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Effect of Prolonging the Time Prioer to Filling into the Silo on Degradation and Digestibility of Structural Carbohydrates of Orchardgrass

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Abstract: Some time forage cut for ensilage takes longer time before being filled into the silo due to due to unexpected problems not on the farmers fault such as mechanical breakdown of farm equipment of difficult weather conditions and some time on the farmers side such as sickness etc. To provide an assessment during such a difficult perio, this study determined the influence of 0, 1 and 2 days (d) delayed period before filling of orchardgrass into a silo on the degradation of its structural carbohydrates and nutritifve value of silages. The nutritive value, of the four treatments (i.e. fresh material of orchardgrass and 0, 1 and 2 days delayed silages) was determined with four wethers in a 4 x 4 Latin square design. Higher ($P<0.05$) contents of acetic acid, butyric acid and ammonia was recorded in 2d silage compared to 0d and 1d delayed silages. Water soluble carbonhydrates losses increased ($P<0.05$) with increased delayed before filling into a silo. The total losses of hemicellulose, cellulose and pectin increased ($P<0.05$) from 7, 3 and 5% in 0d silage to 14, 6 and 24% in 1d silage and to 25, 16 and 44% in 2d silage, respectively. These increased losses in 1 and 2 days silages could be linked to aerobic determioration and prolonged proteolysis of the components before filling as well as during ensiling by microbial activity. Higher dry matter (DM) and crude protein (CP) digestibility was obtained in directly ensiled silage (0d). This probably due to its lower neutral detergent fiber (NDF) content and DM loss associated with its higher total digestive nutrients (TDN) and digestible crude protein (DCP) values compared to 2d silage. Ether extract digestibility was higher ($P<0.05$) in 1 and 2d silages due to increased organic acid content during fermentation. Hemicellulose digestibility was lower in silages compared to material grass probably as result of degradation of araban one of its readily digestible fraction during ensilage. While higher ($P<0.05$) gross energy digestibility was obtained in material grass digestible energy value was lowest in 2d silage. Result from this study conducted in Juen at Obihiro University, Latitude 42.9 N and longitude 143.2 E Japan, showed that delaying the filling of silo for one day did not lower ($P>0.05$) the nutritive value of silage (i.e., DCP % and DE Mcal/kg DM) compared to directly ensiled silage. However, greater decreased ($P<0.05$) in nutritive value was obtained in silage delayed for two days before filling into silo. Althrough is not a common practice to delay filling of forage during ensiling, these results provide some useful information or assessment during such a difficult period to the producers as well as researchers in high quality cool-season grass silage.

Key words: Orchardgrass silage, delayed prior to filling, structural carbohydrates and digestibility

Introduction

Althrough it is not a common practice, some time it became inevitable that forage cut for ensilage takes longer time then necessary before being filled into the silo due to unexpected problems on the farmer side such as sickness. Not the farmers fault, such as difficult weather conditions or mechanical breakdown of farm equipment etc. Much of the recent work was directed towards a study of the effects of prolonged wilting before ensiling or delayed sealing of forages after beign filled into a silo (Bolsen *et al.*, 1996; Elizabeth and Edward 1977; McDonald *et al.*, 1991). However, limited information is available on the effect of delaying the time before filling of forages into a silo after it is being cut for ensilage either voluntarily or due to unforeseen circumstances. As management strategy moderate wilting of high moisture forage before ensiling reduces losses and achieved a lactic acid type of fermentation (Yahaya *et al.*, 2002). Zhang *et al.* (1997) reported that immediately after forage is cut, the activity of plants cell and enzymes of dead tissue continue to undergo oxidative degradation of organic compounds using mostly hexose sugar, which could have some effect during fermentation.

Elizabeth and Edwards (1977) compared silage made with delayed sealing of the silo with those made by ensiling directly and found out that delayed sealing of the silo has an immediate effect in the surface layers of the ensiled material and deterioration occurred in the inner layer after sealing. This study determined the influence of 0, 1 and 2 days delayed period before filling of orcahardgrass into a silo on the degradation of its structural carbohydrates and nutritive value of silage.

Materials and Methods

Silage prepartion: The orchardgrass (*Dactylis glomerata* L.) Was harvested during the early flowering stage around June at the Obihiro University Farm, Latitude 42.9 N. and Longitude 143.2 E. Japan. The grass was cut into 2 to 3cm lengths using a mechanical forage cutter and the entire lots hroughly mixed before dividing into three equal parts. About 38kg of DM from the first part was directly ensiled (0 day stacking) in 3 plastic silos of 120L capacity. The second (42kg DM) and third (41kg DM) parts were stacked outside for 1 and 2 days and ensiled in 3 plastic silos of similar sizes, respectively. Three silos were opened after 56 days (d) of ensiling from the threee groups (total 9) and weighed to determine the extend of structural carbohydarate degradation. Representative sample from each silo was mixed, sub-sampled and the remaining content of the three silos from each groups mixed and frozen at -150°C for the digestion trial.

Digestibility trial: The four treatments (harvested material and 0, 1 and 2 days stacked silages) were fed to four male castrated sheep according to a 4 x 4 Latin square design (Yahaya *et al.*, 2002). Sheep were fed twice daily at a maintenance level (50g (DM)/(kg body weight)$^{0.75}$ at 07:30 and 17:30 hours. Water and mineral s(mineral block contained: Fe 1232, Cu 150, Co 25, Zn 500, Mn 500, I 50, Se 15 & Na 382 mg/kg.

Chemical analyses: The contents of dry matter (DM), crude protein (CP), either extract (EE) Neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) cellulose, hemicellulose, silage pH, water-soluble carbohydrates (WSC). Volatile fatty acids, ammonia, gross energy and nutritive value of silages were analyzed as described previously (Yahaya *et al.*, 2000; 2001). Table 1 shows the chemical composition of material ensiled orchargdgrass.

Statistical analyses: Silage fermentation data was analyzed using ANOVA in a randomized block design (Yahaya *et al.*, 2002), while data obtained from the digestibility trial were analyzed as a 4 x 4 Latin square design, with means differences determined using a multiple range test (Duncan, 1955 and Snedecor and Cochran, 1980).

Table 1: Chemical composition (%) in fresh material orchardgrass

	Grass	0d	1d	2d
Dry matter	23.8	23.8	24.0	25.0
Crude protein	13.7	12.7	13.1	12.9
Ether extract	2.8	2.8	2.9	2.9
Neutral detergent fiber	52.8	52.6	57.9	59.2
Acid detergent fiber	32.8	32.9	38.9	40.2
Acid detergent lignin	6.0	6.0	11.2	13.1
Water soluble crbohydrates	8.2	7.4	6.8	6.0
Structural carbohydrates				
Pectin	4.9	3.5	3.3	3.1
Hemicellulose	20.0	19.7	19.0	19.0
Cellulose	27.2	26.9	27.7	27.1
Grass energy (Mc/kg DM)	4.38	4.38	4.38	4.32

0d=zero day prolonging before filling into silo
1d=one day prolonging before filling into silo
2d=two days prolonging before filling into silo

Results and Discusssion

The composition of silages and their fermentation quality: The chemical composition and fermentation characteristics of silages are shown in Table 2. The DM content was decreased ($P<0.05\%$) in 2d silages. The lower ($P<0.05$) DM content obtained in 2d silage could be due to the prolonged time spent before filling into the silo which resultsed in excessive aerobic deterioration of the material grass at ensiling. The ether extract content was higher in the 1 and 2d silages due to increased contents of organic acid during ensiling. WSC, hemicellulose, pectin and gross energy were significantly ($P<0.05$) lower in 2d silage as a result of their losses during ensiling, in contrast cellulose content increased ($P<0.05$) in 1 and 2d silages. Cellulose is resistant to degradation compared to hemicellulose or pectin.

The fermentation quality of silages in presente din Table 3. The pH value increased ($P<0.05$) in silage with 2 day delayed before filling into the silo. Lactic acid content was higher in directly ensiled silage (0d silage). The increased in pH value observed in 2 days silage probably resulted from decreased contents of WSC, hemicellulose and pectin caused by both aerobic deterioration of the grass and microbial activity during the two days delayed before filling into silo as well as ensiling period. This is also reflected in the silage chemical composition.

Table 2: Chemical composition (5) of silages

	0d	1d	2d	SEM
Dry matter	23.5^{a}	23.3^{a}	23.0^{b}	0.1
	---------- % DM ----------			
Crude protein	13.6	13.9	13.9	0.1
Ether extract	3.0^{b}	3.5^{a}	3.7^{a}	0.1
Neutral detergent fiber	51.4^{c}	56.7^{b}	58.3^{a}	0.1
Acid detergent fiber	32.6^{c}	38.5^{b}	40.5^{a}	0.1
Acid detergent ligning	5.9^{c}	11.2^{b}	13.3^{a}	0.1
Water soluble crbohydrates	2.1^{a}	1.6^{b}	1.4^{c}	<.1
Structural carbohydrates				
Hemicellulose	18.8^{a}	18.3^{b}	17.9^{c}	0.1
Cellulose	26.7^{b}	27.3^{a}	27.2^{a}	0.1
Pectin	3.4^{a}	3.3^{a}	2.8^{b}	<.1
Gross energy (Mc/kg DM)	4.27^{a}	4.18^{b}	4.08^{c}	<.1

Means followed by different superscripts differ ($P<0.05$)
1Each Value indicate means of three silos.
SEM = Standard error of means
0d = zero day prolonging before filling into silo
1d = one day prolonging before filling into silo
2d = two days prolonging before filling into silo

Table 3: Fermentation quality of orchardgrass during ensiling

	0d	1d	2d	SEM
pH	3.90^{b}	4.98^{b}	5.17^{a}	0.04
		-------(organic acids % DM)---------		
Lactic acid	7.20^{a}	5.39^{b}	3.87^{c}	0.12
Acetic acid	0.63^{b}	0.68^{b}	1.17^{a}	0.12
Propionic acid	0.16	0.25	0.18	0.05
Butyric acid	0.05^{c}	1.54^{b}	2.76^{a}	0.17
Valeric acid	1.89^{a}	0.10^{b}	0.16^{b}	0.14
Coproic acid	0.07	0.11	0.09	0.06
Ammonia (% Total N)	6.40^{c}	10.02^{b}	16.04^{a}	0.18

Means followed by different superscripts differ ($P<0.05$)
Each value indicates means of three silo except for grass
0d= zero day prolonging time before filling into silo
1d= one day prolonging time before filling into silo
2d= two days proloning time before filling into silo
SEM= Standard eroor of means

Table 4: Degradation (%) of DM, gross energy, WSC and structural carbohydrates before filling into silo and after 35 days ensiling of orchardgrass

	0d	1d	2d	SEM
degradation during ensiling				
Dry matter	2.3^{c}	3.9^{b}	8.8^{a}	0.2
Energy	4.8^{c}	8.4^{b}	13.8^{a}	0.4
WSC	72.7^{c}	76.9^{b}	78.9^{a}	0.2
Hemicellulose	7.0^{b}	7.9^{b}	14.2^{a}	0.5
Cellulose	3.1^{c}	5.4^{b}	8.5^{a}	0.4
Pectin	4.6^{c}	17.3^{b}	31.8^{a}	1.9
Total degradation (before filling + after ensiling)				
Dry matter	2.4^{c}	7.4^{b}	17.6^{a}	0.2
Energy	4.8^{c}	11.6^{b}	23.3^{a}	0.4
WSC	72.7^{c}	79.4^{b}	84.7^{a}	0.2
Hemicellulose	7.0^{c}	14.1^{b}	25.2^{a}	0.4
Cellulose	3.1^{c}	6.1^{b}	16.7^{a}	0.4
Pectin	4.6^{c}	24.2^{b}	44.3^{a}	1.7

Means followed by different supercripts differ ($P<0.05$)
Each value indicate means of three silos
0d= zero day prolonging time before filling into silo
2d= two days proloning time before filling into silo
WSC = Water soluble carbohydrates
1d= one day prolonging time before filling into silo
SEM= Standard eroor of means

higher digestibility of gross energy was obtained in material grass, in contrast digestible energy value was lower in 2d silage.

Conclusion

Although it is inevitable, some time forages are delayed before or during filling of silo due to unexpected problems on the farmer side, difficult weather conditions or mechanical breakdown of farm equipment etc. Data from this study revealed that delaying the filling of silo for one day did not (P>0.05) lowered the nutritive value of silage compared to directly ensiled silage. However, greater decreased in nutritive value was obtained in silage delayed for two days before filling into silo providing assessment during such a difficult period.

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