Comparison of Protein and Energy Intake, Passage Rate and Roughage Value Index of a Common Reed (*Phragmites communis* Trin.) Silage-Based Diet with Those of a Hay-Based Diet in Ewes at Maintenance

Anri Kawasumi
Ishikawa Prefectural University, Japan

Kohei Takahashi
Ishikawa Prefectural University, Japan

Motohiko Ishida
Ishikawa Prefectural University, Japan

Keigo Asano
Ishikawa Prefectural University, Japan

The XXIII International Grassland Congress (Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection) took place in New Delhi, India from November 20 through November 24, 2015.
Proceedings Editors: M. M. Roy, D. R. Malaviya, V. K. Yadav, Tejveer Singh, R. P. Sah, D. Vijay, and A. Radhakrishna
Published by Range Management Society of India

Paper ID: 460
Theme 2. Grassland production and utilization
Sub-theme 2.1. Quality, production, conservation and utilisation

Comparison of protein and energy intake, passage rate and roughage value index of a common reed (*Phragmites communis* Trin.) silage-based diet with those of a hay-based diet in ewes at maintenance

Anri Kawasumi, Kouhei Takahashi, Motohiko Ishida, Keigo Asano*
Ishikawa Prefectural University, Nonoichi, Japan
*Corresponding author e-mail: p0760001@ishikawa-pu.ac.jp

Keywords: Common reed, Hay, Passage rate, Roughage value index, Total digestive nutrients

Introduction
The international demand for hay has increased due to the rising needs of newly industrializing countries and the unstable production of feed caused by abnormal weather all over the world. The price of imported hay has thus risen sharply, resulting in problems at beef and dairy farms in Japan. The use of domestic hay has the potential to solve these issues. The common reed (*Phragmites communis* Trin.) is a wild grass distributed widely in abandoned paddy fields and riverside sites throughout Japan. Common reed has an annual dry matter (DM) yield of 10t ha^{-1} and is approx. 20% crude protein (CP) and 50% total digestible nutrients (TDN) on a DM basis (Asano *et al.*, 2015). Common reed could be made into high-quality silage with the use of acemonium cellulase and lactic acid bacteria at ensiling (Asano *et al.*, 2013). In the present experiment, we compared the protein and energy intake, passage rate and roughage value index (RVI) of a common reed silage-based diet with those of a hay-based diet to examine the potential of common reed silage as a diet for maintenance ewes.

Materials and Methods
Common reed was harvested from a riverside site on reclaimed land in Kahokugata, Ishikawa Prefecture, Japan (36°40'N and 136°41'E) on 18 May in 2013 and was chopped to a length of approx. 2 cm with a hay cutter. The chopped common reed was prepared into silage by packing into plastic drums with the addition of a commercial silage additive containing *acremonium* cellulose and lactic acid bacteria (Acremo conc., Snow Brand Seed Co.). The common reed silage was preserved at room temperature for 2–3 months. Four treatment diets were formulated to meet the TDN requirement in maintenance ewes (NRC, 1985) as follows: (1) 80.6% common reed silage and 19.4% barley (C treatment), (2) 88.2% oats hay and 11.8% soybean meal (O treatment), (3) 87.9% Sudan grass hay and 12.1% soybean meal (S treatment) and (4) 100% alfalfa hay (A treatment) on a DM basis.

Three periods of digestion trial with a 10-day preliminary phase and a 7-day collection phase were conducted in a 4×3 youden square design in which four Suffolk ewes (average body weight: 64 kg) were allotted to the four dietary treatments. The ewes were fed half of the daily diet allowance at 09.00 and 18.00 h and had *ad libitum* access to water throughout the periods of digestion trial. In the collection phase, orts and total feces collection were carried out daily at 17.00 h to determine the intake of the diets and the digestibility, and the ewes' chewing time was recorded by eye at 3-min intervals for 2 days. The collected samples were composited by the ewes in each treatment and dried at 60°C for 48 h and subjected to the chemical analysis. The RVI was calculated by dividing the chewing time by the DM intake.

We also determined the ruminal passage rate (k_1), the post-ruminal passage rate (k_2), the time of the first appearance of the marker in feces (TT), and the total mean retention time (TMRT) of the diets by the method of Krysl *et al.* (1985). The silage and hays were chopped to 2–5 cm and labeled by immersing in a solution containing 0.5% ytterbium ($YbCl_3.6H_2O$) for 24 h. Yb-labeled silage and hays were dried at 50°C for 48 h. Ewes were fed 15 g of Yb-labeled silage and hays, and then rectal grab samples of feces were obtained from ewes at 0, 4, 8, 12, 16, 20, 24, 28, 32, 36, 48, 54, 60, 72, 84, 96, 108 and 120 h after dosing. The collected feces were dried at 60°C for 48 h and subjected to analyses. The dried samples were dissolved with nitric acid and the Yb contents of samples were determined with atomic absorption spectrophotometer .The parameters k_1, k_2 and TT were estimated by non-linear regression using SPSS 18.0 software (SPSS Japan, Tokyo).

The data in the digestion trial were analyzed by a one-way ANOVA in the GLM Model procedure of SPSS. The differences among the mean values were compared by Tukey's HSD test.

Results and Discussion
Although there were significant differences in DM intake among the four treatment diets, the means of the DM intakes were not so different among the treatments. Generally, the feed intake affects the passage rate in the digestive tract. The

small difference in DM intake was the reason why the k_1, k_2, TT and TMRT values were not significantly different among the treatments (P>0.05). The CP intakes in all treatments were greater than the CP requirement of the maintenance ewes (Fig. 1a). This suggested that supplemental CP was not necessary when common reed silage was used as roughage in the diets for the maintenance ewes. TDN is a function of digestible organic matter (DOM) and digestible ether extracts (DEEs) as shown in the footnote of Table 1, and DOM was the main constitute of TDN in all four treatment diets, because the levels of DEEs in the diets were low (0.4%–2.1%). Because the organic cellular contents (OCC) are the fraction that can be completely digested and DOM is the sum of digestible OCC and digestible organic cell wall (DOCW), the TDN depends on the OCC and DOCW. The TDN content in the C treatment was significantly lower than that in the O treatment (P<0.05), because the C treatment had a lower OCC than the O treatment. Even though the C treatment had a lower OCC than the A treatment, the TDN in the C treatment was not different from than that in the A treatment because of the higher DOCW in the C treatment compared to the A treatment. The TDN in the C treatment was higher than that in the S treatment because of the higher OCC in the C treatment compared to the S treatment.

Diets with a low RVI have an adverse effect on rumen function. The RVI in the C and S treatments were higher than those in the O and A treatments, because the OCW in the C and S treatments were higher than those in the O and A treatments. These results suggest that the common reed silage-based diet had a high enough RVI to maintain the rumen function as a hay or hay-based diet. The TDN intake in the C treatment was significantly lower than that in the O treatment, but it was higher than the TDN requirement for maintenance ewes (Fig. 1 b).

Table 1: Intake passage rate, digestibility, TDN and RVI in treatments

	C	O	S	A
DM intake (g day^{-1})	1098[a]	1009[c]	1029[cb]	1050[b]
Orts (% in allowance)	2.6	0.0	1.3	3.2
Passage rate of roughage				
K1	0.028	0.028	0.028	0.030
K2	0.111	0.061	0.129	0.100
TT (h)	16.0	16.4	16.5	16.5
TMRT (h)	61.6	69.8	61.1	60.9
CP intake (g day^{-1})	136.1[c]	133.1[c]	150.2[b]	245.4[a]
Chemical composition (% DM)				
OM	91.4[c]	95.7[a]	91.5[b]	91.2[c]
OCC	35.3[b]	48.4[a]	30.1[c]	48.8[a]
CP	12.4[c]	13.2b[c]	14.6[b]	23.4[a]
EE	3.5[a]	1.5[bc]	1.3[c]	2.4[b]
OCW	56.2[b]	47.3[c]	61.4[a]	42.5[d]
Oa	9.9[a]	8.3[b]	8.9[b]	9.6[a]
Ob	46.3[b]	39.0[c]	52.4[a]	32.9[d]
Apparent digestibility (% DM)				
OM	59.9[b]	66.4[a]	53.6[a]	64.1[ab]
OCC	81.2[ab]	85.2[a]	76.3[b]	85.7[a]
CP	64.6[b]	66.5[ab]	68.0[ab]	72.3[a]
EE	57.5[a]	28.4[b]	31.9[b]	33.1[b]
OCW	46.5	47.2	42.5	39.2
Oa	100	98.9	99.1	94.8
Ob	35.0[a]	36.3[a]	32.8[ab]	23.0[b]
Digestible nutrients (% DM)				
OM	54.8[c]	63.6[a]	49.0[d]	58.5[b]
OCC	28.6[b]	41.2[a]	23.0[c]	41.8[a]
CP	8.0[c]	8.8[bc]	9.9[b]	16.9[a]
EE	2.1[a]	0.4[b]	0.4[b]	0.8[ab]
OCW	26.1[a]	22.3[ab]	26.1[a]	16.7[b]
Oa	9.9[a]	8.2[c]	8.8[bc]	9.1[b]
Ob	16.2[a]	14.2[a]	17.2[a]	7.6[b]
TDN (% DM)*	57.4[b]	64.1[a]	49.5[c]	59.5[b]
RVI (min kg DM $intake^{-1}$)	627.1[a]	483.1[b]	630.0[a]	301.3[c]

[a ,b, c, d]P<0.05 difference between values *TDN = DOM – DEE x 1.25.

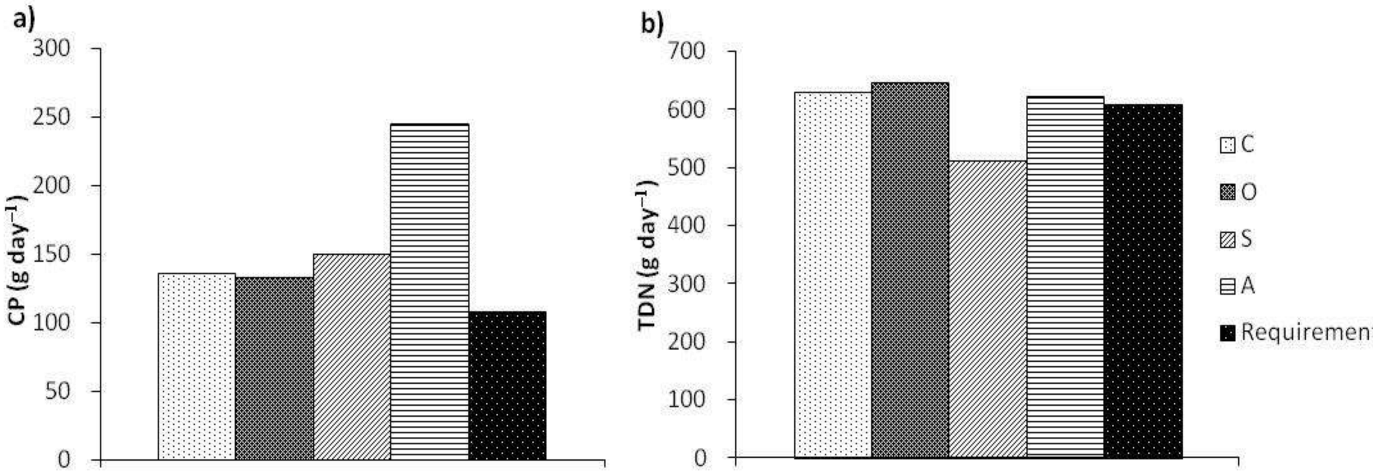

Fig. 1: Intakes and requirements of CP and TDN in Ewes CP- Crude protein; TDN- Total digestible nutrients; C-Common reed silage treatment; O-Oats hay treatments; S-Sudan grass hay treatment; A-Alfalfa hay treatment.

Conclusion

These results indicate that common reed silage could be used as roughage for maintenance ewes when it is supplemented with energy feed such as barley.

References

Asano, K., A. Araie, R. Koike, K. Takahashi, T, Madachi and M. Ishida. 2013. Effect of using additives at ensiling on the fermentation quality of common reed (*Phragmites communis* Trin.) silage. In: Proc. *22nd International Grassland Congress* (Sept. 776-777, 2013), Sydney.

Asano, K., R. Nakamura, A. Araie, R. Koike, K. Takahashi, T. Madachi and M. Ishida. 2015. Effects of year and harvest time within the year on yield and chemical composition of common reed (*Phragmites communis* Trin.) as ruminant feed. *Grassl. Sci* 61: 1-5.

Krysl, L. J., F.T. Mccollum and M. L. Galyean. 1985. Estimation of fecal output and particulate passage late with a pulse dose of Ytterbium-labeled forage. *J. Range Manage* 38: 180-182.

National Research Council (NRC). 1985. *Nutrient Requirements of Sheep, Sixth Revised Edition*. National Academy Press. Washington D.C.