Round baled grass silage as food for reindeer in winter

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Abstract: Round baled silage of mixed grasses was tested as emergency food for reindeer in winter. The silage was made of leaf rich regrowth of *Phleum pratense, Agrostis tenuis* and *Poa* spp. It contained 33.3% dry matter (DM), and 14.8 % crude protein, 24.5 % cellulose and 26.7 % hemicellulose on a DM basis. Palatability, food intake, digestion, rumen fermentation, body mass (BM), carcass weight and gastrointestinal (GI) anatomy were investigated. A group of adult female reindeer (n=38), were taken from natural winter pasture and fed grass silage *ad libitum*. The majority (78 %) of the animals were eating silage after two days and 95 % of the animals ate silage after five days. Five reindeer calves were taken from natural winter pasture and fed lichens *ad libitum* for 14 days after which they were starved for two days before being offered silage *ad libitum*. The median daily DM food intake was 370 g (range 250–610 g) on the first day increasing to 810 g (range 530–1100 g) at days 16 to 20. Median apparent digestibility coefficient (DC) of DM was 64.3 % (range 62.4–66.2 %). The median *in vitro* DM digestibility (IVDMD) of the silage after 72 h of microbial digestion was 68.3 % (range 66.6–71.3 %) (W_S=30, n_1=5, n_2=4, $P<0.01$). Median ruminal VFA concentration and pH were 48.2 mM (range 38.4–52.5 mM) and 7.0 (range 6.95–7.17), respectively, in the reindeer calves (n=5). BM initially increased when the reindeer calves were fed silage, but stabilised after 11 days. The increased BM may have been due to an increased recticulo-rumen digesta load, which amounted to 19.6–23.7 % of BM (n=3). The carcass weight of the reindeer calves was 42.6–44.2 % of the BM (n=3) after 47 days of silage feeding. The results indicate that although the round bale silage of mixed grasses of medium quality was highly palatable to reindeer it was apparantly of only limited value as an emergency food for the reindeer calves, as indicated by low DC of DM and low ruminal VFA concentration.

Key words: *Rangifer tarandus tarandus*, starvation, emergency food.

Rangifer, 15 (1): 27–35

Introduction

In northern Norway herds of semi-domesticated reindeer traditionally migrate between distinct summer and winter pastures owing to pronounced seasonal changes in both quality and availability of plant material. In summer the reindeer graze on productive pastures near the coast where the vegetation is dominated by protein rich vascular plants. In winter, the pastures are covered by snow and the animals migrate inland where the climate is cold and dry and were they eat a mixed winter diet dominated by lichens (S. D. Mathiesen, unpublished). The main lichen eaten is *Cladonia stellaris*, which on a DM basis is rich in hemicellulose (78.4 %) but poor in both cellulose (1.7 %) (Person *et al.*, 1980) and protein (3.1 %) (Jacobsen & Skjenneberg, 1975). In some areas in northern Norway the nomadic reindeer herding is limited by national borders

in Scandinavia and the extent of lichen pasture available in winter is therefore scarce. The only available coastal pastures in winter are often beset by deep hard snow or over-icing which reduces access to the food beneath. In such situations, the reindeer may starve and provision of emergency food is necessary to prevent loss of animals. Starvation changes both the number and the species composition of bacteria in the rumen of reindeer, reducing the animals ability to digest food (Aagnes *et al.*, 1995). To be suitable, an emergency food must have a high palatability and must not cause any digestive disorders when eaten by animals that are already starving. In addition, it should meet their maintenance energy requirements. Several commercially available pelleted feeds have been developed in Norway, but their low palatability makes them difficult for use as emergency food in a large reindeer herd. (Jacobsen & Skjenneberg, 1975; Bøe & Jacobsen, 1981; Bøe *et al.*, 1982; Mathiesen *et al* , 1984; Sletten & Hove, 1990). Grass which is readily available from costal farms in northern Norway and preserved in round bales could have potential as food for reindeer. Several unsuccessful attempts have already been made to use grass silage originally produced as food to cattle and sheep as food to reindeer, owing to low palatability or low digestibility (Jacobsen & Skjenne-berg, 1977; Syrjälä-Qvist, 1982a). The introduction of reindeer from Norway to South-Georgia demonstrates that they do not necessarily need lichens in winter. These reindeer have survived eating mainly vascular plants during both summer and winter (Leader-Williams, 1988), and the main plant eaten in winter is the tussock-grass (*Paradiocola flabellata*) which contains on a DM basis 14.8 % crude protein, 24.3 % cellulose, 25.7 % hemicellulose and 29.0 % water soluble carbohydrates (WSC) (S. D. Mathiesen, unpublished). This study is the first report on the use of round bale grass silage as emergency food for starved reindeer in winter.

Material and Methods

Animals and experimental procedure

Adult female reindeer (*Rangifer tarandus tarandus*) (n=38), from a private herd kept on a natural winter pasture in northern Norway (68° N, 17° E) were rounded up and taken to a snow-covered paddock in the same general area for a palatability study at the end of February 1992. Each reindeer was marked with a numbered plastic collar. The animals were offered silage *ad libitum* for 16 days. The number of animals eating silage was recorded every 15 minutes between 9.00 a.m. and 5.00 p.m. on the first seven days.

For individual studies of food intake and utilisation of silage, trials were conducted on male reindeer calves (n=5, age six months) taken in November 1991 from the same herd to the Department of Arctic Biology, University of Tromsø. On arrival the calves were fed mixed lichens *ad libitum* for 14 days in individual snow-covered paddocks. Thereafter they were moved to individual pens with slatted floor and starved for two days before being offered only silage *ad libitum*. Snow, as the only water source, was available at all times. Silage and snow were offered twice a day in plastic tubs and food intake was measured daily in each animal by removal and weighing the left-overs before each new meal. The pens offered minimal protection against the weather and the animals were exposed to a natural photo period allowing expression of their normal seasonal appetite (Larsen *et al.*, 1985). Animals A, B, and C were offered silage for 47 days; animals D and E were offered silage for 21 days. All animals were subsequently slaughtered and samples of different sections of the GI tract were collected. The rumen large plant fraction was obtained by washing the rumen digesta through a sieve of 2 mm aperture.

Food

The silage was made of locally regrowth *Phleum pratense*, *Agrostis tenuis* and *Poa* spp. which consisted almost only of leaves. The grasses were harvested on the 2nd September 1991 when they were approximately 30–40 cm long. They were wilted before being picked up and baled in a fixed chamber baler (Welger RP-12, Wolfenbüttel, Germany) and mechanically wrapped with 6 layers of plastic. Fertiliser (70 kg/1000 m^2, 12.5 kg N, 1.9 kg P and 10.5 kg K) had been applied to the swards in the spring. No preservative was added to the grasses at ensilage.

Chemical analysis

Samples of the silage (n=6) and standard grasses: two qualities of timothy hay (*Phleum pratense*) (A: high quality (n=1) and B: poor quality (n=1)) (Tilley and Terry, 1963) were analysed for ash, minerals, nitrogen, ammonia and WSC as described by Olsen *et al.* (1994). DM was determined by oven drying for 24 h at 80°C and then at 100°C until dry. Ether extract was determined by the Soxhlet

method, extracted with diethyl ether. The fibre fraction (cellulose, hemicellulose and lignin) which was calculated from values of neutral-detergent fibre (NDF), acid-detergent fibre (ADF) & acid-detergent lignin (ADL) were carried out by methods of Van Soest, (1963 a, b), Van Soest & Wine (1967) and Goering & Van Soest (1970). The methods described above were also used for analyses of crude protein, cellulose, hemicellulose and lignin of the rumen large plant fraction, ammonia of total rumen digesta and faecal material. Rumen digesta samples obtained from the five reindeer calves within 10 min. after death were strained through two layers of muslin and the pH of the filtrate was measured immediately with a calibrated portable pH meter (PHM 80, Radiometer®, Copenhagen) with a combined pH electrode (GK 2501C, Radiometer®, Copenhagen). Duplicates of 5 ml of rumen filtrate were immediately fixed with 1.25 ml 0.5 M HCl, mixed and stored at –20°C prior to analysis of volatile fatty acids (VFA) and lactic acid. Samples were subsequently thawed and analysed by chromatography as described by Sørmo *et al.* (1994).

Digestibility

Apparent digestible energy (DE) was determined in the five reindeer calves by measuring the energy content in the silage offered and the faecal material collected from them over three days (days 18–20). Energy was determined by use of a CBA-301 automatic adiabatic bomb calorimeter with a CVM-3000 microprocessor (Gallenkamp, London) and the DE was calculated by subtraction of faecal energy from energy intake. The silage and faecal samples from each day were subsequently analysed in duplicates. DE was calculated for each day and median values from each animal are presented.

DC of DM, organic matter, crude protein, ether extract, fibers, and minerals were determined in the five reindeer calves by collecting all the faeces over five days (days 16–20) while the animals stood in their pens. The pens served as metabolism crates allowing collection of faeces on trays beneath the pens. The faeces were removed each day, weighed and frozen. The DCs were calculated for each day and median values from each animal are presented.

The IVDMD of the silage was recorded using rumen fluid collected from four calves after they had been fed silage for 21 days (animals D and E) or for 47 days (animals B and C). The procedure followed Tilley & Terry (1963), with the following modifications: silage samples were dried at 60°C for 17 hours and milled using a mesh size of 0.75 mm. The dry weight was determined after heating for 24 hours at 100°C. Standard grasses A and B, with known digestibility in domestic ruminants (Tilley & Terry, 1963) were prepared in a similar way. Quadruplicate samples of approximately 100 mg plant material were placed in prewarmed, dried and cooled and preweighed Hungate anaerobic culture tubes fitted with a screw cap and butyl rubber septum (2047/16–125 Bellco, Vineland, USA). Artificial saliva was made according to McDougall (1948) with the following modifications: 9.8 g/l $NaHCO_3$, 9.3 g/l Na_2HPO_4 x $12H_2O$, 0.47 g/l NaCl, 0.51 g/l KCl, 2.54 g/l $(NH_4)_2SO_4$, 0.06 g/l $MgCl_2$ x $6H_2O$ and 0.04 g/l $CaCl_2$. L-cysteine hydrochloride (0.02 %) was used as a reducing agent and the solution was gassed with CO_2 until pH 6.9. The saliva (9 ml) was added to the tubes under CO_2. Rumen fluid was obtained by straining the rumen content through two layers of muslin. One ml of rumen fluid was then added by syringe to each tube and the tubes were incubated in a water bath at 39°C. After 6, 12, 24, 48 and 72 hours of microbial digestion, 0.3 ml of 2M HCl was added by syringe to each tube and the internal gas pressure released through a needle. The tubes were then shaken and further 0.8 ml 2M HCl was added. The contents were mixed and the excess pressure released through a needle. Pepsin solution (5 mg/ml distilled H_2O) was added, followed by 1.9 ml water, and the tubes were incubated for 48 hours at 39°C, during which they were turned regularly. The tubes were then centrifuged at 300 g for 10 min., the supernatant was removed and the pellets washed in 10 ml distilled water. The procedure was repeated until the supernatant was clear. Each tube was subsequently dried at 100°C to constant weight and cooled in a dessicator before being weighed. Control tubes with artificial saliva and rumen fluid, but no plant material, were treated in the same way. IVDMD were calculated as percent DM disappearance in each tube.

Body mass and gastrointestinal anatomy

BM of twenty of the female reindeer was measured to 1.0 kg between 10.00 a.m. and 02.00 p.m. on day 1, 9 and 16 of silage feeding, using a mobile balance for weighing live reindeer (Bye, 1986), with an electronic weighing system (Hottinger Baldwin Messtechnik, Germany). BM of the five reindeer calves was measured to 0.5 kg before feeding in the morning at day 1, 4, 11, 15, 16, 17, 18, 19 and 20

when fed silage and at slaughter, by using an electronic weighing system (Farmer Tronic, Give, Denmark). Carcass weight (n=3), rumen tissue wet weight (n=3) and rumen digesta wet weight (n=5) were measured to 0.1 kg, by using a spring balance. Wet weight of tissue and digesta from the different parts of the GI tract were measured to 1 g using an electronic balance (Sartorius, GMBH, Göttingen, Germany). The different parts of the GI tract were emptied by squeezing the contents out by hand. The dry weight of the digesta of these sections was calculated after drying at 100°C to constant weight.

Statistical methods

Chemical analyses of the silage and the BM of the female reindeer are given as means and standard deviation from the samples. Daily food intake is expressed as median and range. The IVDMD of the silage was compared with the IVDMD of the standard grasses A and B and the DC of DM of the silage using the Wilcoxen rank-sum test for comparing two treatments (Johnson & Bhattacharyya, 1992). The null hypothesis was rejected at $P<0.05$. Changes in the BM of the adult female reindeer when fed silage were examined using Freidman two-way analysis of variance (Siegel, 1956). The null hypothesis was rejected at $P<0.05$.

Results

Food

The chemical analyses of the grass silage and of the standard grasses A and B are presented in Table 1. The content of crude protein and lignin in the silage was intermediate compared to the standard grasses, while the content of cellulose, WSC and minerals indicate a good quality of the silage compared to the standard grasses. The mean silage DM content and pH was high 33.3 % (SD 4.4 %) and 4.6 (SD 0.1), respectively (Table 1).

Palatability and food intake

As many as 78.4 % of the female reindeer were eating silage in the paddock after two days, and 94.6 % after 5 days (Table 2). The median daily DM

Table 1. Chemical composition of baled mixed grass silage of regrowth *Phleum pratense, Agrostis tenuis* and *Poa* spp. (mean ± SD, n=6) and of standard grasses: two different qualitites of hay (*Phleum pratense*) (A: high quality (n=1) and B: poor quality (n=1)).

	Silage	Hay A	Hay B
Dry matter (DM), %	33.3 ± 4.4	–[b]	–
Chemical composition, % of DM:			
Ash	6.6 ± 0.4	9.8	4.5
Crude protein	14.8 ± 1.2	22.1	6.9
True protein	7.1[a]	–	–
Ether extract	4.4 ± 0.5	3.4	2.1
Cellulose	24.5 ± 1.0	25.2	32.9
Hemicellulose	26.7 ± 2.2	31.9	30.2
Lignin	2.6 ± 0.4	2.3	4.4
Water soluble carbohydrates	10.1[a]	4.9	15.5
Phosphate	0.3 ± 0.03	0.4	0.15
Magnesium	0.3 ± 0.04	0.1	0.07
Calcium	0.7 ± 0.09	0.5	0.4
Potassium	1.3 ± 0.24	3.0	1.3
Butyric acid	<0.04 ± 0	–	–
Ammonia, % of total nitrogen	8.2 ± 0.6	–	–
pH	4.6 ±0.1	–	–
Total energy content (kJ/g DM)	18.9 ±0.2	–	–

[a] n=1

[b] –, not measured

Table 2. Number of female reindeer (n=38) eating mixed baled grass silage of regrowth *Phleum pratense, Agrostis tenuis, Poa* spp. during the first seven days the reindeer were fed silage.

Day	Animals eating silage (%)
2	78.4
3	97.3
4	89.2
5	94.6
6	89.2
7	94.6

silage intake in the reindeer calves was 370 g (range 250–610 g) the first day, increasing to 740 g (range 520–1000 g) after 8 days and 810 g (range 530–1100 g) at days 16 to 20 (Fig. 1, Table 3).

Digestibility

The DE and DC of DM of the five reindeer calves ranged from 7.0 to 12.5 MJ/d and from 62.4 % to 66.2 %, respectively (Table 3).

The median IVDMD of the silage in the reindeer calves increased from 39.7 % (range 38.7–45.7 %) after 6 hours, microbial digestion to 65.1 % (range 62.5–72.8 %) and 68.3 % (range 66.6–71.3 %) after 48 and 72 hours, microbial digestion, respectively (Fig. 2). There was no significant difference between the DC of DM and the IVDMD of the silage after 48 hours (P>0.05), while IVDMD

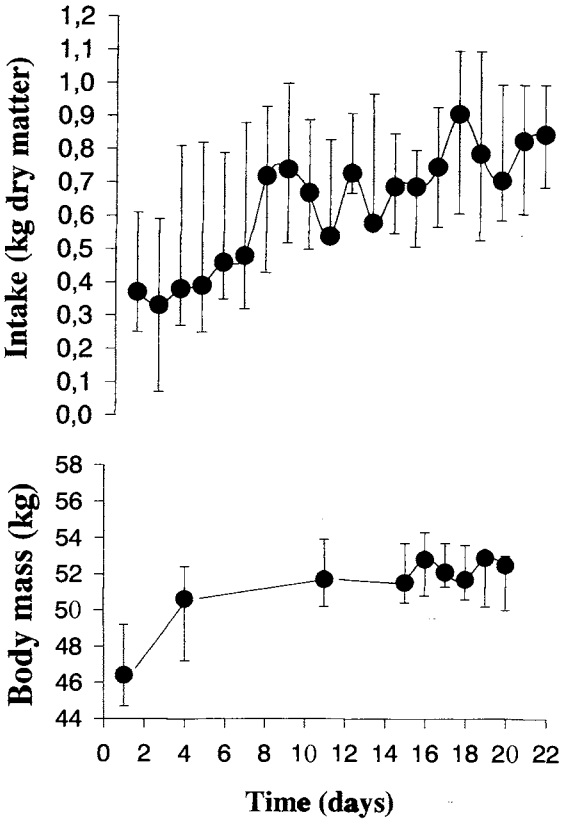

Fig. 1. Food intake and body mass (median and range) in reindeer calves (n=5) fed baled mixed grass silage of *Phleum pratense, Agrostis tenuis* and *Poa* spp. from day one after two days starvation.

Table 3. Food intake (median and range; n=5), apparent digestible energy and apparent digestibility coefficients in reindeer fed baled mixed grass silage of regrowth *Phleum pratense, Agrostis tenuis* and *Poa* spp.

	Animal				
	A	B	C	D	E
Intake DM (kg/day)	0.95 (0.91–1.0)	1.0 (0.89–1.1)	0.68 (0.61–0.71)	0.76 (0.61–0.86)	0.61 (0.53–0.85)
Apparent digestible energy (MJ/d)	11.8	12.5	9.0	7.0	9.8
Apparent digestibility coefficient (%)					
Dry matter	64.3	64.1	64.9	66.2	62.4
Organic matter	65.4	65.5	65.4	67.2	63.4
Crude protein	63.9	63.9	66.9	63.1	65.7
Ether extract	73.3	66.8	71.2	68.3	64.1
Cellulose	66.7	70.7	66.4	71.3	68.4
Hemicellulose	56.8	64.0	56.8	61.0	61.6
Phosphate	88.3	85.4	88.1	87.2	86.1
Magnesium	84.3	86.4	81.3	78.9	78.0
Calcium	84.8	83.9	82.8	78.6	80.5
Potassium	98.4	97.8	98.4	98.8	98.7

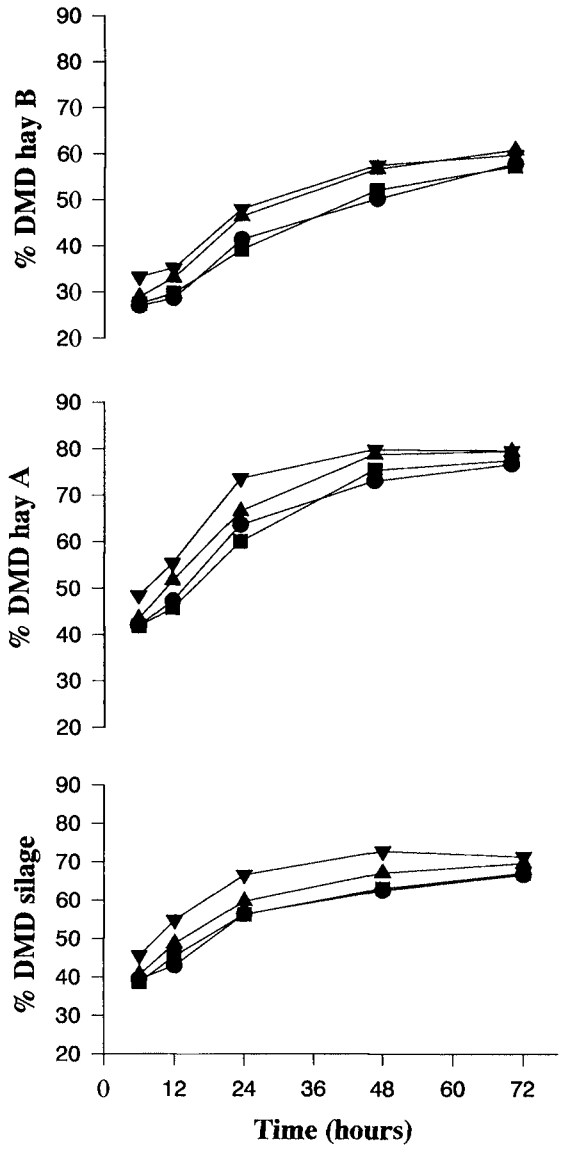

Fig. 2. Median *in vitro* dry matter digestibility (IVDMD) of baled mixed grass silage of regrowth *Phleum pratense, Agrostis tenuis* and *Poa* spp. and of standard grasses: two different qualities of hay (*Phleum pratense*) (A: high quality and B: poor quality), in rumen fluid from reindeer calves fed *ad libitum* silage in winter. All range values were within a limited of 8 % IVDMD less or greater than the median and are not expressed in the figure. Animals B (■); C (■); D (▲); and E (▼).

after 72 hours was significantly higher than the DC of DM (W_s=30, n_1=5, n_2=4, P<0.01). The IVDMD of the standard grass A stabilised after 48 h microbial digestion and was higher than the IVDMD of the silage both after 48 h and 72 h digestion (W_s=26, n_1 and n_2=4, P≤0.02). IVDMD of the standard grass B was significantly lower than the IVDMD of the silage both after 48 and 72 hours (W_s=10, n_1 and n_2=4, P≤0.02) (Fig. 2).

Ruminal chemical composition, pH, VFA and lactic acid concentration

The ruminal pH, VFA and lactic acid concentration and the chemical composition of the rumen large plant fraction are presented in Table 4. The ratio of acetate/propionate ranged from 3.9 to 4.6 between the animals. The fibre content of the rumen large plant fraction amounted to 77.7–85.6 % of DM, while the protein content amounted to 8.3–11.5 % of DM. The ammonia content in total rumen digesta amounted to 0.20–0.24 % of DM (Table 4).

Body mass and gastrointestinal anatomy

The mean BM of the female reindeer was 62.6 kg (SD 9.7 kg) at the start of the silage feeding. BM increased to 67.3 kg (SD 10.4 kg) after 9 days and decreased to 65.9 kg (SD 10.8 kg) after 16 days (P<0.01). The median BM of the reindeer calves was 46.4 kg (range 44.7–49.2 kg) at the start of silage feeding. It increased to 51.7 kg (range 50.2–53.9 kg) by day 11 and remained constant thereafter. (Fig. 1, Table 5). Carcass weight was 42.6–44.2 % of BM (Table 5). The total GI tract tissue wet weight was 4.1–4.5 % of BM of which the reticulo-rumen tissue was 2.4–2.6 % of BM. The digesta wet weight in the total GI tract was 24.2–26.7 % of BM of which the reticulo-rumen digesta wet weight was 19.6–23.7 % of BM. The digesta dry weight of the total GI tract was 2.2–2.4 % of BM of which the reticulo-rumen digesta dry weight was 1.8–2.1 % of BM (Table 5). The tissue wet weight and the digesta wet and dry weight of omasum, abomasum, small intestine, caecum and colon are presented in Table 5.

Discussion

Round bale silage of regrowth mixed grasses was evidently highly palatable when fed to adult female reindeer and reindeer calves (Table 2, Fig. 1). Most importantly, none of the animals showed any digestive disorders when fed silage. Kurkela (1976) and Syrjälä-Quist (1982a), likewise, found that silage was highly palatable in adult reindeer. Jacobsen & Skjenneberg (1977), in contrast, found that reindeer did not like silage.

We assume that the initial increase in BM in the reindeer calves was primarily due to increased recti-

Table 4. Ruminal pH, total VFA and lactic acid concentration, DM, ammonia and chemical composition of the large plant fraction in the rumen in reindeer fed *ad libitum* baled mixed grass silage of regrowth *Phleum pratense, Agrostis tenuis* and *Poa* spp.

	Animal				
	A	B	C	D	E
pH	7.17	6.98	7.0	6.95	7.11
Total VFA (mM)	38.4	48.6	48.2	47.6	52.5
Lactic acid (mM)	0.4	0.4	0.5	0.3	0.6
% of total VFA					
Acetate	77.1	73.9	76.3	75.4	75.1
Propionate	16.7	18.9	17.3	17.5	17.7
Butyrate	6.2	7.2	6.4	7.1	7.2
DM (%)	8.7	10.0	8.3	9.2	9.2
Ammonia (% of DM)	0.23	0.20	0.24	0.22	0.22
Chemical composition, % of DM:					
Crude protein	8.3	8.4	9.1	11.5	10.7
Cellulose	38.9	36.1	35.4	30.0	34.2
Hemicellulose	40.0	40.2	39.1	40.0	38.6
Lignin	6.7	7.2	7.2	7.0	5.7

culo-rumen digesta wet weight (Fig. 1). The mean reticulo-rumen digesta wet weight of adult reindeer feeding on natural pasture in summer in Norway was 13.5 % of BM, representing from 6.1 % – 10.2 % of BM less than found in the silage fed reindeer calves (Staaland *et al.*, 1979) (Table 5). In reindeer D and E slaughtered after 21 days of silage feeding, the reticulo-rumen digesta wet weight was 24.7 % and 20.2 % of BM, respectively, which was similar to the values for the animals fed silage for 47 days (Table 5). The maintained BM, after an initial period when the reticulo-rumen digesta load increased, indicated that the silage supported maintenance energy requirements in the reindeer calves. The increased BM of the female reindeer during the 16 days of silage feeding may be a result of increased recticulo-rumendigesta load, rather than increase in tissue weight.

The silage was adequately preserved according to Saue & Breirem (1969). It contained little butyric acid and the ammonia N value of total nitrogen was at the limit for a good quality. The silage was almost made of only leaves, the lignin content was low and nutrients value was regarded as medium compared to the standard grasses (Table 1). It was therefore unexpected to find a median DC of DM as low as 64.3 % (Table 3). The DC of DM in adult male reindeer fed cocksfoot (*Dactylis glome-rata*) silage, with almost the same chemical composition as our mixed silage, was 69 % (Syrjälä-Qvist, 1982a). Our reindeer calves were first fed lichens and than starved before they were fed silage *ad libitum.* This treatment may have reduced their ability to digest food. In the present study cellulose had a higher DC than hemicellulose (Table 3). Hemicellulose is more closely associated with the poorly digestible lignin, and a substantial portion of hemicellulose escapes the rumen to be fermented in the lower tract (Van Soest, 1982). The DC of DM was similar to the IVDMD of silage after 48 hours microbial digestion, but lower than after 72 hours digestion (Table 3, Fig. 2). The rate of IVDMD of the silage indicates a slow ruminal digestion of the grass particles. The passage rate of the silage through the digestive tract may have been too high to achieve maximum digestion.

The low digestibility of the silage corresponds to the low VFA concentration in the rumen (Table 4). The median ruminal VFA concentration in the reindeer calves fed silage was 43 % lower than the mean value found in adult reindeer fed cocksfoot silage (Syrjälä-Qvist, 1982b) and 48 % lower than the mean value found in reindeer on South-Georgia, eating mainly vascular plants (S. D. Mathiesen,

Table 5. Total body mass (BM) at slaughter, carcass weight and gastrointestinal (GI) tissue and digesta weight (g) in three reindeer calves fed baled mixed grass silage of regrowth *Phleum pratense, Agrostis tenuis* and *Poa* spp.

	Animal		
	A	B	C
BM:	51500	53000	54000
Carcass weight:	22100	23400	23000
Total GI tract:			
Tissue	2225	2385	2230
Digesta: wet weight	13775	12845	13965
dry weight	1240	1270	1170
Recticulo-rumen:			
Tissue	1300	1400	1300
Digesta: wet weight	12200	10400	11600
dry weight	1061	1040	963
Omasum:			
Tissue	65	85	85
Digesta: wet weight	55	165	140
dry weight	8.7	25.8	23.1
Abomasum:			
Tissue	120	120	110
Digesta: wet weight	145	220	210
dry weight	19.3	18.7	22.4
Small Intestine:			
Tissue	500	500	440
Digesta: wet weight	750	1200	1210
dry weight	68.5	95.3	78.7
Caecum:			
Tissue	35	45	50
Digesta: wet weight	235	295	430
dry weight	24.6	27.7	35.7
Colon:			
Tissue	205	235	245
Digesta: wet weight	390	565	375
dry weight	55.5	65.6	47.0

unpublished). The high ruminal pH and low VFA concentration indicates a low fermentation rate of the silage. The median ratio of acetate/propionate was above 4 which indicates fermentation in favour of plant cell wall fibres. Similar values have been found in reindeer fed cocksfoot silage (Syrjälä-Qvist, 1982b) and in reindeer on South-Georgia (S. D. Mathiesen, unpublished).

The low digestibility and low ruminal VFA concentration show that this silage was apparently of only limited value as an emergency food for reindeer in winter. Due to its high palatability and absence of digestion disorders it can be recommended for use in short periods when animals are rounded up in paddocks for ear marking and before and after transport connected to slaughtering.

Acknowledgement

We thank the Eira family from Gielas reindeer pasture district for participating in the project and for providing reindeer. This work was supported by the Reindeer Research Fund under the auspices of the Norwegian Ministry of Agriculture.

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Manuscript accepted 27 March, 1995