

## Effect of Prolonging the Time Prior 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 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 period, 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 nutritive 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 carbohydrates 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 deterioration 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. Although 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

Although it is not a common practice, some time it became inevitable that forage cut for ensilage takes longer time than 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 being 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

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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 orchardgrass into a silo on the degradation of its structural carbohydrates and nutritive value of silage.

### Materials and Methods

**Silage preparation:** 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 thoroughly 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 three groups (total 9) and weighed to determine the extend of structural carbohydrate 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)<sup>0.75</sup> 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), ether 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 orchardgrass.

**Statistical analyses:** Silage fermentation data

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 carbohydrates	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

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).

### Results and Discussion

#### 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 resulted 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 present 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 <sup>a</sup>	23.3 <sup>a</sup>	23.0 <sup>b</sup>	0.1
	----- % DM -----			
Crude protein	13.6	13.9	13.9	0.1
Ether extract	3.0 <sup>b</sup>	3.5 <sup>a</sup>	3.7 <sup>a</sup>	0.1
Neutral detergent fiber	51.4 <sup>c</sup>	56.7 <sup>b</sup>	58.3 <sup>a</sup>	0.1
Acid detergent fiber	32.6 <sup>c</sup>	38.5 <sup>b</sup>	40.5 <sup>a</sup>	0.1
Acid detergent ligning	5.9 <sup>c</sup>	11.2 <sup>b</sup>	13.3 <sup>a</sup>	0.1
Water soluble crbohydrates	2.1 <sup>a</sup>	1.6 <sup>b</sup>	1.4 <sup>c</sup>	<.1
Structural carbohydrates				
Hemicellulose	18.8 <sup>a</sup>	18.3 <sup>b</sup>	17.9 <sup>c</sup>	0.1
Cellulose	26.7 <sup>b</sup>	27.3 <sup>a</sup>	27.2 <sup>a</sup>	0.1
Pectin	3.4 <sup>a</sup>	3.3 <sup>a</sup>	2.8 <sup>b</sup>	<.1
<b>Gross energy (Mc/kg DM)</b>	<b>4.27<sup>a</sup></b>	<b>4.18<sup>b</sup></b>	<b>4.08<sup>c</sup></b>	<b>&lt;.1</b>

Means followed by different superscripts differ (P<0.05)

1Each Value Indicate means of three silos.

SEM = Standard error of means

1d = one day prolonging before filling into silo

0d = zero 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 <sup>b</sup>	4.98 <sup>b</sup>	5.17 <sup>a</sup>	0.04
	----- (organic acids % DM) -----			
Lactic acid	7.20 <sup>a</sup>	5.39 <sup>b</sup>	3.87 <sup>c</sup>	0.12
Acetic acid	0.63 <sup>b</sup>	0.68 <sup>b</sup>	1.17 <sup>a</sup>	0.12
Propionic acid	0.16	0.25	0.18	0.05
Butyric acid	0.05 <sup>c</sup>	1.54 <sup>b</sup>	2.76 <sup>a</sup>	0.17
Valeric acid	1.89 <sup>a</sup>	0.10 <sup>b</sup>	0.16 <sup>b</sup>	0.14
Coproic acid	0.07	0.11	0.09	0.06
Ammonia (% Total N)	6.40 <sup>c</sup>	10.02 <sup>b</sup>	16.04 <sup>a</sup>	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

2d= two days prolonging time before filling into silo

1d= one day prolonging time before filling into silo

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

Means followed by different superscripts differ (P<0.05)

Each value indicate means of three silos

0d= zero day prolonging time before filling into silo

2d= two days prolonging time before filling into silo

WSC = Water soluble carbohydrates

1d= one day prolonging time before filling into silo

SEM= Standard error 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 decrease 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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