Corn Silage Quality in Vojvodina Province in Two Seasons

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Abstract

Corn is one of main crops in Serbia's northern province of Vojvodina, and one of most important export products of Serbia. While majority of corn is used for grain production, lesser part is harvested for whole crop silage and used predominantly for cattle feeding. Irrigation is not widespread practice ("dry farming") and corn silage yield and quality are under strong influence of season specific factors. Data on nutritional quality of corn silage samples from two seasons were obtained from Laboratory for quality control of feed and animal products of Department of Animal Science in Novi Sad, and used for comparison. Total of 80 samples were used. Corn silage samples from two seasons differed significantly in majority of analyzed parameters (crude fiber, crude fat, NDF, ADF and ADL) and observed differences can be attributed to different grain yield in two seasons. Corn silage samples from season with higher grain yield had significantly more fat, significantly less fiber (crude, NDF, ADF, ADL) and almost significantly (p=0,05) less crude protein. Differences in levels of dry matter and crude ash were not observed.

Keywords: corn silage, forage quality, fiber

1. Introduction

Serbia's northern province of Vojvodina is mainly arable farmland used for production of field crops, mostly corn, wheat, sunflower, soybeans and sugar beet. Out of one million hectares used for corn production in the Republic of Serbia, approximately 600 000 hectares are in Vojvodina province [1]. The amount of corn grain produced usually far exceed amounts used by domestic animal farming and industry, so corn grain is one of most important export products of Serbia with approximately 2 million tons being exported annually [1]. One of alternative uses of corn is production of whole plant corn silage that makes excellent ruminant feed. Over the course of last century corn silage become dominant forage for dairy cows and fattening cattle in Vojvodina province.

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Growing conditions of Vojvodina province are well suited for corn production, except often low rainfall, with average of 600 mm annually and high variability [2]. Despite some attempts by Serbian authorities to increase use of irrigation, vast majority of corn is produced in conditions of "dry farming". This results in quite variable corn grain yield from year to year. In the same time, it also affects both yield and quality of main forage used in cattle farming in Vojvodina province, corn silage. Strong correlation between forage corn yield and rainfall during growing season, rainfall during May and rainfall during August have been demonstrated for Vojvodina province [3]. Also, strong correlation was found between rainfall and corn grain yield [4].

Whole plant corn silage is palatable forage rich in fiber and starch, with low and not very variable amount of protein. Main factors determining corn silage quality, beside absence of mycotoxins, unwanted yeasts and bacteria and unwanted fermentation products, are fiber level and its lignification and the level of starch. Corn silages with lower fiber levels, low lignifiaction and higher starch are usually ingested in larger

amounts by ruminants, digested more easily and provide ruminants with more energy [5,6].
It is very important to access forage quality and to adjust supplementary portion of ruminant daily ration according to it. Unfortunately, this is not common practice in Serbia. Due to small farm size [7], animal nutrition management is usually not very intensive and do not rely on feed analysis. Only a small number of large farms analyze their forage quality commonly.

2. Materials and methods

Data used for comparison was obtained from Laboratory for quality control of feed and animal products of Department of Animal Science in Novi Sad. Data on corn silage samples submitted to analysis by farms and organizations located in Vojvodina province were used.
Samples submitted to analysis between October 2013 and July 2014 had been attributed to the harvest of 2013, and samples submitted between October 2014 and July 2015 had been attributed to the harvest of 2014. Only samples analyzed for at least four of following parameters were included in comparison: moisture (dry matter), crude protein, crude fiber, crude fat, ash, neutral detergent fiber, acid detergent fiber and acid detergent lignin.
Moisture content (MC) was determined as weight loss after drying (AOAC Official Method 934.01). Crude protein (CP) was analyzed according to standard Kjeldahl method (AOAC Official Method 2001.11), while crude fat content (EE) was determined as petroleum ether extract (AOAC Official Method 991.36). Crude fiber (CF) was determined according to AOCS Approved Procedure Ba 6a-05 (AOCS, 2005). Ash content was obtained by applying dry ashing at 600 °C during 2 hours (AOAC Official Method 942.05). Nitrogen-free extract (NFE) was calculated as follows: NFE (%) = 100 - MC (%) - CP (%) - EE (%) - CF (%) - Ash (%).
Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined using ANKOM Fiber Analyzer, following methodology recommended by producer.
Total of 41 samples for harvest of 2013 were used, with 36 to 41 data on each parameter and total of 39 samples for harvest of 2014, with 25 to 39 data on each parameter. Comparison was made using t test with p value of 0.05.

3. Results and discussion

Average qualities of corn silage samples from harvests of 2013 and 2014 are shown in Table 1, together with standard deviations, coefficients of variation and number of data on each parameter. Average dry matter levels in both years are within usual recommendation for corn silage [8], but with high standard deviation indicating that corn was often harvested out of the optimal harvesting period. Corn silage quality in Vojvodina province is very similar to the average corn silage quality in meta-analysis [9], except somewhat higher variability of most parameters and higher lignin content.
Difference in crude protein level between seasons was almost statistically significant, while ash level was quite similar in two seasons. Main difference between silages from two harvests was fiber content. Silage from harvest of 2014 had significantly less crude fiber, NDF, ADF and ADL. All these values were 14% lower indicating very different fiber level, but very similar fiber composition in two seasons. Also, silage from 2014 had significantly more crude fat and NFE. Higher NFE content is probably due to more starch.
Observed differences were not just statistically significant, but also quite large. Difference of 7% of NDF certainly could affect dry matter intake, digestibility and energy value of ration [5], under the usual conditions where corn silage makes large part of the ration. Assuming the usual dairy cow ration, with 20 kg of dry matter, including typical 8-9 kg of dry matter from corn silage, it would be necessary to include about 2 kg more of cereal grains to obtain same NDF level, when using silage with 7% NDF more.

Table 1. The comparison of quality of corn silage from two harvests[1].

	Dry matter	Crude protein	Crude fiber	Crude fat	Ash	NFE[2]	NDF[3]	ADF[4]	ADL[5]
Corn silage from harvest of 2013									
Average	33%	8.4%	24%	2.4%	4.3%	61%	47%	27%	3.6%
SD	7%	1.6%	4%	0.5%	1.0%	5%	7%	4%	1.1%
CV	23%	20%	16%	21%	24%	8%	14%	16%	30%
N	41	41	36	36	41	36	39	39	39
Corn silage from harvest of 2014									
Average	35%	7.7%	20%	2.7%	4.1%	65%	40%	23%	3.1%
SD	5%	1.0%	5%	0.4%	0.9%	5%	8%	3%	0.8%
CV	14%	13%	22%	17%	22%	8%	19%	13%	25%
N	39	29	29	28	28	28	33	25	25
t test									
p value	0.34	0.051	0.00	0.01	0.43	0.00	0.00	0.00	0.046

[1]All values except dry matter are expressed on dry matter basis.
[2]NFE = Nitrogen-free extract
[3]NDF = Neutral detergent fiber
[4]ADF = Acid detergent fiber
[5]ADL = Acid detergent lignin

Differences in silage quality could easily be linked with differences in corn grain yields in those two years [10], as shown in Table 2.

Table 2. Corn grain yield in Serbia in two years (t/ha)

	Republic of Serbia	Province of Vojvodina
2013	6.0	7.0
2014	7.5	8.8

Same year that resulted in higher grain yield also resulted in higher percentage of grain in forage corn. Higher grain percentage increased NFE and fat levels while lower percentage of stalks and leaves reduced fiber levels. Almost significant difference in protein level could possibly be explained in the similar way.

4. Conclusions

Corn silage quality can change significantly due to the influence of a season. Therefore, using the same corn hybrid and the same silage preparing technology, can't guarantee stabile silage composition under the conditions of "dry farming". Instead, farmers should be prepared to check silage quality each year and to adjust supplementary part of ration according to quality of particular silage they are using currently. Failure to do so certainly leads to unbalanced ration and negative nutritional and economic results of its usage.

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