



UNIVERSITY OF LIFE SCIENCES "KING MIHAI I" FROM
TIMISOARA
"YOUNG PEOPLE AND MULTIDISCIPLINARY RESEARCH
IN APPLIED LIFE SCIENCES"



"Young people and multidisciplinary
research in applied life sciences"

13-14 November, 2025

PHYSICO-CHEMICAL QUALITY ANALYSIS OF MAIZE USED AS
CATTLE FEED

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Abstract

Feed quality is essential for maintaining the health, productivity, and welfare of cattle, directly influencing milk and meat production. Maize, as the main energy source and a key component of the feeding ration, provides carbohydrates, a moderate amount of protein, and lipids necessary for growth and lactation. In this study, maize samples were collected and analyzed at a livestock farm located in the Moldavia region over a two-year period to evaluate the main physico-chemical parameters relevant to animal nutrition and feed safety. Moisture, dry matter, crude protein, total lipids, crude fiber, and ash content were determined using standardized methods (SR ISO and European regulations). The results indicated stable values of moisture and crude protein between years, confirming the consistent nutritional quality of maize, while total lipids and crude fiber showed significant variations influenced by climatic conditions, grain maturity stage, and storage practices. These findings highlight the importance of regular feed quality monitoring and provide valuable insights for optimizing feeding strategies. The study confirms that the analyzed maize meets the quality standards for cattle feed and supports informed management decisions aimed at improving zootechnical performance.

Introduction

Maize is one of the most important cereal crops worldwide, with an annual production of around 1.2 billion tons, over half of which is used for animal feed. In Romania, maize is a major crop, reaching about 8.5 million tons in 2023. Due to its high starch content and excellent digestibility, maize represents a fundamental energy source in livestock nutrition and is widely used in various forms such as dry kernels, silage, or ground mixtures. Its nutritional profile directly influences animal performance, feed efficiency, and production quality in both dairy and meat sectors. The chemical composition of maize can vary considerably depending on hybrid type, soil fertility, climatic conditions, and post-harvest handling, which may affect its nutritional balance and storage stability. Therefore, continuous assessment of feed quality is essential to ensure both consistency and safety. Physico-chemical analyses play a essential role in evaluating the nutritional value, stability, and hygienic safety of maize used in cattle feeding. They provide objective data on key parameters such as moisture, dry matter, crude protein, total lipids, crude fiber, and ash content, supporting the formulation of balanced feed rations and the optimization of feeding strategies. Such evaluations are fundamental for maintaining feed quality standards and for developing evidence-based management practices aimed at improving animal health and productivity.

Material and method



For nutritional characterization, the main physico-chemical parameters were determined using standardized methodologies according to SR ISO and Regulation (EC) No. 152/2009. Moisture and dry matter were determined by drying the sample at 105°C to constant weight (SR ISO 6496:2001), crude protein by the Kjeldahl method (SR ISO 5983-2/2010), crude fat by Soxhlet extraction with organic solvents (SR ISO 6492:2001), and crude fiber by the Gerhardt method, using acidic and alkaline solutions and the Fibretherm F12 apparatus (SR ISO 6865:2002). Crude ash was determined by calcining the sample at 550°C to constant weight (SR ISO 2171:2010). All analyses were performed in triplicate, and results were expressed as mean ± SD. Differences between years or batches were statistically evaluated using ANOVA to highlight possible variations determined by climatic factors, cultivation technology, or grain maturity stage. This approach provides a comprehensive assessment of feed quality and supports the optimization of rations and zootechnical performance.



Table 1. Results on the physico-chemical composition of maize used in animal feed

Month	Year	Moisture (%)		Dry matter(%)		Protein (%)		Total lipids (%)		Crude fiber (%)		Ash (%)	
		X ± SD	p-value	X ± SD	p-value	X ± SD	p-value	X ± SD	p-value	X ± SD	p-value	X ± SD	p-value
January	2022	13.26±0.57	0.518	86.74±0.57	0.518	6.76±0.56	0.199	2.55±0.22	0.000	2.60±0.12	0.011	2.89±0.24	0.004
	2023	13.39±0.60	ns	86.61±0.60	ns	6.53±0.50	ns	3.40±0.11	***	2.33±0.20	**	2.46±0.36	***
February	2022	13.15±0.59	0.676	86.85±0.59	0.676	6.69±0.40	0.194	2.66±0.10	0.301	3.04±0.35	0.011	2.66±0.30	0.174
	2023	13.06±0.50	ns	86.94±0.50	ns	6.92±0.59	ns	2.52±0.15	ns	2.77±0.09	**	2.86±0.48	ns
March	2022	13.56±0.51	0.613	86.44±0.51	0.613	6.44±0.24	0.016	2.82±0.11	0.448	2.52±0.41	0.000	2.72±0.17	0.029
	2023	13.67±0.43	0.613	86.33±0.43	ns	6.88±0.36	**	2.92±0.17	ns	2.90±0.16	***	2.40±0.21	*
April	2022	13.58±0.35	0.884	86.42±0.35	0.884	6.43±0.61	0.047	3.07±0.54	0.029	2.57±0.28	0.000	2.69±0.47	0.732
	2023	13.61±0.37	ns	86.39±0.37	ns	6.79±0.56	*	3.36±0.26	*	3.00±0.20	***	2.74±0.13	ns
May	2022	13.09±0.55	0.801	86.91±0.55	0.801	7.37±0.67	0.203	3.51±0.23	0.070	3.24±0.22	0.511	2.68±0.09	0.588
	2023	13.04±0.58	ns	86.96±0.58	ns	7.14±0.31	ns	3.76±0.49	ns	3.17±0.07	ns	2.76±0.21	ns
June	2022	13.85±0.12	0.801	86.15±0.12	0.801	7.33±0.44	0.000	3.32±0.32	0.000	2.71±0.35	0.003	1.56±0.31	0.000
	2023	13.80±0.35	ns	86.20±0.35	ns	6.60±0.37	***	2.80±0.29	***	2.40±0.20	***	2.17±0.38	***
July	2022	14.00±0.09	0.169	86.00±0.09	0.169	6.47±0.29	0.001	3.56±0.56	0.271	3.04±0.09	0.058	2.85±0.41	0.002
	2023	14.28±0.55	ns	85.72±0.55	ns	7.10±0.24	***	3.71±0.30	ns	2.84±0.19	ns	2.40±0.34	***
August	2022	13.56±0.22	0.778	86.44±0.22	0.778	6.97±0.29	0.081	3.55±0.41	0.888	2.25±0.23	0.064	2.15±0.49	0.000
	2023	13.62±0.27	ns	86.38±0.27	ns	6.65±0.35	ns	3.57±0.44	ns	2.45±0.28	ns	2.87±0.26	***
September	2022	13.80±0.73	0.778	86.20±0.73	0.778	6.26±0.30	0.424	2.28±0.30	0.384	2.80±0.23	0.000	2.68±0.47	0.187
	2023	13.75±0.35	ns	86.26±0.35	ns	6.40±0.23	ns	2.40±0.21	ns	2.29±0.34	***	2.48±0.39	ns
October	2022	13.05±0.46	0.698	86.95±0.46	0.698	6.29±0.29	0.090	2.34±0.18	0.053	2.40±0.15	0.614	2.34±0.46	0.178
	2023	13.13±0.21	ns	86.87±0.21	ns	6.60±0.23	ns	2.60±0.19	ns	2.35±0.21	ns	2.15±0.11	ns
November	2022	12.44±0.16	0.478	87.56±0.16	0.478	6.50±0.27	0.561	2.50±0.19	0.179	2.80±0.31	0.000	2.12±0.13	0.328
	2023	12.30±0.82	ns	87.71±0.82	ns	6.40±0.13	ns	2.68±0.20	ns	2.41±0.17	***	1.97±0.27	ns
December	2022	12.11±0.28	0.004***	87.89±0.28	0.004	6.56±0.44	0.573	2.74±0.18	0.186	2.50±0.15	0.017	2.44±0.22	0.579
	2023	12.70±0.42	***	87.30±0.42	***	6.66±0.32	ns	2.91±0.35	ns	2.76±0.22	**	2.52±0.31	ns
OVERALL	2022	13.29±0.69	0.214	86.71±0.69	0.214	6.67±0.54	0.332	2.91±0.55	0.000	2.71±0.37	0.027	2.48±0.49	0.997
	2023	13.36±0.69	ns	86.64±0.69	ns	6.72±0.43	ns	3.05±0.54	***	2.64±0.35	**	2.48±0.40	ns

Significance: p > 0.05 = not significant / ns, p < 0.05 = significant / *, p < 0.01 = highly significant / **, p < 0.001 = very highly significant / ***
ANOVA – Analysis of Variance

Results and discussions

- Moisture values showed no significant differences between 2022 and 2023 ($p > 0.05$), remaining around 13.3%, which meets the recommended levels for safe storage and feed use.
 - Dry matter averaged 86.6%, also without significant yearly variation.
 - Crude protein content remained relatively stable, with 6.67% in 2022 and 6.72% in 2023 ($p > 0.05$), confirming that maize is primarily an energy source with moderate protein contribution.
 - Total lipid content showed highly significant differences between years ($p < 0.001$), with higher values in 2023 ($3.05\% \pm 0.54$) compared to 2022 ($2.91\% \pm 0.55$), likely due to environmental factors, climatic conditions, and cultivation technology.
 - Crude fiber was significantly higher in 2022 ($p < 0.01$), potentially affecting feed digestibility.
 - Ash content showed no significant variation ($p > 0.05$).
- Monthly analysis revealed fluctuations in protein, lipid, and crude fiber levels, with higher protein and lipid content in summer and increased fiber in spring and autumn. These variations are associated with grain maturity and storage conditions. Overall, maize composition is dominated by carbohydrates (mainly starch), with moderate protein and lipid content, low fiber, and mineral content. All measured parameters fall within recommended standards for cattle feed, confirming the nutritional quality of the maize used.

Conclusions

The results confirm that the maize analyzed during 2022–2023 meets quality standards for animal feed. Moisture, dry matter, crude protein, and ash remained stable between years, while total lipids and crude fiber showed significant variations influenced by environmental factors, cultivation practices, and grain maturity. Monthly analysis of physico-chemical parameters revealed fluctuations associated with grain maturity and storage conditions, highlighting the importance of continuous feed quality monitoring. Overall, these findings support the optimization of rations and ensure consistent and adequate nutrition for livestock.