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FERMENTATION AND CELL WALL DEGRADATION IN GUINEAGRASS AND ITALIAN RYEGRASS SILAGES

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Abstract

Guineagrass (*Panicum maximum* Jacq.) was ensiled at the room temperature and Italian ryegrass (*Lolium multiflorum* L.) was ensiled at the room temperature and at 30 °C under the laboratory conditions. As a result, the acetic acid silage was made from Guineagrass and the lactic acid silages were made from Italian ryegrass. The loss of cell wall components during ensiling was the most in hemicellulose followed by NDF, but those of cellulose and AD-lignin were slight. In the hemicellulosic monosaccharides, the loss of hexose (galactose and glucose) was relatively high and that of pentose (arabinose and xylose) was relatively low in the three types of silage. The temperature had little effect on the losses from Italian ryegrass, and the loss of hemicellulose was higher in Guineagrass silage than in Italian ryegrass silages.

Keywords: Acetic acid silage, cell wall, Guineagrass, hemicellulose

Introduction

Some tropical grasses appear to produce the silage with a low content of lactic acid and a high content of acetic acid, and this acetic acid silage has proved stable against anaerobic decomposition in the silo (Catchpoole and Henzell, 1971; Sujahta et al., 1986; Kim and Uchida, 1990, 1991). There has been, however, little information about how to produce the acetic acid silage. In this study, we made the silages from Guineagrass (tropical grass) and Italian ryegrass (temperate grass) and observed the fermentation and cell wall degradation during ensiling.

Material and Methods

Guineagrass (*Panicum maximum* Jacq.) and Italian ryegrass (*Lolium multiflorum* L.) were ensiled into a laboratory bag silo at August 20, 1996 and at April 21, 1998, respectively. Their bags were left at room temperature (24-30 °C in Guineagrass, 22-26 °C in Italian ryegrass). Additionally, Italian ryegrass silages were stored at 30 °C in a incubator. The raw materials and the silages were subjected to the determinations for the total non-structural carbohydrate (TNC), NDF, ADF, AD-lignin, cellulose (ADF minus lignin minus insoluble ash) and hemicellulose (NDF minus ADF). For the determination of hemicellulosic monosaccharides, the cell wall residues treated with α -amylase were hydrolyzed by 1M sulfuric acid. The hydrolysates were subjected to the determinations for neutral sugars by GLC (Englyst and Cummings, 1988).

Results and Discussion

Guineagrass and Italian ryegrass before ensiling contained the moisture of 76.2 and 76.4%, TNC of 5.3 and 20.9% in DM and NDF of 67.2 and 60.5% in DM, respectively.

The fermentation characteristics of silages were shown in Table 1. As a result, the acetic acid silage was made from Guineagrass and the lactic acid silage was made from Italian ryegrass. The temperature had little effect on the fermentation of Italian ryegrass silage.

The recoveries of cell wall components and hemicellulosic monosaccharides from silage were shown in Table 2. In the three types of silage, the loss of cell wall components was the most in hemicellulose followed by NDF, but those of cellulose and AD-lignin were very slight. This result indicates that the loss of cell wall during ensiling was largely attributable to that of hemicellulose. The temperature had little effect on the losses of Italian ryegrass silage, and the loss of hemicellulose was higher in Guineagrass silage than in Italian ryegrass silages.

In the hemicellulosic monosaccharides, the loss of hexose (galactose and glucose) was relatively high and that of pentose (arabinose and xylose) was relatively low in the three types of silage. These results mostly agree with the data previously reported (Morrison, 1979; Kawamura et al., 1994). The temperature had little effect on the losses of Italian ryegrass silage, and the losses of hemicellulosic monosaccharides were higher in Guineagrass silage than in Italian ryegrass silages.

The results obtained in this experiment suggest that the low TNC content and the high hemicellulose degradation in tropical grass may both induce the production of acetic acid

silage.

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Table 1- Fermentation characteristics

After ensiling	pH			LA (% of fresh matter)			AA (% of fresh matter)			BA (% of fresh matter)		
	Guinea	Italian		Guinea	Italian		Guinea	Italian		Guinea	Italian	
	RT	RT	30 ^U Y	RT	RT	30 ^U Y	RT	RT	30 ^U Y	RT	RT	30 ^U Y
0	6,11	6,20	6,20	0,01	0,01	0,01	0,00	0,02	0,02	0,00	0,00	0,00
2days	5,15	5,05	4,83	0,38	0,65	0,86	0,35	0,08	0,10	0,00	0,00	0,00
10days	5,15	4,13	4,05	0,38	1,31	1,47	0,53	0,22	0,24	0,10	0,00	0,00
15days	5,20	4,09	3,99	0,27	1,51	1,47	0,60	0,28	0,26	0,20	0,00	0,01
30days	4,94	3,91	3,96	0,09	1,78	1,79	0,88	0,38	0,40	0,32	0,00	0,03
60days	4,79	3,82	3,96	0,03	1,61	1,66	1,25	0,43	0,41	0,42	0,02	0,09
90days	4,88	3,91	3,96	0,02	1,92	1,58	1,19	0,47	0,31	0,44	0,07	0,21
LSD(0.05)	0,18	0,08	0,12	0,04	0,08	0,29	0,26	0,06	0,09	0,16	0,01	0,08
LSD(0.01)	0,26	0,12	0,18	0,06	0,11	0,43	0,38	0,09	0,13	0,24	0,02	0,12

LA:Lactic Acid; AA:Acetic Acid; BA:Butyric Acid; VBN:Volatile Basic Nitrogen; RT:Room Temperature.

Table 2 - Recovery percentage of cell wall componests and hemicellulosic monosacchari from silage.

After ensiling	NDF			AD-Lignin			Cellulose			Hemicellulose		
	Guinea	Italian		Guinea	Italian		Guinea	Italian		Guinea	Italian	
	RT	RT	30 ^U Y	RT	RT	30 ^U Y	RT	RT	30 ^U Y	RT	RT	30 ^U Y
0	100	100	100	100	100	100	100	100	100	100	100	100
2days	100,6	101,1	92,0	100,9	102,8	95,1	100,2	103,0	95,5	100,2	99,1	85,7
10days	98,1	95,0	97,1	91,6	99,4	98,6	102,9	100,1	102,8	88,0	87,4	89,0
15days	94,3	95,2	94,7	85,4	101,1	99,1	98,0	100,1	100,1	89,8	97,5	85,6
30days	92,0	92,8	105,3	95,6	94,9	101,2	98,6	98,5	111,0	79,0	84,7	97,2
60days	86,1	111,1	96,2	96,0	114,2	99,7	95,7	119,5	103,0	63,0	98,6	85,4
90days	89,3	91,0	92,7	99,5	89,1	92,7	98,3	95,9	97,2	67,9	83,8	84,8
LSD(0.05)	4,50	3,21	9,08	7,20	4,13	11,39	3,93	2,67	9,65	10,43	4,56	8,14
LSD(0.01)	6,66	4,74	13,44	10,70	6,10	16,86	5,81	3,96	14,28	15,43	6,75	12,46

After ensiling	Arabinose			Xylose			Galactose			Glucose		
	Guinea	Italian		Guinea	Italian		Guinea	Italian		Guinea	Italian	
	RT	RT	30 ^U Y	RT	RT	30 ^U Y	RT	RT	30 ^U Y	RT	RT	30 ^U Y
0	100	100	100	100	100	100	100	100	100	100	100	100
2days	104,8	98,6	91,3	102,0	97,1	94,4	97,2	97,2	84,5	98,7	88,4	76,0
10days	93,6	93,8	101,6	96,9	98,5	107,9	71,0	85,7	85,4	80,9	69,8	77,1
15days	76,7	95,8	93,0	88,2	102,0	96,0	64,2	82,0	80,7	76,2	71,0	69,2
30days	62,3	84,8	95,7	85,9	89,9	104,8	47,6	73,6	83,2	53,8	61,4	71,3
60days	51,7	103,2	86,5	73,1	112,0	94,9	41,6	87,6	73,6	41,1	69,8	61,7
90days	50,9	90,5	91,7	74,2	93,6	94,5	35,1	80,4	80,6	43,4	70,0	63,9
LSD(0.05)	20,55	5,42	13,12	17,20	4,04	14,17	13,74	5,88	11,50	23,29	4,19	8,07
LSD(0.01)	30,40	8,02	19,41	25,45	5,98	20,97	20,33	8,70	17,01	34,45	6,20	11,93

RT:Room Temperature.