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QUALITY PARAMETERS OF SILAGE MAIZE HYBRIDS FOR RUMINANT FEED

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Abstract: Silage is a byproduct of carefully regulated fermentation that takes place in anaerobic environments where oxygen is absent and is fed to farm animals. When it comes to biomass quality, yield, ensiling suitability, and variety of uses in domestic animal diets, maize is the most significant fodder plant. Four commercial hybrids from the Maize Research Institute Zemun Polje were investigated in this study at four separate locations in Serbia. The amount of lignocellulosic fibers, dry matter content, and digestibility of the whole hybrid maize plant were evaluated. Based on the obtained results of ZP, corn hybrids are characterized by high digestibility of dry matter of the whole corn plant.

Keywords: *in vitro* digestibility, maize, ruminant feed, silage quality

Introduction

One of the main sources of forage and energy for livestock production is whole plant maize silage. In the Republic of Serbia, maize (*Zea Mays* L.) accounts for 53% of the harvested area under cereals, making it the most common cereal crop (Grčak et al., 2020). The fact that practically all of the plant's above-ground biomass can be utilized is the indication of the unique economic significance of maize. The whole maize plant is used to produce over 1,600 different industrial products. In livestock production, above-ground biomass, either fresh or used to make silage, comes next. The whole grain of maize is used as concentrated fodder for feeding farm animals (Popović, 2010). Based on statistical data, 2,711 hectares of silage maize were planted in Serbia in 2021 (Statistical Yearbook of the Republic of Serbia, 2022). Hybrids of different subspecies of maize are also intriguing to small farmers because their grain is becoming a more significant part of peoples' diets. Silage preparation is a traditional farming method that dates back more than 3,000 years. Silage was first used to preserve animal feed. The development of machinery for forage collection led to a wider application of the new forage preservation technology

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after the turn of the 19th century. Today, ensilaging is a commonly used method of animal feed preservation worldwide. The benefit of using silage plant mass is that forage plants can be harvested at the ideal time of development and keep them segregated until they are needed. Silage is made by fermenting soluble carbohydrates, which results in the production of acids that protect the fodder. Silage offers several benefits over animal fodder, including superior quality, high digestibility, and good palatability (Coblentz and Akins, 2018). These days it is difficult to imagine intensive livestock production without the use of silage storage. Silage of green biomass from fodder plants allows for more intensive land use and their early removal from production areas (Rakašćan et al., 2019). The fact that the initial silage material remains mostly unchanged following the acidification of the green mass via natural fermentation processes or the addition of specific additives is indicative of the significance of silage. When it comes to livestock nutrition, silage can completely replace fodder. As the most direct alternative to fodder, silage feeding is considered the cornerstone of contemporary, economically sound animal husbandry (Đorđević et all., 2011). The aim of this work is to determine the quality parameters of silage corn hybrids.

Materials and methods

Five ZP maize hybrids of the FAO 700 maturity group created at the Maize Research Institute Zemun Polje were tested for quality parameters in the Maize Research Institute's Group for Food Technology and Biochemistry laboratory in order to assess the hybrids' potential for silage preparation. Four distinct locations in Serbia were selected for silage maize hybrid field experiments, namely: Žarkovac in Srem, and three locations in Central Serbia - Murgaš, Valjevska Loznica and Donja Trepča. Hybrid 7001 was utilized as a standard in addition to the four tested hybrids. Along with determining the total dry matter content and *in vitro* digestibility of the maize plant, also measured the amount of lignocellulosic fibers present. According to the detergent method of Van Soest (1980), with minor modifications, the fiber analysis comprised identification of lignocellulosic constituents: neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL), hemicellulose, and cellulose (Mertens, 1992). The studied maize hybrid whole plant samples' *in vitro* dry matter digestibility was evaluated using Aufrere's (2007) enzymatic pepsin-cellulase technique. The results are shown as percentages of dry matter (d.m.).

Results and discussion

The main nutritional benefit of maize is its high carbohydrate content given that it has low protein and mineral content. Data on the *in vitro* digestibility of dry matter and the fractions of lignocellulosic fibers (NDF, ADF, ADL, hemicellulose, and cellulose) are required for a more accurate definition of the nutritional value of coarse nutrients. When selecting individual lines to create hybrids for silage that will eventually find a home on the domestic and international markets, breeders should find assistance from these quality parameters. Table 1. shows the amount of lignocellulosic fibers in each location throughout the tested maize hybrid plants.

Table 1. The content of lignocellulosic fibers in the whole plant of the tested maize hybrids, by location

Location	Hybrid	The content of lignocellulosic fibers				
		NDF	ADF	ADL	Hemicellulose	Cellulose
Žarkovac (Srem)	7001std.	54.11	26.51	2.80	27.61	23.71
	ZP 707	51.62	23.33	2.48	28.28	20.86
	ZP 7357	51.33	26.52	3.36	24.81	23.16
	ZP 7777	53.40	25.41	2.94	27.98	22.47
	ZP 7900	49.83	24.46	2.84	25.37	21.62
Murgaš (Central Serbia)	7001	58.42	24.13	2.33	34.29	21.81
	ZP 707	53.34	21.31	2.04	32.04	19.26
	ZP 7357	48.31	24.69	3.37	23.91	21.32
	ZP 7777	54.53	26.68	3.27	27.78	23.48
	ZP 7900	54.08	25.95	3.37	28.13	22.58
Valjevska Loznica (Central Serbia)	7001	45.37	19.82	2.31	25.55	17.51
	ZP 707	51.12	24.43	3.06	26.68	21.38
	ZP 7357	42.46	18.69	2.28	23.77	16.41
	ZP 7777	49.00	23.74	3.15	25.76	20.59
	ZP 7900	39.69	18.76	2.38	20.93	16.37
Donja Trepča(Central Serbia)	7001	54.92	24.61	1.99	30.32	22.61
	ZP 707	50.76	23.37	1.81	27.39	21.56
	ZP 7357	52.99	26.21	2.28	26.78	23.93
	ZP 7777	50.09	24.96	2.65	25.13	22.32
	ZP 7900	59.89	22.67	4.13	26.50	29.45

Taking into account the outcome of domestic animals' nutrient utilization is vital to evaluate the nutritional value of maize plants as feed. Nutrient digestibility tests are performed for this reason, and the results show how well the nutrients are being utilized. Digestion-based hybrid evaluation is a more unbiased and trustworthy method of comparison. Given that the digestibility of cellulose-containing plant parts is genetically based, analyses of the in vitro digestibility of the whole and morphological fractions of the maize hybrid plant are especially important because there are notable variations in digestibility (Demirel et al., 2011). Given that digestibility is unaffected by energy density, it is becoming more and more crucial to examine it when it comes to domestic animal nutrition. Table 2. shows the content of dry matter as well as the digestibility of dry matter of the whole plant.

Table 2. Dry matter content and digestibility of the whole maize hybrid plant, by location

Location	Hybrid	Dry matter content (%)	*In vitro* dry matter digestibility (%)
Žarkovac (Srem)	7001 std.	44.16	50.33
	ZP 707	51.30	56.64
	ZP 7357	59.02	53.05
	ZP 7777	54.49	56.51
	ZP 7900	64.83	59.82
Murgaš (Central Serbia)	7001 std.	45.52	57.64
	ZP 707	47.38	62.95
	ZP 7357	63.09	61.13
	ZP 7777	52.38	57.62
	ZP 7900	69.09	59.26
Valjevska Loznica (Central Serbia)	7001 std.	50.47	64.17
	ZP 707	47.83	59.64
	ZP 7357	48.84	68.41
	ZP 7777	46.21	60.71
	ZP 7900	49.19	67.71
Donja Trepča (Central Serbia)	7001 std.	40.73	58.96
	ZP 707	37.40	64.89
	ZP 7357	34.57	61.01
	ZP 7777	34.72	64.27
	ZP 7900	34.93	53.75

Agrometeorological conditions, hybrid selection, sowing density, harvest time, and swath height all affect the quantity and quality of maize biomass produced (Ayub et al., 2011). The selection of hybrids has a significant impact on the quality and yield of maize biomass. Whether the hybrid will be grown as a main crop or a secondary crop is taken into consideration when choosing the hybrid, as well as the altitude at which it will be grown. Studies have indicated a discernible pattern in the rise in the dry matter yield when the FAO group of maize hybrids ripens. For instance, FAO group 700 exhibited a yield that was ten tons per hectare greater than FAO group 200. No compensatory differences in yield between hybrids of early and late FAO ripening groups were observed with higher sowing densities of earlier ripening group hybrids. For silage production, maize hybrids should be sown at an ideal density that is 5–10% higher than that of grains. Silage maize should be harvested at the point of physiological maturity, which occurs when the plant's dry matter content ranges from 35 to 42% (full waxy maize maturity). For silage maize, a swath height of 20 cm is ideal. Tables 3 and 4 show the average values of in vitro digestibility and dry matter content of the whole plant, both by hybrids and by location, as well as the coefficient of variation.

Table 3. Average values of *in vitro* digestibility and dry matter content of the whole plant by hybrids for all locations and coefficient of variation

Hybrid	Dry matter content (%)	CV (%)	*In vitro* dry matter digestibility (%)	CV (%)
7001 standard	45.22±4.03	8.93	57.78±5.71	9.88
ZP 707	45.98±5.98	13.01	61.03±3.64	5.97
ZP 7357	51.38±12.71	24.73	60.90±6.27	10.30
ZP 7777	46.95±8.88	18.91	59.78±3.48	5.82
ZP 7900	53.01±13.94	26.39	60.13±5.74	9.55

Table 4. Average values of *in vitro* digestibility and dry matter content of the whole plant for each location for all hybrids and coefficient of variation

Location	Dry matter content (%)	CV (%)	*In vitro* dry matter digestibility (%)	CV (%)
Žarkovac	54.76±7.81	14.26	55.27±3.65	6.61
Murgaš	54.24±8.41	15.49	59.71±2.31	3.87
Valjevska Loznica	48.51±1.59	3.28	64.13±3.97	6.18
Donja Trepča	36.30±2.79	7.69	60.57±4.51	7.46

In terms of quality parameters for maize silage production, the best hybrids were ZP 7357, ZP 7900, ZP 7777, and ZP 707. In most cases, all investigated hybrids performed better than the standard. Regarding digestibility, the relative stability by location was a characteristic shared by all tested hybrids. Whereas ZP 7357 varied the most in terms of digestibility and dry matter content, ZP 7001 was found to be the weakest hybrid overall. Higher amounts of lignin (ADL), ADF, and cellulose had a detrimental effect on the plant's overall digestibility. Despite having the highest dry matter content overall, the hybrids at the Žarkovac ZP location had the lowest digestibility. The lowest dry matter content was achieved by all tested hybrids at the Donja Trepča location.

Conclusion

Based on the obtained results, the Maize Research Institute, Zemun Polje silage ZP maize hybrids are distinguished by a high yield of digestible dry matter and total dry matter per hectare, a high proportion of cob dry matter in the total dry matter yield, and a high digestibility of the dry matter of the whole maize plant. When compared to hybrids chosen by both domestic and international selection firms, their quality is competitive.

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