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DETERMINING EFFECT OF STRAW AND INOCULANT ADDITION ON SILAGE QUALITY OF SUGAR BEET LEAVES SILAGE

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Abstract

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Aim of this study was to investigate addition of wheat straw (WS) and inoculant to sugar beet leaves silage nutrient composition, silage quality and silage acids. Experimental groups consisted of control (sugar beet leaves. SBL), SBL+ 2 mL or 4 mL/ inoculant kg silage material, 90% SBL + 10% WS+ 2 mL or 4 mL inoculant kg of silage material. While addition of inoculant did not have effect on DM, ash, ADF and CP content of silages, it increased NDF content of silages in general ($P<0.05$). Addition of WS increased DM, ADF and NDF content however it decreased CP content ($P<0.05$). Addition of WS and inoculant decreased pH value of silages and increased Fleig score ($P<0.05$). Physical and sensory scores of silages were not affected from WS and inoculant addition except 2 mL inoculant containing group. Inclusion of WS and inoculant decreased ammonia N level of silages ($P<0.05$). In vitro DM digestibility was not affected from inoculant addition but it was decreased with addition of WS ($P<0.05$). Inoculant inclusion did not affect lactic acid content however WS decreased lactic acid content of silages. In this study, propionic and butyric acids were not detected in any silage. As a conclusion, inclusion of inoculant did not have a desired improvement on SBL silages. However, WS addition increased silage quality via increasing DM content and Fleig scores of SBL silages.

Key words: sugar beet leaves silage; inoculant; straw; silage quality; *in vitro* digestibility

Introduction

Supplying nutrient requirements of ruminant animals only with concentrate feeds is not sufficient and possible. Addition to concentrate feeds usage of fresh or dried roughages and silages are required for cheap diet formulation and health status of ruminants. Sugar beet leaves are consumed eagerly as a fresh or dried and ensiling due to their nutrient contents of leaves by ruminants (Akyildiz, 1983). Sugar beet leave has low level of dry matter and crude fiber in contrast to its high ash content (Yuksel et al., 1998). Therefore, ensiling of sugar beet leaves to preserve nutrient contents and protecting them from molding are become more an issue (Deniz and Tuncer, 2003). Pimlott (1991) reported that approximately 80% of total beet tops were ploughed into soil and only 2% was ensiled and the leaves consist 80-85% of whole tops. Corporaal (1987) reported that ensiling sugar beet leaves with straw (3:1 ratio) increased dry matter content however its nutritive value was still low. He suggested that this silage is only suitable for young animals or dry cows. Addition of straw or hay to sugar beet leaves prior to ensiling have been suggested to increase dry matter content and decrease loss with silage effluent by same researcher. Beckhoof (1977) indicated that chopping leaves of sugar beet increased the amount of effluent from the silo and lowered pH values, NH_3-N and butyric acid contents. Sugar beet leaves also can be used as an organic fertilizer for crop production however Beiss (1986) concluded that sugar beet leaves are more appropriate as an animal feed than as an organic fertilizer.

Weinber and Muck (1996) reported that although, homofermentative lactic acid bacteria (LAB) are not always advantageous, these inoculants have been used as commercially bacterial inoculants due to their fast and efficient pro-

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ducers of lactic acid. Other advantages of bacterial inoculants are intensive and easy usage, safer natural products for environment (Ozduven et al., 2009). In addition to improvement of crop silage quality, inoculants improved milk yield, gain, and feed efficiency in some studies (Kung et al., 2003).

Aim of this study was to investigate addition of wheat straw (WS) and inoculant to sugar beet leaves silage nutrient composition, silage quality and silage acids.

Materıals and Methods

Silage Preparation

Sugar beet leaves obtained from a small farm in Kayseri Province at October 2014 and wheat straw (grain included) provided from Animal Research Unit of Harran University were used as study materials. Sugar beet leaves were chopped into 1-1.5 cm pieces for desired size to ensile without wilting. *Basillus subtilis* (1.7 × 109 CFU/g) containing commercial inoculant source was used. Experimental groups consisted of control (sugar beet leaves, SBL), SBL+ 2 mL or 4 mL/ inoculant kg silage material, 90% SBL + 10% wheat straw (WS)+ 2 mL or 4 mL inoculant kg of silage material. Following sufficient mixing of each combination, mixture was packed tightly in 1 L jars with 4 replicates per combination by hand pressing with orange juicer. Jar lids were drilled with knife and jars were leaved upside down for 48 h to drain excess water then holes were sealed with rubber tape and leaved for incubation at room temperature.

Physical and Chemical Analysis

All silage jars were opened following 60 d of ensiling. Dry matter contents and pH values of the silages were measured after opening of jars. Dry-matter contents of the silages were measured by drying approximately 25 g of the ensiled material at 105°C for 24 h in a forced-air oven and weighing it. A total of 25 g of fresh silage material was broke into pieces with 100 mL distilled water with vegetable blender for 2-3 minutes determining of pH, NH_3-N and volatile fatty acids (VFA). Blended samples were filtered through two layers of cheesecloth and immediately pH values of the filtrate were detected with a laboratory pH meter (WTM.noLab – pH 7310). The NH_3-N content of silages was determined by the Kjeldahl method according to Broderick and Kang (1980). Lactic acid and VFA were measured according to method reported by Suzuki and Lund (1980) using high-performance liquid chromatography (HPLC: Shimadzu L.C-20 AD HPLC pump, Shiimadzu SIL-20 ADHT Autosampler, Shimadzu SPD M20A Detector (DAD), Shimadzu cto-20ac Columun oven, Icsep Corogel (87H3 colon).

The below equation reported by Kilic (1984) was used to calculate Fleig points of silages:

$$\text{Fleig points} = 220 + (2 \times DM\% - 15) - 40\times pH$$

where Fleig points refer to values between 0 and 20, worthless; 21-40 modorate quality; 41-60 satisfying quality;61-80 good quality; 81-100 very good quality.

Silage samples were dried and then analyzed for DM, OM, ash, and CP by procedure of AOAC (1990). NDF and ADF contents were determined according to the procedure of Goering and Van Soest (1970). In vitro dry matter digestibility (IVDMD) of silages was determined according to the procedure described by Tilley and Terry (1963). Ruminal fluid inoculum was obtained via ruminal probe from Kilis male goats fed diet based on corn silages.

● Data of this study were analyzed in a completely randomized design (CRD) using GLM procedure of SAS. The means of treatment were compared using LSD comparison test of SAS (1989).

Results and Dıscussıons

Effect of WS (includind grain) and inoculant addition on nutrient composition of SBL silages are presented in Table 1. Addition of inoculant to SBL did not affect DM content of silages but WS inclusion increased DM content comparison with control SBL silages (P<0.05). DM content(12.59%) of

Table 1

Effect of WS (including grain) and inoculant addition on nutrient composition of SBL silages

Treatments	DM	Crude Ash*	ADF*	NDF*	CP*
Sugar beet leaves (SBL)	12.59^{c}	21.46^{b}	14.20^{e}	33.64^{e}	23.52^{a}
SBL + 2 mL/kg inoculant (I)	11.97^{c}	22.39^{a}	14.43^{e}	37.02^{d}	23.37^{a}
SBL+ 4 mL/kg I	12.65^{c}	22.24^{a}	17.35^{d}	38.68^{d}	23.47^{a}
SBL+10 % Wheat Straw (WS)	19.05^{a}	16.29^{d}	29.68^{b}	49.63^{b}	18.60^{c}
SBL+ 10%WS+ 2 mL/kg I	19.44^{a}	16.31^{d}	28.73^{b}	52.70^{a}	18.05^{c}
SBL+ 10%WS+ 4 mL/kg I	19.73^{a}	16.95^{d}	33.32^{a}	50.99^{ab}	18.30^{c}
SEM	0.30	0.23	0.96	0.91	0.33

$^{a\text{-}c}$ For each column, mean values with different letters are significant at P<0.05;

*: Values based on DM (% of DM)

SBL silages were determined less than some studies (Azman et al., 1997; Ak et al., 2003; Can et al., 2003) and similar with value reported by Kilic (1984).

● In current study, addition of inoculant did not change DM content of silages. This result is in agreement with result of Kung et al. (2003) ve Sultany (2015). DM content of silages rised with addition of WS. This increament can be explaned higher DM content of WS (92.04%). Inclusion of inoculant increased crude ash content of silages whereas WS did not affect it. In contrast to current study, Inoculant inclusion increased crude ash content in previos studies of Aydin (2014) and Sultany (2015).

Inclusion of inoculant increased ADF (except 2 mL/kg) and NDF contents comparison to control treatment ($P<0.05$). ADF (14.20%) and NDF (33.64%) values of control SBL silages were found similar with values reported by Can and ark. (2003). Higher ADF and contents of WS raised ADF and NDF contents of silages ($P<0.05$). Whilst addition of inoculant did not change the CP content of silages, WS addition decreased CP content ($P<0.05$). Inoculant addition lowered (Aydin, 2014), increased (Sultany, 2015) and did not affect (Denek et al., 2011) CP content of silages in previous studies. CP (23.52%) values of control SBL silages value is found similar to values (22.29%) of former study carried out by Can et al. (2003).

Effect of WS and inoculant addition on pH value, Fleig point, physical and sensory evaluation points and NH_3-N content of silages are presented in Table 2. WS and 4 mL inoculant addition decreased pH value of silages ($P<0.05$). pH value (3.98) of control SBL silage was found higher (3.70) (Can et al., 2003) and similar (3.85) (Azman et al., 1997) in previous studies. While addition of 4 mL/kg lowered pH value of SBL silage in current study, same inoculant did not affect pH value of alfalfa silages at previous study of Sultany (2015).

Addition of WS to silages raised Fleig points and their values were ranged in very quality but inoculant inclusion lowered the SBL values ($P<0.05$). Fleig point of SBL silage in current study was less than formerly reported value of Can et al. (2003). In contrast to this study, Sultany (2016) reported that inclusion of same inoculant did not affect Felig points of Alfalfa silages. Physical and sensory evaluation point of silages were determined simalar except of 2 mL/kg level which was deminished physical and sensory evaluation point. All of the silages refered to very good quality. Not only WS both also inoculant addition to SBL silage decreased NH_3-N values ($P<0.05$). Carpintero et al. (1969) reported that less than 11 % NH_3-N of total N in silages indicator of desired silage fermentation. All silages had lower values than 11% NH_3-N in our study.

Effects of WS and inoculant addition on IVDMD, lactic acid and VFA content were presented in Table 3. Whilst of inoculant addition did not affect IVDMD, WS decreased digestibility values ($P<0.05$). Inoculant addition improved organic matter digestibility of silages in previous studies (Denek et al., 2011; Aydın, 2014; Sultany, 2015). This diference might be releated with varing nutrient contents of silage materials (Alfalfa vs SBL) or chosen inoculant types (*Lactobacillus plantarum* vs. *Basillus subtilis).*

Addition of WS to silages decreased IVDMD of silages as a expected ($P<0.05$). Similarly, Denek and Can (2002) reported that addition of 15% WS or 20% WS to tomato pomace silage lower in vivo DM, OM, CP, ADF, and NDF digestibility. This can be explained higher cell wall content and lower digestibility of WS.

Whilst inclusion of inoculant did not affect lactic acid content of silages, WS addition lowered lactic acid contents ($P<0.05$). Low soluble carbohydrate content of WS probably resulted with lowering lactic acid content of silages. Kung

Table 2
Effect of WS and inoculant addition on pH value, Fleig point, physical and sensory evaluation points and NH_3-N content of SBL silages

Treatments	pH	Fleig Point*	Physical and sensory evaluation points***	%NH_3 N***
Sugar beet leaves (SBL)	3.98^b	71.08^b	18.25^a	9.26^a
SBL + 2 mL/kg inoculant (I)	3.98^b	69.83^c	14.75^b	7.89^b
SBL+ 4 mL/kg I	4.11^a	65.61^c	19.25^a	8.46^b
SBL+10 % Wheat Straw (WS)	3.83^c	90.01^a	20.00^a	6.38^{cd}
SBL + 10% WS +2 mL/kg I	3.83^c	90.88^a	20.00^a	6.77^c
SBL + 10% WS +4 mL/kg I	3.84^c	91.03^a	19.00^a	5.73^d
SEM	0.04	1.56	1.04	0.31

$^{a-d}$ For each column, mean values with different letters are significant at $P<0.05$

*:Points refer to 81-100 “very good”, 61-80 “good”, 41-60“satisfactory”, 21-40‘modorate”, 0-20“worthless”

**Points refer to10-15 “very good”, 7-9“good”, 5-6 “moderate”, 0-4 “worthless”

*** Percentage of total nitrogen

Table 3
Effects of WS and inoculant addition on IVDMD, lactic acid and VFA content of SBL silages

Treatments	IVDMS	LA g/kg	AA g/kg	PA g/kg	BA g/kg
Sugar beet leaves (SBL)	80.82[a]	80.29[a]	15.78[ab]	–	–
SBL + 2 mL/kg inoculant (I)	79.40[a]	74.12[a]	13.25[ab]	–	–
SBL+ 4 mL/kg I	75.82[ab]	75.27[a]	14.61[ab]	–	–
SBL+10 % Wheat Straw (WS)	66.81[cd]	57.10[b]	14.18[ab]	–	–
SBL + 10% WS +2 mL/kg I	62.55[d]	55.71[b]	13.76[ab]	–	–
SBL + 10% WS +4 mL/kg I	63.00[d]	47.86[b]	12.58[b]	–	–
SEM	2.22	4.22	0.98	–	–

[a-d] For each column, mean values with different letters are significant at $P<0.05$
IVDMD : In vitro dry matter digestibility, LA: Lactic acid, AA: Acetic acid, PA: Propionic acid,
BA: Butyric acid

(2010) reported that total acids content of silages consisted of at least 65-70 lactic acids in well preserved silages. In current study all silages had desired level of lactic acid content. Acetic acid content of silages did not affect by both WS and inoculant addition ($P>0.05$). Undesired propionic and butyric acid were not detected in any silage.

Conclusion

According to result of this study, when SBL is considered to preserve with ensiling, use of *Bacillus subtilis* as an inoculant will not have any beneficial effect on silage quality. However, WS addition will improve SBL silage quality via increasing especially DM content and Fleig points. Feeding trials should be carried out to determine effect of WS including SBL silage on live animal performance.

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