ID # 21-20

FERMENTATION QUALITY OF PHASEY BEAN AND GUINEAGRASS SILAGES

Y. Imura, T. Namihira and Y. Kawamoto

Department of Animal Science, Faculty of Agriculture, University of the Ryukyus 903-0213, Okinawa, Japan

Abstract

Silages were made from guineagrass (*Panicum maximum Jacq. var. maximum*) and phasey bean (*Macroptilium lathyroides (L.) Urb*.) at three-growth stages. The silages were investigated in relation fermentation quality. Phasey bean silage showed a better fermentation quality than guineagrass silage. The latic acid to total acid ratio of phasey bean silage was higher than 500g/kg DM, and the volatile basic nitrogen to total nitrogen ratio was lower than 100g/kg. It is concluded that phasey bean is an unique legume suitable for good silage fermentation.

Keywords: Phasey bean, silage fermentation, tropical legumes

Introduction

Tropical grasses have low concentration of water soluble carbohydrates (WSC), a factor for their poor quality silages (Wilkinson, 1983). Legumes also make no good quality silages because they are highly buffered, generally have low WSC dry matter (DM) contents (McDonald et al., 1991). Still, napiergrass (*Pennisetum purpureum Schumach*) is known to produce good quality silage regardless wilting or use of additives (Yokota et al., 1995). According to Skerman et al. (1988) the tropical legume phasey bean (*Macroptilium lathyroids L*.) has been used in

Uruguay as silage material. Although napiergrass silages have been investigated by many scientists there is few research about phasey bean.

In this experiment, phasey bean was ensiled to examine the possibility of this legume to make good quality silage and characterize the fermentation quality of its silage in comparison to guineagrass silage.

Material and Methods

Silage making

Guineagrass (*Panicum maximum Jacq. Var. maximum*) and phasey bean (*Macroptilium lathyroids (L.) Urb*.) were cultivated at Fukuoka, Japan. These forages were cut for silage at 43, 65 and 79 days after seedling emergence. Growth stages of Phasey bean were: vegetative stage (45 days), early blooming (65 days) and blooming stage (79 days), and those of guineagrass were: vegetative stage (45 days), early heading stage (65 days) and heading stage (79 days). These silages materials were chopped at about 4 cm length by manual chopper and ensiled in 2liter volume experimental silos, in duplicates. Each silo contained 1.0kg (fresh weight) forage material. These silages were stored for about 100days at 20 ^{o}C constant temperature.

Chemical analysis

After opening the silos, about 500g of samples were collected for chemical analysis. Dry matter (DM) of fresh materials and respective silages were determined by air drying at 70^{o}C for 48 hours and corrected for volatile fatty acid and volatile basic nitrogen losses. Total non-structure carbohydrates (TNC) was extracted by hot water and measured by Anthron method (Faichney and White, 1983). Total nitrogen (TN) was analyzed by Kjeldahl method from undried samples. Silage samples were extracted with distilled water and used for measuring volatile basic nitrogen (VBN), pH and organic acid composition. VBN were measured by steam distillation technique. pH of silages was measured using pH meter (Model F13, HORIBA, Japan). Lactic acid (LA) was measured by method of Barker and Summerson, and the acetic acid (AA) and the butyric acid (BA) were measured by gas chromatography (National Grassland Research Institute, 1975). Lactic acid ratio (LA/TA) was calculated according to:

$$LA/TA=LA/(LA+AA+BA)$$

Statistical analysis

Experimental data were submitted to analysis of variance and treatments differences were tested by Duncan's multiple Range Test.

Results and Discussion

Material composition

Composition of fresh ensiled material is presented in Table 1.The DM of Phasey bean at any growth stage did not exceed 200g/kg. This value is thought not adequate to warrant a good silage fermentation. Guineagrass dry matter was also lower than 200g/Kg at vegetative and early heading stages. Only at heading stage its dry matter approached ideal value for a silage material.

Apparently about 30g/kg fresh weight of WSC is required to warrant good quality silage (Haigh, 1990). In the case of temperate grasses, TNC is made up by glucose, fructose, sucrose and storage carbohydrate fructosan. All of this constituents are water-soluble and can be utilized by silage bacteria during storage periods. On the other hand, TNC of tropical grasses contains starch as storage carbohydrate, which is not readily available for fermentation by silage bacteria. Accordingly, it is considered that fermentable substrates present in Phasey bean and Guineagrass are lower than TNC content. Phasey bean at blooming stage and Guineagrass at heading stage have high TNC content, but not as high for proper fermentation.

According to Playne and McDonald (1966) materials with high buffering capacity resist to pH drop. Buffering capacity of a temperate grasses ranges from 250-400 m E/kg DM and that of legumes ranges from 400-600 m E/kg DM. Buffering capacity of Phasey bean, 346-526 m E/kg DM, is thought to be as higher as that of any other legume.

Fermentation quality of silages

The pH, VBN and organic acid composition of silages are presented in Table 2. Catchpoole (1970) described that most tropical grass silage is “acetate type”. They defined silage of high acetic acid proportion as "acetate type". Acetic acid was the main organic acid found in all Guineagrass silages and latic acid was not detected. The pH of all Guineagrass silages was higher than 4.2 and the VBN/TN ratio was higher than 100g/kg. A low packing density (1kg /2 liter), showed no excretion of effluents and long chopped length (4 cm) were regarded as the reason why Guineagrass silages showed low fermentation quality. Still, under these inadequate conditions, organic acid composition of Phasey bean silage was excellent with LA/TA ratio higher than 600g/kg, and VBN/TN ration lower than 100g/kg at any growth stage. Fermentation quality of legume silages are usually not good. Lactic acid (LA) contents of Phsey bean silages were below 80g/Kg DM. In the case of well-preserved temperate grass silages the latic acid lies in the range of 80 to 120g/Kg DM (McDonald et al., 1995). Accordingly, Phasey bean is regarded as a unique legume suited for silage use.

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Table 1 – Composition of ensiled fresh materials

Treatment	DM* (g/kg FW)	WSC* (g/kg FW)	TN* (g/kg DM)	BC* (m E/kg DM)
Phasey bean* vegetative	122.1	10.2	39.9	526
Phasey bean early bloom	158.6	11.9	27.2	400
Phasey bean bloom	177.0	16.5	26.2	346
Guineagrass* vegetative	132.1	7.5	23.3	488
Guineagrass early heading	194.7	9.2	10.8	359
Guineagrass heading	266.1	26.8	9.7	289

Buffering capacity (BC) was expressed as millie equivalents (mE).
DM; dry matter, WSC; water soluble carbohydrate, TN; total nitrogen, BC; buffering capacity.

Table 2 – Composition of silage

Treatment	pH	VBN/TN (g/kg)	Lactic acid (g/kg FW)	Acetic acid (g/kg FW)	Butyric acid (g/kg FW)	LA/TA (g/kg)
Phasey bean vegetative	$4.44^{a,b}$ [1)]	$98.17^{a,b}$	7.15^{b}	$1.13^{a,b}$	N[2)]	861.44^{b}
Phasey bean early bloom	3.98^{a}	49.32^{a}	5.36^{a}	0.92^{a}	N	847.68^{b}
Phasey bean bloom	$4.39^{a,b}$	$94.25^{a,b}$	3.58^{a}	$1.89^{a,b}$	N	648.61^{a}
Guineagrass vegetative	5.17^{c}	306.07^{d}	N	$1.94^{a,b}$	1.44^{a}	0.00
Guineagrass early heading	4.52^{b}	$162.21^{b,c}$	N	5.25^{b}	2.72^{a}	0.00
Guineagrass heading	5.67^{d}	204.34^{c}	N	$4.61^{a,b}$	3.29^{a}	0.00

[1)]Values in column with different superscript letters differ ($P<0.05$).
[2)] N (not detected)