

Control of Corn Silage Quality on Farms for Milk Production in Northern Bosnia and Herzegovina

Midhat Glavić¹, Aleksandra Budiša¹, Senad Osmanagić¹, Amir Hasić²,
Amir Zenunović²

¹*FARMA Founded by USAID/SIDA, Tuzla, Bosnia and Herzegovina*

²*Institute of Agriculture, Tuzla, Bosnia and Herzegovina*

Abstract

The research objective was to monitor and compare the quality of corn silage on farms in the period 2008 - 2012 by years of the research. The analysis of corn silage was done at 65 farms in the northern part of Bosnia and Herzegovina, where is the largest production of raw milk - about 85 % of total production in Bosnia and Herzegovina. The medium value of crude protein (CP) per years of the research is 6.94 % in 2008; 6.82 % in 2010 and 6.31 % in 2012. The acidity (pH), the medium value per years of the research is 3.81 in 2008; 4.03 in 2010 and 4.01 in 2012. The medium value of crude cellulose (SC) per years of the research is 31.69 % in 2008; 31.9 % in 2010 and 33.99 % in 2012. The moisture content (SV), the medium value per years of the research is 68.48 % in 2008; 68.75 % in 2010 and finally, 68.43 % in 2012.

Key words: protein, cellulose, acidity, humidity

Introduction

The corn for silage production can be grown as a major, subsequent and an after grain crop. High milk production can only be achieved with high quality forage because type and quality of forage affect the quantity and content of milk (Caput, 1996).

Maize for forage production is relatively widely used, although we should cultivate a far more forage maize due to its high production potential of high-quality forage (Mišković, 1986).

The whole plant of silage corn is one of the most important energy source in the nutrition of dairy cows, since this plants gives a high yields of green mass and has a relatively high energy content of dry matter. It is characterized by high palatability and represents an indispensable component for the preparation of a fully mixed meal (Forouzmand et al., 2005).

The usage of different corn hybrids increases the yield per unit area (Hunt et al., 1993).

The content of nutrients and energy value of corn silage is biologically determined by the ratio of the stem, leaves and ears (grain) in the dry matter of hybrids, the level of fertilization, climatic conditions in the year of production, stage of maturity and silage technology, and content and digestibility of starch and fiber (Moss et al., 2001).

Johnson et al. (1999) indicate that the stage of maturity at the mowing time has the strongest effect on digestibility, energy value and suitability of whole corn silage plant.

Desired dry matter content of silage maize plant is about 35%, when is achieved an optimal ratio between the content of starch as a carrier of energy value and water soluble sugars needed to produce sufficient quantities of lactic acid that by lowering the acidity below pH 4 canned whole corn plant (Horrocks & Vallentine, 1999).

The corn plant that contains less than 30 % of dry matter has a low content of starch, which increases nutrient losses with silage juice runoff, and reduces the consumption of silage. If the dry matter content is higher than 40%, it is difficult to achieve proper ensiling conditions due to poor compaction, which often leads to spoilage of silage mass (Kalivoda, 1990).

Bal et al. (1997) state that delaying of corn silage harvest from 35 to 45 % of dry matter (physiological maturity of grain maize) does not affect the intake of dry matter silage, but due to declining digestibility of organic matter, acid detergent of fiber and starch, it leads to reducing the production of milk and milk protein content.

The ripening of corn crop increases the dry matter content, the amount of starch, and in the dry matter reduces the amount of fiber (De Visser, 1993).

A lot of tests on leafy maize hybrids for silage have been performed, recently. These hybrids are characterized by large amounts of leaves, a higher moisture content in grain and softer texture of the corn cob.

Dwyer et al. (1998) reported that in North America about 16 % corn silage is produced from leafy hybrids.

In order to increase the nutritional value of corn silage, for this purpose hybrids with increased oil content are grown waxy (Weiss & Wyatt, 2000; Akay & Jackson, 2001).

Stage of maturity of corn silage is an important factor that dictates digestibility. Ripening of corn increases the overall yield as well as a percentage of participation of the cob (and grains) in total plant mass. However, the accumulation of starch in the grain parallel leads to the reduction in the digestibility of the tree (Struik et al., 1985).

Material and Methods

The research includes the samples of corn silage from 63 farms (Una-Sana Canton, Banja Luka, Kozarska Dubica, Prnjavor, Bijeljina, Bratunac, Modriča, Tuzla Canton and Posavina Canton). The farmers are classified as significant producers of milk with each farmer breeding more than 10 milking cows. The samples were delivered to the laboratory of the Agricultural Extension Service of the Una-Sana Canton.

The following methods of chemical quality of corn silage samples were used:

- Proteins - (sample preparation, digestion, distillation, titration), using Kjeldahl method;
- Cellulose (fiber) - Method manufacturers (Velp) - extractor for cellulose;
- Moisture (dry matter) - automatic hygrometer (Ohaus);
- Mineral matter - method of burning and annealing (burner and furnace annealing).

The results of research were analyzed in the statistical program SPSS 12.

The samples for analysis were taken in 2008, 2010 and 2012.

Results and Discussion

The pH Value

Tab. 1. pH value
pH vrijednost

	2008	2010	2012
Min.	3.39	3.31	3.71
Max.	4.12	7.36	4.86
Average <i>Prosjek</i>	3.81	4.03	4.01

Tab. 2. F – test of pH value
F – test pH vrijednosti

Deviation <i>Devijanse</i>			d.f. <i>br. stepeni slobode</i>	Variance <i>Varijansa</i>	Analysis <i>Analiza</i>			
					F		d.f. <i>br. stepeni slobode</i>	
Source of Variation <i>Izvor varijabilnosti</i>	Amount <i>Iznos</i>	%			Calc. <i>Izračunato</i>	Tab. <i>Tablično</i>	More <i>Veće</i>	Less <i>Manje</i>
Between treatment means <i>Između sredina tretmana</i>	1.96903	3.61	2	0.984518	3.485	2.99	2	186
Residual or sample errors <i>Ostatka ili ogleadne greške</i>	52.5473	96.39	186	0.282513				
Total <i>Ukupno</i>	54.5163	100	188					

The determined value of average pH ranged from 3.81 to 4.03, indicating a good fermentation of silage samples. Statistically, there is a significant difference in pH by years of the testing. This was influenced by very different agro-climatic conditions for production of silage.

Crude Protein Content (%)

Tab. 3. Crude protein content (%)
Sadržaj sirovog proteina (%)

	2008	2010	2012
Min.	5.29	2.40	4.11
Max.	8.57	13.82	7.65
Average <i>Prosjek</i>	6.94	6.82	6.31

Tab. 4. F – test of crude protein content (%)

F – test sadržaja sirovih protein (%)

Deviation <i>Devijanse</i>			d.f. <i>br. stepeni slobode</i>	Variance <i>Varijansa</i>	Analysis <i>Analiza</i>			
					F		d.f. <i>br. stepeni slobode</i>	
Source of Variation <i>Izvor varijabilnosti</i>	Amount <i>Iznos</i>	%			Calc. <i>Izračunato</i>	Tab. <i>Tablično</i>	More <i>Veće</i>	Less <i>Manje</i>
Between treatment means <i>Između sredina tretmana</i>	14.42419	5.39	2	7.212098	5.294	2.99	2	186
Residual or sample errors <i>Ostatka ili ogledne greške</i>	253.37	94.61	186	1.362209				
Total <i>Ukupno</i>	267.80	100	188					

The fortified low crude protein content in the tested corn silage averaged from 6.31 to 6.94%, and it was lower than the average of 8.0 to 8.5% for corn silage containing 40% dry matter (National Research Council [NRC], 2001; Deutsch Landwirtschafts Gesellschaftn [DLG], 1997). Corn silage corn is quantitatively poor in content of crude protein.

Statistically, there is a significant difference in the content of crude protein per years of the research, and as a major factor in the differences of crude protein are agro climatic conditions of production.

Cellulose Content (%)

Tab. 5. Cellulose content (%)

Sadržaj celuloze (%)

	2008	2010	2012
Min.	20.41	18.06	25.91
Max.	40.27	58.77	38.73
Average <i>Prosjek</i>	31.69	31.90	33.99

Tab. 6. F – test of cellulose content (%)
F – test sadržaj celuloze (%)

Deviation <i>Devijanse</i>			d.f. <i>br. stepeni slobode</i>	Variance <i>Varijansa</i>	Analysis <i>Analiza</i>			
					F		d.f. <i>br. stepeni slobode</i>	
Source of Variation <i>Izvor varijabilnosti</i>	Amount <i>Iznos</i>	%			Calc. <i>Izračunato</i>	Tab. <i>Tablično</i>	More <i>Veće</i>	Less <i>Manje</i>
Between treatment means <i>Između sredina tretmana</i>	203.7221	3.82	2	101.8611	3.69	2.99	2	186
Residual or sample errors <i>Ostatka ili ogledne greške</i>	5,132.95	96.18	186	27.5965				
Total <i>Ukupno</i>	5,336.67	100	188					

The results show a high average content of cellulose in tested corn silage samples from 31.69% to 33.99%. The optimum content of cellulose in corn silage is 20% to 25%. The cause of the high content of cellulose of the prepared silage is agro-climatic conditions of production. Statistically, there is a significant difference in terms of cellulose content by years of the research.

Moisture Content (%)

Tab. 7. Moisture content (%)
Sadržaj vlage (%)

	2008	2010	2012
Min.	54.17	52.67	57.47
Max.	74.37	84.99	74.30
Average <i>Prosjek</i>	68.48	68.75	68.43

Tab. 8. F – test of moisture content (%)

F – test sadržaja vlage (%)

Deviation <i>Devijanse</i>			d.f. <i>br. stepeni slobode</i>	Variation <i>Varijansa</i>	Analysis <i>Analiza</i>			
					F		d.f. <i>br. stepeni slobode</i>	
Source of Variation <i>Izvor varijabilnosti</i>	Amount <i>Iznos</i>	%			Calc. <i>Izračunato</i>	Tab. <i>Tablično</i>	More <i>Veće</i>	Less <i>Manje</i>
Between treatment means <i>Između sredina tretmana</i>	3.69112	0.09	2	1.845562	0.084	2.99	2	186
Residual or sample errors <i>Ostatka ili ogledne greške</i>	4,091.93	99.01	186	21.99965				
Total <i>Ukupno</i>	4,095.62	100	188					

The fortified average moisture content ranged from 68.43 to 68.75%; that indicates the preparation of silage at the optimum stage of maturity of maize, which is very important. It is not noticed a statistically significant difference in moisture content.

Mineral Matter Content (%)

Tab. 9. Mineral matter content (%)

Sadržaj mineralnih materija (%)

	2008	2010	2012
Min.	1.54	1.15	1.11
Max.	3.83	3.51	3.34
Average <i>Prosjek</i>	2.45	2.31	2.05

Tab. 10. F – test of mineral matter content (%)

F – test sadržaj mineralnih materija (%)

Deviation <i>Devijanse</i>			d.f. <i>br. stepeni slobode</i>	Variance <i>Varijansa</i>	Analysis <i>Analiza</i>			
					F		d.f. <i>br. stepeni slobode</i>	
Source of Variation <i>Izvor varijabilnosti</i>	Amount <i>Iznos</i>	%			Calc. <i>Izračunato</i>	Tab. <i>Tablično</i>	More <i>Veće</i>	Less <i>Manje</i>
Between treatment means <i>Između sredina tretmana</i>	5.112585	9.73	2	2.556293	10.028	2.99	2	186
Residual or sample errors <i>Ostatka ili ogledne greške</i>	47.41289	90.27	186	0.254908				
Total <i>Ukupno</i>	52.52548	100	188					

The determined average mineral matter content from 2.05 to 2.45 indicates the proper preparation of corn silage, primarily the height of cut corn silage.

Conclusion

According to conventional chemical indicators of quality silage (pH, crude protein, cellulose, moisture and mineral matter), it can be concluded that all the tested parameters are typical for silage that was prepared in the later stages of maize plant.

Agro climatic conditions have a great impact on the quality. Therefore, it can be concluded that while applying the agrotechnics of corn silage, it must be taken into account the choice of hybrids for sowing (planting drought tolerant hybrids), while irrigation should be applied wherever possible, as well.

One of major factors is the lack of new and adequate mechanization for preparing corn silage.

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Kontrola kvaliteta kukuruzne silaže na farmama za proizvodnju mlijeka u sjevernom dijelu Bosne i Hercegovine

Midhat Glavić¹, Aleksandra Budiša¹, Senad Osmanagić¹,
Amir Hasić², Amir Zenunović²

¹*FARMA Founded by USAID/SIDA, Tuzla, Bosna i Hercegovina*

²*Poljoprivredni zavod, Tuzla, Bosna i Hercegovina*

Sažetak

Cilj ovog istraživanja bio je praćenje kvaliteta kukuruzne silaže na farmama u periodu od 2008. do 2012. godine i poređenje kvaliteta silaže po godinama istraživanja. Urađena je analiza kukuruzne silaže na 65 farmi iz sjevernog dijela Bosne i Hercegovine, gdje je i najveća proizvodnja sirovog mlijeka (oko 85%) od ukupne proizvodnje u BiH. Srednja vrijednost sirovih proteina (SP) po godinama istraživanja je 6,94% u 2008. godini; 6,82% u 2010. godini; i 6,31% u 2012. godini. Kiselost (pH), srednja vrijednost po godinama istraživanja je 3,81 u 2008. godini; 4,03 u 2010. godini; i 4,01 u 2012. godini. Srednja vrijednost celuloze (SC) po godinama istraživanja je 31,69% u 2008. godini; 31,9% u 2010. godini i 33,99% u 2012. godini. Sadržaj vlage (SV), srednja vrijednost po godinama istraživanja je 68,48% u 2008. godini; 68,75% u 2010. godini i 68,43% u 2012. godini.

Ključne riječi: protein, celuloza, kiselost, vlaga

Midhat Glavić
E-mail address: midhatg2000@yahoo.com

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