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Nutritive Value of High Moisture Corn Grain Silage

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Abstract: The procedure of ensiling high moisture corn (HMC) is based on its harvesting, grinding and storing in different structures with a moisture content of 30-40%. By means of compression of the ground HMC, anaerobic conditions, suitable for the development of lactic acid fermentation are established. This way of storing enables, even in poor weather conditions, when it is difficult to use drying or some other method, achieving the maximum utilization of the ensiled grain of the high yielding, late maturing corn hybrids. The storing of HMC is intensified, especially when the weather conditions are not favorable and when drying would be too expensive. However, such silage is not the commodity intended to market and, therefore must be consumed right on the farm where it is produced. It is understood that the HMC silage producing farms must have cattle and swine units. This investigation pointed out that practically there were no differences between the chemical composition of the HMC ensiled in bunker silo and silo tower.

Key words: High moisture corn, silage, bunker silo, silo tower, chemical composition.

Introduction

Hot air drying in the grain dryers makes the corn production more expensive. Because of that storage of the high moisture corn (HMC) is gaining in popularity in actual practice. The point of this method is based on harvesting, grinding and storing with a moisture level of 30-40%, then it must be compressed in order to establish the anaerobic conditions and the rest of work is done by the lactic acid fermentation. After Vuckovic and Kovcin (1978) this method of corn storing ameliorates its nutritive value in comparison with the artificially dried corn. Besides, it sets free the ploughed land areas in due time and enables ploughing, soil preparation and sowing to be done within optimum time. According to Cobic et al. (1983) the corn silage production makes the usage of plough lands more rational. Since the same crop can be used for many different purposes (grain, dried ear, high moisture corn, entire plant) so that the harvesting can be adjusted to meet the demands of production. Ensiling enables the conservation of feed under less favorable weather conditions, when no other method can be applied, such as drying for example. In such a way, it is possible to make the most of the high yielding and late maturing corn hybrids.

However, Markicevic (1978) emphasizes that such silage is not a commodity for market, which means that it must be consumed on the place of its production. It is well understood that HMC silage producing farms must have cattle and swine units.

Material and method

The investigations were carried out at the Agro-Industrial Complex (AIC) Becej in Becej. For the purpose of ensiling of HMC, the following medium late maturing corn hybrids were used, NS-606, NS-640, NS-677, ZP-704, and ZP-753, all grown at usual time for sowing. The crop density was as suggested for the dry corn production. Usual technology of growing was provided, but under dry farming conditions.

Harvest was performed, using CASE -527 combine harvester at the stage of the moisture grain content of more than 32-35% i.e. at full dough stage. Different silo structures were used for ensiling of the HMC such as concrete bunker silos and silo towers. In order to establish anaerobic conditions, for as short time as possible, the silo was covered with a plastic sheet just after being filled up with the ground HMC

For the purpose of testing the quality of the ensiled HMC in trench silo, samples were taken from three different depths. The first was taken from 1 m from the top, the second from the middle of silo and, the third 1 m from the bottom.

Samples from silo tower were taken at delivery auger.

Using standard methods of the Laboratory of Feeds Quality Research within AIC Becej at Becej, samples were analyzed for crude protein (CP), ether extract (EE), crude fiber (CF) ash, as well as for calcium, phosphorus and pH.

Contents of lactic, acetic and butyric acids were also found.

The estimation of organoleptic traits like color, odor and structure was also given.

Besides, the quality of silage was estimated according to Kolarska and Pavlicevic (1970) on the basis of chemical composition, pH, presence of single organic acids and organoleptic traits, which, at the same time, represent the silage usability.

Results and discussion

Based on the analytical data, the quality of HMC ensiled in bunker silo and silo tower is presented in tables 1 i 2.

Tab.1. Moisture content (%), chemical composition (% dry matter), pH and organic acids content (%) of HMC ensiled in bunker silo and silo tower

Indices of quality	Bunker silo Depth				
	I	II	III	Average	Silo tower
Moisture content	37.80	34.80	38.90	37.17	29.05
CP	9.05	9.32	8.71	9.03	9.17
CF	3.30	3.00	3.12	3.14	5.14
EE	3.36	3.95	4.85	4.05	4.18
Ash	1.87	2.00	1.45	1.77	1.41
- P	0.26	0.27	0.21	0.25	0.29
- Ca	0.26	0.15	0.07	0.16	0.12
NFE	82.42	81.73	81.86	82.01	82.01
Ph	3.59	3.53	3.36	3.49	3.86
Lactic acid	1.40	1.59	1.96	1.65	1.11
Total acetic acid	0.37	0.31	0.87	0.52	0.25
Total butyric acid	0.0	0.0	0.02	0.006	0.0

At different depths of sampling, the moisture in HMC ensiled in bunker silo was found to be 37,2%. It seems that somewhat higher moisture level (38,9 %, 3 rd depth) makes the protein content (8,71%) drop down and vice versa at the moisture content of 34,8% (2 rd depth) the level of crude protein in HMC sample was 9,32%. Regardless of the sampling depth, crude protein content proved to be very satisfactory (on the average 9,03%).

Depending on the sampling depth, the ether extract values ranged from 3,36-4,85%, whereas the content of crude fiber was within the range of 3,00-3,30%. The value for the ash content was on the average 1.77%, whereas P and Ca contents were 0,25% and 0,16%, respectively.

Since the corn, as such, is a carbohydrate feed, the level of nitrogen free extractives was found to be 82,01% (Tab.1.).

As far as the presence of organic acids is concerned, the lactic acid content should be especially emphasized in the context of its role in preserving.

The average lactic acid content, derived from the same values for all the three depths of sampling was 1,65%. Total values for acetic acid were by far less than those of lactic acid (0,52 %), while the content of butyric acid was so low that it can practically be neglected.

Not so high differences existed between the same values from the samples analyzed from both types of silos. The content of all the nutrients in the sample taken from silo tower were within the values obtained for the trench silo sample. In comparison with the crude fiber content in the HMC silage from bunker silo (3,14%), the same value in the sample taken from silo tower was 5,14%, the difference being only 2% on behalf of the silage from silo tower. Acidity in the silo tower sample (3,86) was somewhat less than that achieved in bunker silo (3,49).

Although no butyric acid was found in the silage from silo tower, total content of acetic acid 0,25%) was not good enough to get the best evaluation.

Though, having in mind the possibility of better compression, the HMC silage in silo tower is expected to be of better quality, it was contrary in this case. Silage from trench silo got an average number of points 32,6 and, therefore, an excellent evaluation. At the same time it means that, if full attention is paid to the process of ensiling in bunker silo, top quality silage can be expected.

Tab.2. Evaluation of quality (points) of the HMC ensiled in trench and tower silos (according to Kolarska and Pavlicevic, 1970)

Indices of quality	Bunker silo Depth			Average	Silo tower
	I	II	III		
pH	4	4	2	3.3	2
Total acetic acid	4	4	1	3.0	1
Total butyric acid	12	12	12	12.0	12
Color	13	4	4	3.6	4
Odor	6	7	7	6.6	7
Structure	4	4	4	4.0	4
Total No of points	33	35	30	32.6	30
Evaluation of quality	Excellent	Excellent	Very good	Excellent	Very good

As for relationship between the moisture content and protein content in the ensiled HMC, Benkovic (1981) came to the same conclusion like we did in this investigation. Namely, he asserts that the protein content in HMC silage depends on the moisture content. In other words, if the moisture content in silage is 25%, in this case the protein content is about 6,58%. However, if the water content is as high as 37-40% the protein content will be about 5,01%. Thus, the lower moisture content in silage, the higher protein content, and *vice versa.*

Kolak et al. (1982), Maricic (1984) dealing with the presence of organic acids in HMC silage, obtained the higher maximum values for the lactic acid content, (2,55% and 2,76%), respectively in relation to the same values obtained

in this investigation. As far as the acetic acid is concerned, the values we obtained are within the range got by the above mentioned authors.

Conclusion

This investigation proved that silage made of the HMC might be of very good and excellent quality with a high participation of crude protein, ranging from 9,03% (bunker silo) to 9,17% (silo tower), with ether extract ranging from 4,05% (trench silo) to 4,18% (silo tower).

Under existing circumstances in Yugoslavia, this method of storing grain corn is very recommendable to be practiced, on both, private and public farms.

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HRANLJIVA VREDNOST SILIRANOG VLAŽNOG ZRNA KUKURUZA

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Rezime

U radu je prikazan kvalitet visoko vlažnog zrna kukuruza siliranog u horizontalnom ili bunker silosu i vertikalnomsilosu ili silo tornju. U bunker silosu, udeo vlage u siliranom zrnu je bio 37,17%, dok je u silo tornju udeo vlage bio 29,05%. U oba tipa silosa postignute su odgovarajuće pH vrednosti (u bunker silosu 3,49, a silo tornju 3,86). Na osnovu pH, udela mlečne, sirćetne i buterne kiseline i organoleptičkih osobina, u oba tipa silosa kvalitet silaže je bio vrlo dobar i odličan