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The Effect of Water Intake on the Nitrogen Utilization in Sheep Fed Only Grass Diets in Either the Fresh or Dried Form*

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生草又は乾草を給与されたメンヨウの
窒素利用に対する飲水量の影響

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Two experiments were carried out to investigate the effect of water consumption on the nitrogen utilization in sheep fed only grass diets in either the fresh or dried form. In Experiment I, water intake was equalized in both feedings of fresh and dried grasses, and in Experiment II, water intake in dried grass feeding was restricted about 50% of that in fresh grass feeding. The digestibilities of nutrients tended to be clearly high in feeding dried grass when water intake was equalized to that in feeding fresh grass. The digestibilities of crude protein and crode fat were depressed after feeding dried grass when water intake was restricted about 50% of that in feeding fresh grass, although digestibilities of the other nutrients were similar in both diets of fresh and dried grasses. The retained nitrogen was significantly more after feeding dried grass with equalized water intake than after feeding fresh grass. When water intake was restricted in feeding dried grass, nitrogen retention was similar in both feedings of fresh and dried grasses, although urinary nitrogen excretion was clearly decreased after feeding dried grass. The concentration of total VFAs in the rumen fluid tended to be clearly great after feeding dried grass than after feeding fresh grass, when water intake was equalized in both feedings. When water intake was restricted in feeding dried grass, ruminal VFAs level also tended to be higher in dried grass feeding than in fresh grass feeding. The level of blood urea-nitrogen was almost the same in both feedings of fresh and dried grasses, when water intake was equalized. The level of blood urea-nitrogen was significantly increased in feeding dried grass when water intake was restricted about 50% of that in feeding fresh grass. There was no obvious effect of equalized water intake on the level of plasma total protein, although the level of plasma total protein was significantly increased by restriction of water intake in feeding dried grass. From these results, it would be suggested that the nitrogen

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utilization in sheep fed on hay (or dried grass) can be fairly improved by adjusting water intake to that in feeding fresh grass, when dry matter intake was similar in both feedings.

Introduction

It is generally known in ruminants that the extent of ruminal fermentation clearly affect the utilization of feed eaten, and also the physical property as well as chemical composition of diet would influence the extent of microbical fermentation in the rumen.[1] In particular, the factor affecting the utilization of dietary protein as well as other dietary nutrients might be a difference of physical form of diet, which influence the extent of microbial degradation in the rumen.[2] It has been shown that the solubility of protein in forage is clearly changed by drying treatment.[3, 4] It has been also reported that the digestibility of organic matter was obviously lower in feeding hay than in feeding fresh grass,[5] and the direct absorption of nitrogen (ammonia) in the rumen of goats was smaller in feeding of orchardgrass hay than in feeding fresh orchardgrass.[6] In the previous report,[7] it has been shown that the efficiency of nitrogen utilization in grass diet was quite high after feeding fresh forage as compared with that after feeding hay using same forage. The difference in physical property of fresh and dried grass (or hay), when they were harvested at a same growth stage from a same pasture, might be mainly a difference in moisture contents of them. Thus, it is esaily assumed that the animals fed on fresh grass only should be forcedly drunk a large amount of water, and therefore water consumption in feeding fresh forage should affect the degradability of dietary protein in the rumen. On the other hand, the solubility of forage protein would be partially changed by drying (dehydrating) treatment, and then, the water intake in feeding dried grass or hay should has also some certain effects on the microbial fermentation in the rumen.

In the present study, the utillzation of dietary nitrogen in sheep fed on fresh or dried grass was investigated when water intake was equalized in both feedings or restricted in feeding dried grass. A part of the results obtained in this study was already reported earlier.[8]

Materials and Methods

Animals and experimental diets

Experiment I: Two Japanese Corriedale sheep (nos. 531 and 541) and one wether (no. F 535), each weighing 38–43 kg, were used repeatedly. The fresh grass was harvested each morning from a predominantly Italian-ryegrass pasture (Ist and 2 nd cut). The dried grass was made from the herbage harvested at the same time when harvested the fresh grass. The fresh grss was dried for about 15 hours in forced air drier at 55°C. Each grass diet was cut about 8 cm long just before feeding.

Table 1.　Chemical composition of diet

Expt.	Diet		Organic matter	Crude Protein	Crude fat	Crude fibre	NFE[a]
	Cutting	Form					
I	1st cut	Fresh	91.3[b]	11.4	2.5	28.0	49.4
		Dried	91.7	10.5	2.6	31.1	47.5
	2nd cut	Fresh	91.3	10.7	3.1	31.8	45.7
		Dried	91.3	10.7	3.0	34.4	43.2
II	1st cut[c]	Fresh	93.1	14.6	3.2	19.1	56.2
		Dried	92.4	12.1	3.0	19.8	57.5

a　Nitrogen free extract.
b　% of dry matter.
c　Early cut (before heading out).

Experiment II: Three Japanese Corriedale male sheep (nos. 531, K 433 and K 790), each weighing 31-39 kg, were used repeatedly. The fresh grass was harvested each morning from a predominantly Italianryegrass pasture (early Ist cut). The method for making the dried grass was same as in Experiment I. Each grass diet was cut about 3 cm long just before feeding. Chemical composition of the fresh grass and dried grass are shown in Table 1.

Experimental procedure

Experiment I: The experimental animals were kept in the metabolism cages throughout the experimental period. Five day sampling periods were preceded by 7-8-day preliminary periods. Each sheep was given a diet in which the dry matter was 2.25% of body weight per day. Water was freely available in fresh grass feeding, and in dried grass feeding, the calculated volume of fresh water was forcedly given orally just after the feed consumption to equalize water intake to that in fresh grass feeding at each feeding time.

Experiment II: Each sheep was given 2.0% as dry matter of diet per kg body weight per day. Water was not given in fresh grass feeding, and in dried grass feeding the water intake was restricted as about 50% of that consumed in fresh grass feeding. The other experimental procedures were as described previously.[7] Statistical analysis was made by the method of Yoshida.[9]

Chemical analysis

Nitrogen in the diet, faeces and urine were analyzed by the Kjeldahl method, and the contents of crude fat, orude fibre and crude ash in the diet and faeces were determined according to the AOAC method.[10] Ammonia in the rumen fluid was analyzed by the method of Oser.[11] Ruminal VFAs were determined by the aeration method[12] and using a gas chromatography.[13] Blood urea-nitrogen and plasma total protein were analyzed using the Unitest System (Model 300, Biodynamics, Inc., USA).

Results

As shown in Table 1, crude protein contents of Ist cut forage used in the

Table 2. Apparent digestibility and nitrogen balance

	Experiment I				Experiment II	
	1st cut		2nd cut		1st cut♯	
	fresh	dried	fresh	dried	fresh	dried
Apparent digestibility, %						
Organic matter	65.9±0.4*	66.5±0.9	59.4±1.4[a]	68.0±1.3[b]	70.7±3.6	67.7±5.4
Crude protein	69.0±0.9	67.9±0.3	64.7±0.7[a]	70.7±1.9[b]	72.4±3.3[a]	62.4±3.1[b]
Crude fat	63.8±1.2[b]	70.3±1.3[b]	50.8±1.4[a]	69.6±1.7[b]	52.7±1.8[a]	45.3±1.4[b]
Crude fibre	54.9±0.3[b]	59.6±1.3[b]	60.4±0.9[a]	71.7±0.4[b]	55.5±5.0	56.2±2.2
NFE**	71.9±0.5	70.0±1.2	58.1±2.0[a]	64.2±0.8[b]	68.7±1.7	67.5±2.7
Nitrogen balance (g/kg B. W.$^{0.75}$/day)						
Intake	0.96±0.01	0.94±0.01	0.77±0.01	0.91±0.01	1.17±0.04	1.01±0.05
Faecal nitrogen	0.30±0.02	0.30±0.01	0.27±0.01	0.27±0.01	0.32±0.06	0.37±0.14
Urinary nitrogen	0.46±0.02[a]	0.38±0.04[b]	0.49±0.01	0.47±0.08	0.66±0.08[a]	0.47±0.05[b]
Retention	0.20±0.02[a]	0.26±0.03[b]	0.01±0.01[a]	0.17±0.09[a]	0.19±0.11	0.16±0.12
	(30.4±2.8)	(40.1±4.7)***	(2.8±2.8)	(27.6±13.6)	(22.2±12.8)	(24.1±17.0)

♯ Early cut (before heading out)
* Mean±S. E. of 3 sheep.
** Nitrogen free extract.
*** % of digested nitrogen
a–b Significance of difference between means of fresh and dried ($p<0.05$).

Experiment I was slightly lower in dried from than in fresh from, whereas the contents of crude protein as well as other nutrients of 2 nd cut forage were almost equal in the fresh and dried forms. The crude protein contents of Ist cut forage used in the Experiment II was fairly higher than that of forages used in the Experiment I, and further the crude fibre contents of it was extremely lower than that of the forages used in the Experiment I. The crude protein contents decreased fairly during the drying treatment of forage used in the Experiment II.

The Table 2 shows the apparent digestibilities of nutrients and the nitrogen balance of sheep fed the grass diets of fresh or dried form with equalization or restriction of water intake. The digestibilities of organic matter, crude protein and nitrogen free extract (NFE) of the Ist cut forage in Experiment I were similar in both the fresh and dried grasses, and the crude fat and crude fibre digestibilities were significantly higher in dried grass than in fresh grass. In the 2 nd cut grass, the digestibilities of all the nutrients were significantly greater in dried form than in fresh form. In the Experimental II, the digestibilities of organic matter, crude fibre and NFE were similar in both diets of fresh and dried form, and those of crude protein and crude fat were significantly lower in dried grass than in fresh grass. In Experiment I, nitrogen intake was almost the same in the feeding of Ist cut forage, and there were slight difference of nitrogen intake in feeding of 2 nd cut forage due to the difference in amount of ration consumed. The faecal nitrogen output in Experiment I was very similar in both of cutting stage and/or fresh and dried forages. The urinary nitrogen excretion after feeding fresh grass tended to be more than that after feeding dried grass in both cutting stages in Experiment I. As a whole, retained nitrogen was significantly more after feeding dried form than after feeding fresh form in both the Ist and 2 nd cut forages. In the Experiment II, the nitrogen intake in feeding fresh grass was slightly more than that in feeding dried grass, although the faecal nitrogen output was almost the same in both feedings. The urinary nitrogen excretion was clearly depressed in feeding dried grass with restricted water intake. As a whole, retained nitrogen was similar in both feedings.

Table 3. Water balance in sheep fed on fresh or dried forage (g/kg B. W.$^{0.75}$/day)

	Experiment I				Experiment II	
	1st cut		2nd cut		1st cut♯	
	Fresh	Dried	Fresh	Dried	Fresh	Dried
Intake						
Feed	191.6±1.4*	7.9±0.1	189.1±1.7	7.4±0.1	256.9±10.7	9.2±0.5
Drink	6.9±6.9	183.4±8.0	11.3±10.5	183.5±11.7	0	131.9±10.3
Total	198.5±5.0	191.3±7.9	200.4±8.9	190.9±11.7	256.9±10.7	141.1±10.7
Excretion						
Faecal	32.7±6.2	28.6±6.8	29.4±9.1	39.4±8.9	28.5±7.6	18.5±7.3
Urinary	109.6±8.0^{a}	90.2±3.0^{b}	97.5±2.1	87.7±11.8	157.6±12.7^{a}	55.2±3.5^{b}
Total	142.3±3.0^{a}	118.8±4.4	126.9±7.8	127.1±11.1	186.1±20.2^{a}	73.7±8.1^{b}

♯ Early cut (before heading out).
* Mean±S. E. of 3 sheep.
a-b Significance of difference between means of fresh or dried ($p<0.05$).

Table 3 shows the water balance in sheep fed on fresh or dried grass with controlled water intake. In the feeding Ist cut forage in Experiment I, urinary water excretion was significantly greater with fresh form than with dried form, though water intake was similar in both feeding, and total water excretion was also more in the former than in the latter. The faecal water output after feeding dried form of 2 nd cut grass tended to be greater than that after feeding fresh form.

As shown in Table 4, ruminal pH values in Experiment I were almost the same in both feedings of fresh and dried forms in Ist and 2 nd cut forgaes. The ruminal ammonia level after feeding fresh form of Ist cut grass in Experiment I was significantly higher than that after feeding dried form, whereas there was no significant difference in ammonia level after feeding fresh or dried form of 2 nd cut forage. The concentration of total VFAs after feeding dried form was higher, but not significantly, than that after feeding fresh form with Ist cut forage in Experiment I. Similarly, total VFAs level after feeding dried form was significantly higher than that after feeding fresh form with 2 nd cut forage. The level of acetic acid after feeding dried form was significantly higher than that after feeding fresh form with Ist cut forage. With the 2 nd cout forage, the levels of acetic, propionic and butylic acids were significantly higher after feeding dried grass than after feeding fresh grass. In Experiment II, there were no changes in the ruminal pH values, and in the levels of ruminal ammonia and total VFAs after feedings of

Table 4. Ruminal pH and the concentrations of ammonia and VFAs in ruminal fluid of sheep fed the fresh or dried grass diet.

	Experiment I				Experiment II	
	1st cut		2nd cut		1st cut#	
	Fresh	Dried	Fresh	Dried	Fresh	Dried
pH	6.88±0.06*	6.77±0.03	6.88±0.01	6.72±0.03	7.10±0.20	7.10±0.30
Ammonia(mg/dl)	19.7±1.3[a]	10.5±1.1[b]	17.5±2.9	19.8±1.4	12.6±6.1	12.4±4.3
Total VFAs (mM/dl)	9.32±0.40	10.21±0.50	7.77±0.45[a]	11.15±0.56[b]	7.20±1.30	7.90±1.20
Acetic acid	6.72±0.26[a]	7.75±0.14[b]	5.77±0.43[a]	8.21±0.40[b]	—	—
Propionic acid	1.55±0.05	1.54±0.04	1.31±0.04[a]	1.93±0.10	—	—
Butyric acid	0.94±0.10	0.88±0.03	0.59±0.04[a]	0.93±0.06	—	—
Valeric acid	0.09±0.01	0.07±0.00	0.10±0.01	0.10±0.01	—	—

Early cut (before heading out).
* Mean±S. E. of 3 sheep.
a-b Significance of difference between means of fresh and dried ($p<0.05$).

both diets of fresh and dried grasses.

Table 5 shows the concentrations of some blood constituents in sheep fed on fresh grass or dried grass with equalized or restricted water intake. Haematocrit value was slightly high in Experiment II, though there was no large difference between fresh-grass feeding and dried-grass feeding in both Experiments. The level of blood urea-nitrogen in Experiment I tended to be higher after feeding 2 nd cut forage than after feeding Ist cut forage in both dietary forms of fresh and dried. In Experiment II, the level of blood urea-nitrogen was significantly higher after feeding dried grass than after feeding fresh grass. Plasma total protein level in Experiment I was almost similar after feedings of fresh and dried forms in both cutting stages of forage, whereas the level in Experiment II was significantly higher after feeding dried grass than after feeding fresh grass.

Discussion

The forage samples for determining the chemical composition of diet were taken

Table 5. Haematocrit value and the concentrations of blood urea-nitrogen and plasma total protein in sheep fed the fresh or dried grass diet.

	Experiment I				Experiment II	
	1st cut		2nd cut		1st cut#	
	Fresh	Dried	Fresh	Dried	Fresh	Driea
Ht	25.4±0.5*	24.1±0.9	24.0±0.7	22.2±1.0	26.8±1.0	27.8±1.0
Blood urea-nitrogen (mg/dl)	10.3±0.6	10.1±0.5	13.3±0.6	12.1±1.6	8.2±0.6[a]	13.4±1.4[b]
Plasma total protein (g/dl)	6.33±0.42	7.05±0.25	7.25±0.69	6.77±0.42	6.03±0.15[a]	6.25±0.06[b]

Early cut (before heading out).
* Mean±S. E. of 3 sheep.
a-b Significance of difference between means of fresh and dried ($p<0.05$).

every three days during the Experimental period. As shown in Table I, chemical composition of fresh and dried grass was almost similar in the Ist and 2nd cut forage in Experiment I. A slight decrease of crude protein of Ist cut dried-grass in Experiment I might be due to some autolysis of forages during drying process,[14] and same result was obtained in Experiment II. The extent of decrease in contents of crude protein was slightly more in early Ist cut forage used in Experiment II, though those were in a range of changes accepted generally.[14] The values shown in Table I were very similar to that indicated in standard table[15] on Italian-ryegrass at each cutting stage, though there were some differences in contents of crude protein and crude fibre of forage in Experiment I and that in Experiment II.

In the previous report,[7] there were no significant differences in digestibilities of nutrients in sheep fed only fresh grass or sun-cured hay, though the digestibilities of crude fat and crude fibre were quite high in feeding fresh grass. In this study, when used Ist cut forage, digestibility of nutrients was primarily the same as that reported earlier,[7] and the differences between fresh and dried grasses in digestibilities of crude fat and crude fibre were significant statisically (Expt. I). The drying treatment of forage might does no appre. ciably lower its digestibility if green forage is dried without any waste and in a way as to prevent fermentation. There are, however, usually some losses of part of nutrients while drying is taking place and in handling afterward. Therefore, green forage may be somewhat more digestible and give better results than dried forage.[16]

It has been concluded that the fresh green alfalfa was digested better than the hay, although the difference was not great, when steers were fed with alfalfa in either the fresh or hay.[17] Holter and Reid[18] also reported that apparent digestibility of the protein in green forage was slightly higher than that in hay. On the other hand, there is an opposite conclusion following digestion trials using sheep fed a hay of mixed forage.[16] In the present study, digestibilities of organic matter, crude protein and NFE were similar in both the diets of fresh and dried forage, and the digestibilities of crude fat and crude fibre were significantly higher in feeding dried grass than in feeding fresh grass (Ist cut). This result was similar to that reported previously,[7] and would show that the dried grass used was a good quslity as same as the fresh grass. Digestibilities of crude fat and crude fibre in feeding dried grass was clearly accelerated by equalization of water intake (Expt.1), and this would show that there were some changes in ruminal fermentation after feeding dried grass. On the other hand, in feeding 2nd cut forage, the digestibilities of every nutrients were significantly higher with dried grass than with fresh grass, although dry matter intake was slightly more in the former than in the latter. This would show that the digestion in the rumen was obviously stimulated by addition of water after feeding dried grass, because it is generally recognized that apparent digestibility of nutrient with forage diet is clearly increased with a derease of dry matter intake. As shown in the previous report,[8] the rumination appearance (lag time after eating) was shortened by the addition of water after feeding dried grass, i. e., the rumination in sheep occurred faster in feeding dried grass when they were forcedly drunk water after eating dried grass. This would also suggest that ruminal fermentation was clearly changed by water intake in feeding dried grass. In feeding of the dried grass with restricted water intake (Expt. II), the digestibilities of crude protein and crude fat were significantly lower with dried grass than with fresh grass, and the digestibilities of organic matter, crude fibre and NFE were almost the same in both feedings. In Experiment II, there was slight decrease of intake of crude protein in feeding dried grass, and this might affect the digestibility of crude protein after feeding dried grass. These findings in Experiment II confirmed clearly the results obtained in the previous study, in which the fresh or dried diet of same forage were given to sheep at same level of dry matter intake.[7]

On the nitrogen balance of sheep in Experiment I, faecal nitrogen output in sheep fed on dried grass was almost similar to that in sheep fed on fresh grass, and in Experiment II faecal nitrogen output in sheep was somewhat more when they were fed on dried grass than when fed on fresh grass. Urinary nitrogen excretion after feeding dried grass was significantly (Ist cut) and slightly decreased (2 nd cut) when water consumption by sheep was equal to that in feeding fresh grass (Expt. I). Urinary nitrogen excretion was also fairly decreased with a decrease of water consumption (Expt. II), and these results are in good agreement with those reported other workers.[19, 20] As a result, the retained nitrogen was significantly more in feeding dried grass than in feeding fresh grass (Expt. I). The nitrogen retained in sheep tended to be more in feeding fresh grass than in feeding dried grass when water intake by sheep was strictly decreased (Expt. II), although nitrogen intake was not always similar in both feeding. As shown in Table 3, urinary water excretion was similar trend to nitrogen excretion into urine in both Experiments, and this clearly confirmed the fact that there are close relationships between urinary nitrogen excretion and urine volume.[21]

On the water balance (Table 3), it may be easily assumed that there are some effects of changes in environmental condition (temperature and/or humidity) on water losses from the body surface in animals. In this study (Expt. I), the average environmental temperature during each period of feeding trials with Ist cut forage was 18.2 and 23.4°C in feeding fresh grass and dried grass, respectively, and that when fed 2 nd forages was 20.7 and 18.9°C in feeding fresh grass and dried grass, respectively. Therefore, the differences in total water excretion after feeding fresh and dried form of Ist cut forage in Experiment I would be due to the difference in environmental temperature during the experimental period. In Experiment II, the environmental temperature during the experimental period was almost similar to that mentioned above (with 2 nd cut forage), which was in a range of thermoneutral zone (18-20°C).[22]

The concentration of ruminal ammonia was significantly higher in feeding fresh form than in feeding dried form with Ist cut forages, and contrarily, with 2 nd cut forage, the level of ruminal ammonia tended to be nigher in feeding dried form than in feeding fresh form. The values indicated in Table 4 are slightly low as compared with that of the previous report,[7] in which ruminal ammonia level in sheep was 24.1 and 17.3 mg/100 ml after feeding fresh grass and hay when sheep were fed on diets containing dietary protein of 17.9 and 16.5% per dry matter, respectively. This would be due to a difference in dietary protein level in both experiments. McIntyre[23] reported with sheep that ruminal ammonia concentration was increased with an increase of nitrogen intake, and thereafter, the level of blood urea-nitrogen was also increased clearly. The result with Ist cut forage (Expt. I) basically confirmed the result described earlier,[7] in which the sheep were fed on fresh grass or hay without any treatment of water consumption. This might show that there was no obvious effect of equalized water intake on the degradation of dietary nitrogen in the rumen after feeding dried grass, and this would be explained by the findings with eating and rumination behaviour as mentioned earlier.[8] On the other hand, with 2 nd cut forage the ruminal ammonia level tended to be higher after feeding dried grass than after feeding fresh grass, and this clearly show that there were obviously a stimulated degradation of dietary protein in the rumen after feeding dried grass, i. e., the equalized water intake might stimulate clearly the ruminal fermentation. There was also some stimulation of rumination and/or shortening the lag time after eating in feeding dried grass as described previously.[8] From these results, it is assumed that the degradability of dietary protein might be slightly different in both forages used in Experiment I. The ruminal ammonia in sheep fed Ist cut young forage (Expt. II) did not change in both feedings of fresh grass and dried grass with restricted water intake, and this result basically confirmed that reported earlier.[7] The concentrations of ruminal VFAs after feeding fresh grass were very comparable to that reported earlier,[7] and that after feeding dried grass were quite high as compared with that reported previously.[7, 24] The levels of ruminal VFAs after feeding dried grass tended to be higher than that after feeding fresh grass in Experiment I, and this may be mainly due to an increase of the concentration of acetic acid. Shibata[25] reported that in sheep fed on fresh or hay of wild grass, fresh form did increase the production of propionic acid and hay increased acetic acid production in the rumen. The results in this study did not always support Shibata's findings, i. e., the ratio of acetic acid to propionic acid was very similar in both feedings of fresh grass and dried grass in Experiment I. Thus, it is obvious that the ruminal fermentation after feeding dried grass was fairly stimulated by equalization of water intake, and might be similar to that after feeding fresh grass in the present study. with 2 nd cut forage (Expt. I), the level of total VFAs, acetic, propionic and butyric acids were significantly high after feeding dried grass as compared with that after feeding fresh grass, and this would be partially due to an increase of dry matter intake when fed dried grass. When water intake was fairly restricted (Expt. II), the level of total VFAs was also slightly higher in feeding dried grass than in feeding fresh grass. This might indicate that the dried grass used was a good quality, i. e., easily fermentable as well as the fresh grass.

The concentration of blood urea-nitrogen (Table 5) was almost the same in both feedings of fresh and dried grasses (Ist cut), although the ruminal ammonia level was quite high after feeding fresh grass. Contrarily, the level of ruminal ammonia level after feeding dried form tended to be high as compared with that after feeding fresh form with 2 nd cut forage, and the level of blood urea-nitrogen tended to be higher after feeding fresh grass than after feeding dried grass. According to Kameoka and Morimoto,[6] the ratio of nitrogen absorption from rumen wall may be low in feeding hay as compared with that in feeding fresh form when sheep were fed on fresh or hay of orchardgrass. Wohlt et al.[20] reported that ruminal ammonia level is clearly oncreased with an increase of solubility of dietary protein. In the present study, however, there was no clear relationship between ruminal ammonia level and the level of blood urea-nitrogen as shown in earlier reports.[6, 7] As shown in Table 4, the concentration of ruminal VFAs tended to be increase with dried grass, and this would indicate that ruminal fermentation was stimulated after feeding dried grass with water intake equalized to that in feeding fresh grass (Expt I). Ruminal ammonia, therefore, would be more utilized effectively for microbial protein synthesis in feeding dried grass than in feeding fresh grass, and consequently, the nitrogen retention was clearly increased in the former than in the latter as indicated in Table 2. In Experiment II, the levels of blood urea-nitrogen and plasma total protein were clearly higher in dried grass feeding than in fresh grass feeding, and this would show that restricted water intake obviously was of use to save nitrogen in the body as reported formerly.[19, 20]

As a whole, the results obtained in this study showed that the nitrogen utilization was clearly increased in feeding dried grass when water consumption was epualized to that in feeding fresh grass, although the levels in ruminal ammonia, blood urea-nitrogen and plasma total protein did not always show an explainable trend in both feedings. There was also clear effect of epualization in water intake on the microbial fermentation in the rumen. From these results, it may be suggested that a difference in nitrogen utilization in sheep fed on fresh grass and hay (or dried grass) mainly due to a difference in water consumption in both feedings.

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摘　　要

飼料として同一圃場から同時に収穫したイタリアンライグラス主体の混播牧草を生草または乾草として与えられたメンヨウの窒素利用に及ぼす水分摂取量の影響について調査するために二つの試験を行った．生草または乾草給与時の乾物摂取量はほぼ等しく，乾草給与時の飲水量を実験1では青草給与時のそれと等しくし，実験2では青草給与時の約55％に制限して代謝試験を行った．各成分の消化率は実験1では青草給与時に比べて乾草給与時で高くなる傾向が示された．乾草給与時に水分摂取量を制限すると粗蛋白質と粗脂肪の消化率は青草給与時のそれより低下したが，他の成分の消化率は青草給与時のそれと同様であった．窒素の体内蓄積量は青草給与時と乾草給与時の水分摂取量が等しい場合は乾草給与時で有意に増加した．一方乾草給与時に水分摂取量を制限すると尿中窒素排泄量は著しく減少したが，体内蓄積量に差はみられなかった．水分摂取量の等しい場合，第一胃内液中の低級脂肪酸濃度は乾草給与時で著しく高くなる傾向があり，飲水制限した場合もほぼ同様の結果を示した．血中尿素態窒素濃度は水分摂取量の等しい場合は青草または乾草給与時でほぼ同様であったが，乾草給与時に水分摂取量を制限すると青草給与時のそれに比べて有意に高くなった．血中総蛋白濃度は青草または乾草給与時の水分摂取量が等しい場合には差はなかったが，乾草給与時に水分摂取量を制限すると青草給与時のそれと比べて有意に高くなった．これらの結果から，青草または乾草給与時の乾物摂取量がほぼ同様の場合，乾草給与時の水分摂取量を青草給与時のそれと等しくすることることによってメンヨウにおける窒素の利用性はかなり改善されることが示された．