An Evaluation of Round Bale Silage

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Abstract

Round bale silage made of wilted Italian ryegrass (60% moisture) was compared with a conventional high moisture (90%) silage ensiled in a trench silo for fermentation quality, nutritive value, loss during silage making, production cost and animal performance. The fermentation quality of the bale silage was higher than that of the conventional silage. Content of neutral detergent fiber and *in vitro* digestibility by rumen microbes were not greatly different between the two silages. The conventional silage had a large dry matter loss (29%) during silage making compared with the bale silage (8%). In total production cost, the bale silage resulted in approximately 23yen/DM less than the conventional silage. Although dry matter intake of the bale silage by heifers was higher than that of conventional silage, rate of live weight gain and feed efficiency were similar for the two silages.

Key words: animal performance, bale silage, fermentation quality, loss during silage making, production cost.

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Introduction

Round bale silage, a bale of low-moisture material wrapped with elastic film, has been rapidly adopted into the livestock feeding system and replacing high moisture silage ensiled in various types of silo[2,8]. There have been, however, few data evaluating use of round bale silage in livestock production in Japan. In the present study, round bale silage made of wilted Italian ryegrass was compared with a conventional high moisture silage ensiled in a trench silo for fermentation quality, dry matter loss during silage making, production costs and animal performance under practical conditions.

Materials and Methods

Second-cutting Italian ryegrass (*Lolium multiflorum* LAM. cv.WASEYUTAKA) (Table 1) grown to

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heading stage (26th April) at the Miyazaki University Livestock Farm was used to make two types of silage. The grass was cut using a disk mower, wilted for 2 days on the field and rolled into round bales (1.3m in diameter, 434kg on average). The bales were wrapped with four layers of white elastic film and made into silage. The conventional silage was made by cutting the grass using a forage harvester and ensiling (13,110kg) immediately into a trench silo (1.5×1.5×10.0m). While the grass was being cut, 1 kg each of the freshly cut grass was taken and put into several nylon net bags (60×35cm, 2mm mesh). These bags were left in the grass heaps lying on the field so that the bags were inside of the silages when they were made. The bags were retrieved when the silages were unloaded and the weight of contents was recorded to analyze for losses during silage making. Samples of the fresh grass collected at cutting and the materials in the bags were analyzed for pH, chemical composition and *in vitro* digestibility by rumen microbes (IVDMD)[1]. Fermentation quality of the silage was evaluated by FLIEG's score and V-score[6]. Production costs of the silages were estimated according to the method described in our previous papers[3,4]. Four heifers (Holstein×Japanese Black, 14-16 months old, 321-371 kg) were housed together in a pen attached with electric gate feeders. Each silage was fed twice a day to 2 heifers *ad libitum* with daily supplement of 3kg concentrate (TDN 72%, DCP 12%) for 35 days. Water and mineralized salt was given freely to the animals. Feed intake was measured daily and live weight of the animals was recorded weekly.

Table 1. Proximate composition of Italian ryegrass before ensiling.

	Moisture	Crude protein	Ether extract	Crude ash	Crude fiber	NFE
	(%)	(% in dry matter)				
(Before wilting)	90.7	11.4	4.4	10.2	30.0	44.0
(After wilting)	62.4	11.0	3.2	10.6	29.9	45.3

Table 2. Fermentation quality, IVDMD of silages and DM loss during silage making.

Silage	pH	Moisture	LA	AA	BA	VBN/TN	NDF/DM	IVDMD	DM loss
		(% in fresh matter)				(%)	(%)	(%)	(%)
Bale silage (n=9)	5.6	56.0	2.7	0.4	0.5	9.6	63.8	78.4	7.7
	ns	**	**	*	**	**	ns	ns	*
Conventional trench-silage (n=4)	5.5	86.1	0.3	0.6	1.6	43.1	68.4	75.6	28.8

Abbreviations: IVDMD; *in vitro* dry matter digestibility, LA; lactic acid, AA; acetic acid, BA; butyric acid, VBN; volatile basic nitrogen, TN; total nitrogen.
Difference between silages: ns; not significant, **; $p<0.01$, *; $p<0.05$

Table 3. Silage production costs (yen/kgDM).

Silage	Implement shed[1)]	Machinery[2)]	Labor	Expendables[3)]	Total	Corrected for DM loss
Bale silage	5.04	18.34	4.88	13.32	41.58	45.05
Conventional trench-silage	5.04	20.49	11.99	10.71	48.23	67.73

[1)]; Garage, Irrigation facilities and Fertilizer shed. [2)]; Depreciation, Fuel, Repair and Safety check.
[3)]; Seed, Fertilizer, Film and Small tools.

Table 4. Live weight gain and intake of heifers fed with two silages.

Silage	Bale silage		Conventional trench-silage	
Animal No.	1	2	3	4
Initial live weight (kg)	321	371	349	361
Final live weight (kg)	350	409	374	393
Silage intake (as fed kg/day)	9.71	9.10	24.81	28.50
(DM kg/day)	4.27	4.00	3.45	3.96
Daily gain (kg)	0.83	1.09	0.71	0.91
Gain / Silage DM intake	0.19	0.27	0.21	0.23

Results and Discussion

The fermentation quality and IVDMD of the silages and dry matter loss during silage making are shown in Table 2. The fermentative quality of the bale silage (FLIEG's score; 53.1, V-score; 50.3) was higher than that of the conventional trench silage (FLIEG's score; 4.0, V-score; 3.9). The bale silage had significantly higher lactic acid and lower butyric acid and volatile basic nitrogen (VBN) than the conventional trench silage. Neutral detergent fiber (NDF) content and IVDMD were not greatly different between the two silages. Compared with the bale silage, the conventional trench silage had large dry matter loss (28.8%) during silage making. Dry matter loss during silage making varies greatly depending on types of silo and herbage moisture content[7)]. In our previous experiment, a lesser extent of dry matter loss (19.7%) was observed with a high moisture (82%) Italian ryegrass silage[5)] and this is due probably to the difference of moisture content.

A summary of the production costs for the two silages is shown in Table 3. The bale silage resulted in a higher expendable cost (including the film and twine) but lower costs for the machinery and labor compared with the conventional trench silage. In total production cost, the bale silage ended up with 7yen/kgDM cheaper than the conventional trench silage. Moreover, when correction was made for dry matter loss during silage making, the bale silage was estimated to be 23yen/kg DM cheaper than the other.

Table 4 shows the results of the feeding trial. Dry matter intake was higher for the bale silage than for the conventional trench silage. In fact, various chemical parameters affect the intake of silage[7] and a main reason for the difference in intake may be the large difference in VBN content[9] whereas NDF content and IVDMD were not greatly different for the two silages. Rate of live weight gain and feed efficiency were similar between the two silages.

In the present study, the low-moisture round-bale silage had an advantage in fermentation quality, losses during silage making, production costs and voluntary intake compared with the conventional silage ensiled in a trench silo. The bale silage system, on the other hand, has some disadvantage especially under practical conditions i.e. a relatively large loss during feeding, its cumbersomeness, wastefulness of elastic film etc. A further research is urged to establish the bale silage feeding system suitable to the Japanese livestock production.

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ロールベールサイレージの評価についての一事例

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要　約

近年，低水分牧草をロールベールとし，ストレッチフィルムで被覆密閉して調製したサイレージを家畜に給与する体系が全国的に急速に普及しつつある．本報では，予乾したイタリアンライグラス（水分60%）を用いて調製したロールベールラップサイレージの発酵品質，飼料成分，調製に伴う成分損失，生産費および家畜生産性について，同時に刈り取ってそのままトレンチサイロに埋蔵して調製したサイレージ（水分90%）と比較した．その結果，発酵品質はロールベールサイレージの方が有意に高かった．細胞壁構成物質（NDF）含量および反芻胃内微生物による *in vitro* 消化性においては両サイレージで有意な差はなかった．ロールベールサイレージの調製に伴って８%の乾物が損失した．一方トレンチサイロでの乾物損失は29%であった．これを考慮して両サイレージの生産費を試算すると，ロールベールサイレージのほうが乾物１kg当たり23円安かった．未経産雌牛（ホルスタイン種×黒毛和種，14-16カ月齢）を用いた飼養試験では，乾物採食量はロールベールサイレージの方が多い傾向を示したが，日増体と飼料効率は同程度であった．

キーワード：家畜生産性，生産費，貯蔵損失，発酵品質，ロールベールサイレージ．

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