring of forage chemical composition may contribute to the assessment of nutritive value and support nutritional management decisions in cattle production systems.

Introduction

Forage quality is a key factor in cattle nutrition, as the chemical composition of feed influences nutrient supply and ration formulation. Crude protein and crude fiber are commonly used to characterize forage nutritive value and assess their contribution to animal diets. However, these parameters should be interpreted in relation to the overall composition of the feed and the analytical basis used to express the results. Maize silage is widely used in cattle feeding due to its energy contribution and the possibility of preserving the whole maize plant. Its chemical composition may be influenced by harvest maturity, plant characteristics, and ensiling conditions. Alfalfa hay (Medicago sativa L.) is an important legume forage, valued for its protein content and contribution to dietary fiber. Its nutritive characteristics depend on plant maturity, the leaf-to-stem ratio, and harvesting and preservation practices. Although these forages have different nutritional profiles, they serve complementary roles in cattle diets. Their chemical composition may vary under practical production and storage conditions, making periodic evaluation useful for characterizing feed quality and supporting informed feeding decisions. Assessing crude protein and crude fiber can therefore provide relevant information for evaluating forage consistency and its suitability for use in cattle nutrition.

Material and method

The study was conducted during 2022–2023 on maize silage and alfalfa hay collected from a cattle farm in the Moldavia region of Romania. For each forage type, 12 samples were collected monthly throughout both years. Crude protein (CP) and crude fiber (CF) contents were determined using standardized chemical analysis methods. Results were expressed as mean ± standard deviation (mean ± SD). Differences between years were evaluated for each month and for annual means using analysis of variance (ANOVA). Statistical significance was set at $p < 0.05$.

Table 1. *Chemical Composition of Maize Silage*

Month	Year	Protein (%)		Crude fiber (%)	
		X̄ ± SD	p-value	X̄ ± SD	p-value
January	2022	7.33±0.29	0.012	21.76±0.23	0.005
	2023	7.58±0.47	*	22.06±0.23	**
February	2022	7.57±0.32	0.959	22.27±0.20	<0.001
	2023	7.57±0.23	ns	22.77±0.17	***
March	2022	7.55±0.24	0.576	22.48±0.27	<0.001
	2023	7.60±0.23	ns	23.49±0.20	***
April	2022	7.62±0.32	0.745	24.04±0.20	0.002
	2023	7.59±0.50	ns	23.71±0.40	**
May	2022	7.76±0.11	0.000	24.40±0.30	0.977
	2023	7.26±0.15	***	24.40±0.30	ns
June	2022	8.52±0.18	0.054	25.44±0.09	0.576
	2023	8.71±0.11	ns	25.49±0.16	ns
July	2022	8.96±0.20	0.590	25.41±0.27	0.277
	2023	9.01±0.23	ns	25.52±0.26	ns
August	2022	7.95±0.03	0.032	25.41±0.17	0.616
	2023	7.73±0.15	*	25.36±0.07	ns
September	2022	7.83±0.06	0.768	26.55±0.29	0.019
	2023	7.86±0.10	ns	26.31±0.24	*
October	2022	7.45±0.07	0.223	26.57±0.11	0.089
	2023	7.33±0.07	ns	26.75±0.14	ns
November	2022	7.26±0.03	0.102	24.39±0.22	0.482
	2023	7.09±0.05	ns	24.32±0.20	ns
December	2022	7.25±0.05	0.776	23.69±0.23	<0.001
	2023	7.22±0.06	ns	22.54±0.31	***
OVERALL	2022	7.75±0.53	0.154	24.37±1.56	0.404
	2023	7.71±0.61	ns	24.39±1.48	ns

Maize silage - As shown in Table 1, annual mean crude protein and crude fiber contents did not differ significantly between years ($p > 0.05$). Crude protein peaked in July at approximately 9% in both years. However, significant monthly differences were observed, particularly in crude fiber, with the largest contrast in December ($p < 0.001$).

Alfalfa hay - As shown in Table 2, annual mean crude protein content was 12.75% in both years, while crude fiber content was similar (27.50% in 2022 and 27.41% in 2023). Significant monthly differences were observed for both parameters, with the most pronounced crude fiber difference in September (27.90% in 2022 vs. 25.84% in 2023; $p < 0.001$).

Overall, similar annual means coexisted with monthly variation, particularly in crude fiber. Monthly monitoring therefore provides complementary information for assessing forage composition.

Table 2. *Monthly Chemical Composition of Alfalfa Hay*

Month	Year	Protein (%)		Crude fiber (%)	
		X̄ ± SD	p-value	X̄ ± SD	p-value
January	2022	12.26±0.15	0.844	30.14±1.80	<0.001
	2023	12.21±0.32	ns	28.35±1.13	***
February	2022	12.19±0.24	0.132	29.20±1.75	0.313
	2023	12.56±0.28	ns	29.70±1.50	ns
March	2022	12.63±0.32	0.967	27.83±1.01	0.017
	2023	12.64±0.42	ns	26.63±0.98	*
April	2022	12.23±0.22	0.576	27.91±0.89	0.027
	2023	12.36±0.16	ns	29.02±1.08	*
May	2022	13.69±0.93	0.758	25.38±0.25	<0.001
	2023	13.61±1.00	ns	27.48±0.29	***
June	2022	13.45±0.91	0.465	26.31±0.70	0.098
	2023	13.63±0.91	ns	27.14±0.59	ns
July	2022	13.90±1.01	0.012	27.77±1.06	0.127
	2023	13.29±0.72	*	28.53±0.88	ns
August	2022	12.88±0.67	0.748	26.91±2.22	0.047
	2023	12.95±0.54	ns	27.90±1.73	*
September	2022	12.19±0.42	0.777	27.90±1.45	<0.001
	2023	12.12±0.28	ns	25.84±0.68	***
October	2022	12.46±0.39	0.557	26.61±0.29	0.035
	2023	12.31±0.37	ns	25.55±0.30	*
November	2022	12.72±0.14	0.892	27.24±0.84	0.575
	2023	12.69±0.18	ns	26.96±0.82	ns
December	2022	12.38±0.22	0.355	26.84±1.11	0.033
	2023	12.60±0.16	ns	25.76±0.43	*
OVERALL	2022	12.75±0.79	0.988	27.50±1.71	0.506
	2023	12.75±0.71	ns	27.41±1.58	ns

Conclusions

The chemical composition of maize silage and alfalfa hay remained broadly consistent between 2022 and 2023, with no statistically significant differences in annual mean crude protein or crude fiber contents. However, significant year-to-year differences were identified in selected monthly comparisons, particularly for crude fiber. The results show that similar annual averages do not necessarily reflect uniform compositional patterns throughout the year. Monthly monitoring of crude protein and crude fiber can provide complementary information for evaluating forage composition and supporting cattle feeding management. Further studies incorporating harvest maturity, botanical characteristics, and preservation conditions are needed to investigate the factors associated with the observed variation.