RESEARCH ON CHEMICAL COMPOSITION OF CORN SILO OBTAINED IN DIFFERENT PRODUCTION SYSTEMS (CONVENTIONAL AND ORGANIC)

Nadia Mirela Aioanei[1*], I.M. Pop[1]

[1]*University of Agricultural Sciences and Veterinary Medicine Iasi, Romania*

Abstract

The aim of this work was a comparative analysis of the chemical composition determined for 10 samples of corn silage, derived from two farms in the North-East part of Romania, with different production systems (conventional and organic). The research focused on determining the gross chemical composition (content of dry matter, crude ash, crude protein, crude fat, crude fiber, ADF, NDF and SEN) using Weende scheme and mineral content (Ca and P) by spectrophotometric method. In order to determine the chemical composition, the guidelines were standards like: ISO 6496:2001, ISO 6498:2001, EN ISO 6869:2001, ISO 6492:2001, EN ISO 6865:2002, EN ISO 6497 : 2005. Statistical analysis revealed significant differences between average values for corn silage samples, derived from the conventional system compared with the ecological one for crude ash content (5.11±0.11% Ash vs. 4.11±0.07% Ash) and calcium (0.315±0.005% Ca vs. 0.219±0.001% Ca); distinct significant for crude protein content (7.39±0.10% CP vs. 6.12 ± 0.30% CP), acid detergent fiber (28.00±0.46% ADF vs. 25.94±0.34% ADF) and phosphorus (0.224±0.009% P vs. 0.185±0.003% P); significant for nitrogen free extract substances content (59.66±0.65% SEN vs. 57.00±0.84% SEN). For dry matter, organic matter, crude fat, crude fiber and NDF content, the differences were insignificant.

Key words: organic feed, corn silage, chemical composition, calcium, phosphorus

INTRODUCTION

Forage maize is grown for use features such as green mass and to be preserved like silage, due to high content of soluble carbohydrates [10].

Energy value of corn does not decrease with increasing vegetation as other forage plants, on the contrary increases slightly to milk-wax stage of growth and then stabilizes. In terms of protein content, it drops to near mature milk-wax stage [7].

The literature provides a wide range of data on the chemical composition of corn silage produced in conventional production systems, the statement can not be sustained for organic crops where data is insufficient.

MATERIAL AND METHOD

In order to achieve the objective were analyzed a total of 10 samples of corn silage, taken in accordance with in force standards and legislation [12].

Half of the samples were taken from a conventional production profile unit of Iaşi county, and the other half from a specialized in organic production unit in Botoşani county.

Samples were transported to the laboratory in polyethylene bags, to prepare it for analysis.

Samples were subjected to drying processes, shredding and grinding up to 1mm in diameter according to thr in force standard [18], in order to unify and prepare the samples for laboratory determinations.

Corn cilage samples were analyzed for dry matter content (DM), crude ash (Ash), crude protein (CP), crude fat (EE), crude fiber (CF), neutral detergent fiber (NDF) and acid detergent fiber (ADF) following the required standards of analytical methods [13, 14, 15, 16, 17, 19, 20]. Nitrogen free extract (NFE) was calculated by the following formula:

$$\%NFE = OM - (CP\ \% + EE\% + CF\%) \quad [1]$$

*Corresponding author: nadiamirela@yahoo.com
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Mineral content of the samples was evidence by determining the concentration of calcium (Ca) and phosphorus (P).

In order to determine the mineral content, atomic absorption spectrophotometry method was used; SHIMADZU spectrophotometer UVmini 1240, was set at a wavelength of λ = 422.7 nm for calcium concentration respectivly λ = 430 nm for the phosphorus concentration, the comparison being made with reference solution.

Expression of the results was done on DM basis for all items resulting from laboratory analysis.

Statistical processing of the obtained values was performed by calculating the location and variation statistical estimators (arithmetic mean ($\overline{X}$), standard deviation (s), standard deviation of the mean $s_{\overline{x}}$ and coefficient of variation (V%)). In order to determine the statistical significance of differences between calculated mean values FISHER test was used.

RESULTS AND DISCUSSIONS

Chemical composition of corn silage samples taken from the two production systems (conventional and organic) with the significance of the differences (calculated value and table value for $\hat{F}$) average value calculated separately for each analyzed element, are presented in Table 1.

Mean results from analyzes conducted for dry matter content of corn silage were within the range found in the literature of 24.0% [8] to 36% [11] with values of 35.22% for samples from the conventional system and 35.1% for samples from the ecological one.

The average value of 35.1% DM resulting in samples from the organic system is 8% higher than the 32.5% DM [9], value resulting from chemical analyzes carried out on samples of corn silage from 77 organic farms in southern Germany; the difference between the average values for this parameter is not statistically significant.

For crude ash content of corn silage, mean results from performed analyzes were within the range found in the literature of 3.7% [21] and 7% [11], with values of 4.11% for the samples derived from the conventional system and 5.11% for the samples derived from the ecological one; the difference between the average values for this parameter is very significant, statistically speaking.

The range found in the literature from 93.1% [1] to 95.8% [3] for the organic matter content of corn silage, included the mean results for both conventional (90.77%) and organic system (91.46%) analyzed samples; difference between the results for this parameter is not significant in statistical terms.

Regarding crude protein content of corn silage, the mean value of 6.12% resulting from samples derived from organic system was below the lower limit found in the literature from 7.0% [21] to 11% [8], while the value of 7.39% found in samples derived from the conventional system was within the limits mentioned above; difference between the results for this parameter is distinctly significant, statistically speaking.

The value of 6.12% CP found in samples derived from the organic system is 22.5% less than the value of 7.9% CP [9], value resulting from chemical analyzes carried out on samples of corn silage from 77 organic farms in southern Germany.

Mean values resulting from analyzes for crude fat content of corn silage were within the range found in the literature of 2.5% [3] and 5% [8].

Mean values resulting from the research are 2.19% EE for samples derived from the conventional system and 1.86% EE for samples collected from the ecological one; difference between the results for this parameter is not statistically significant.

The crude fiber content of corn silage, mean values results from performed analyzes were within the range found in the literature of 18% [4] to 26% [11].

Mean results from research are 24.18% CF for samples taken from the conventional system and 23.83% CF for samples derived from the ecological one; the difference between the average values for this parameter is not statistically significant.

Table 1 Chemical composition of corn silage, taken from two different production systems, conventional and organic

SPECIFICATION			n	$\bar{X} \pm s_{\bar{x}}$	s	V%	Range		FISHER Test
							Min	Max	
DM%[1]		Conv.	5	35.22±0.43	0.97	2.74	34.03	36.30	$\hat{F}$ =0.03 < $F_{0.5}$= 238.9
		Eco.	5	35.10±0.54	1.21	3.45	33.17	36.22	
% DM	Ash[2]	Conv.	5	4.11±0.07	0.15	3.61	3.89	4.25	$\hat{F}$ =60.33 > $F_{0.01}$=25.42
		Eco.	5	5.11±0.11	0.25	4.86	4.97	5.55	
	OM[3]	Conv.	5	90.77±0.74	1.65	1.82	87.89	91.97	$\hat{F}$ = 0.52 < $F_{0.5}$= 238.9
		Eco.	5	91.46±0.61	1.37	1.50	89.36	93.08	
	CP[4]	Conv.	5	7.39±0.10	0.23	3.12	7.09	7.65	$\hat{F}$ =16.17 > $F_{0.1}$= 11.26
		Eco.	5	6.12±0.30	0.67	10.96	5.60	6.92	
	EE[5]	Conv.	5	2.19±0.21	0.46	20.99	1.79	2.87	$\hat{F}$ = 2.33 < $F_{0.5}$= 5.32
		Eco.	5	1.86±0.07	0.16	8.44	1.70	2.06	
	CF[6]	Conv.	5	24.18±0.33	0.74	3.07	23.12	25.01	$\hat{F}$ = 0.39 < $F_{0.5}$= 238.9
		Eco.	5	23.83±0.47	1.05	4.40	22.32	24.58	
	NFE[7]	Conv.	5	57.00±0.84	1.88	3.31	53.67	58.33	$\hat{F}$ =6.26 > $F_{0.5}$= 5.32
		Eco.	5	59.66±0.65	1.45	2.42	57.51	61.12	
	NDF[8]	Conv.	5	54.67±0.69	1.53	2.80	52.25	56.11	$\hat{F}$ = 3.74 < $F_{0.5}$= 5.32
		Eco.	5	53.10±0.44	0.99	1.86	51.98	54.05	
	ADF[9]	Conv.	5	28.00±0.46	1.02	3.65	26.33	28.84	$\hat{F}$ =13.25 > $F_{0.1}$= 11.26
		Eco.	5	25.94±0.34	0.76	2.91	24.98		
	Ca	Conv.	5	0.219±0.001	0.003	1.44	0.215	0.223	$\hat{F}$ =327.3 > $F_{0.01}$=25.42
		Eco.	5	0.315±0.005	0.011	3.63	0.298	0.329	
	P	Conv.	5	0.185±0.003	0.007	3.52	0.18	0.20	$\hat{F}$ =17.48 > $F_{0.1}$= 11.26
		Eco.	5	0.224±0.009	0.020	9.02	0.195	0.251	

[1]DM%= dry matter; [2]Ash= crude ash; [3]OM= organic matter; [4]CP= crude protein; [5]EE= ether extract; [6]CF= crude fiber; [7]NFE= nitrogen free extract; [8]NDF=neutral detergent fiber; [9]ADF= acid detergent fiber;

The 23.83% CF value found in samples from organic system is 15% higher than the 20.7% CF value resulting from chemical analyzes carried out on samples of corn silage from 77 organic farms in southern Germany.

The resulting values for corn silage content on nitrogen free extract are 57% for samples derived from the conventional system and 59.66% for samples derived from the ecological one; difference between the results for this parameter is not significant, statistically speaking.

The range found in the literature from 36% [6] to 57% [8] for neutral detergent fiber content of corn silage, included mean values for both analyzed samples results, deriving from the conventional (54.67%) and organic (53.10%) system; difference between the results for this parameter is not statistically significant.

Acid detergent fiber content of corn silage found in the literature range from 21% [6] to 33% [6] included the mean values results for both samples derived from the conventional (28.01%) and organic system (25.94%); difference between the results for this parameter is distinctly significant, statistically speaking.

Regarding mineral content of corn silage, both resulting values from samples of the conventional and the ecological system were within the limits of variation found in the literature.

Thus, the calcium content limit of variation is from 0.19% [21] to 1.19% [7], with average values resulting from the researches of 0.219% for samples derived from the conventional system and 0.315% for samples derived from the ecological one; difference between the results for this parameter is very significant, statistically speaking.

For phosphorus content of corn silage, the literature limit of variation is between 0.18% [21] and 0.26% [2], with average values resulting from the researcf of 0.185% for samples derived from the conventional system and 0.224% for samples derived from the organic; difference between the results for this parameter is distinctly significant, statistically speaking.

Differences with statistical significance between the mean values calculated for Ash, CP, NFE and ADF can be considered the result of the influence of specific agrotechnical factors for the two production systems, like the different nature of fertilization and fertilizing products.

Fodder maize crop fertilization in conventional production system was in spring, along with seeding, with a NPK 20-20-0 complex, 80 kg/ha.

In the organic production system, fertilization was carried out only with manure derived from cattle, applied to the soil surface in winter, prior seeding, in a quantity of 60 t / ha.

Another possible explanation regarding the differences may be the influence of a number of factors, independent of the operating system type, conventional or organic, such as growth phase at the time of harvesting, harvesting technology, silage technique or storage conditions.

Distinct significant statistically difference of phosphorus concentration and the very significant difference for calcium, with higher values for samples derived from the organic system, could be explained by the lack of additional calcium application and small quantities phosphorus application for the conventional system and the existence of calcium and phosphorus in the cattle derived manure applied to the soil surface before seeding for organic farm.

CONCLUSIONS

The analysis performed on corn silage samples, taken from the two production systems, conventional and organic, allow us to conclude by saying that:

- chemical fertilization with NPK 20-20-0 complex influence protein content, so a larger amount was found in the samples from the conventional system;
- concentration of calcium, phosphorus and thus the amount of crude ash was higher in samples derived from the organic system.
- many factors that can influence the chemical composition are both dependent and independent to production system, conventional and organic, and therefore further research regarding differences in chemical composition of fodder from the two systems is appropriate and in order to increase the accuracy of the results influence factors should be limited as much as possible by organizing researchers in well-controlled environments.

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