Evaluation of silage diets offered to reindeer calves intended for slaughter. I. Feeding of silage and barley from September to March

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Abstract: An experiment involving 75 male reindeer calves (mean initial live weight 39.6 kg, SD=3.7) intended for slaughter was undertaken to study the effect of proporrion of barley to silage in the diets on animal performance. The calves were alloted to five groups including one group slaughtered at the start of the experiment in September. The remaining groups were offered diets containing either, 30% (LB), or 60% (HB) rolled barley, based on the dry matter (DM) content, until slaughter in November (LB and HB) or in March (HB). The silage (43% DM) was made from the primary growth of a predominantly grass sward preserved as plastic-wrapped big bales. Small amounts of lichens were mixed with the rations during rhe first two weeks of the experiment and the calves adapted well to the experimental diets. However, health problems and deaths occurred on borh rarions after five weeks of feeding. Since the animals fed the LB diet lost live weight and condition the experimental feeding of these calves were interrupted at the slaughter in November. Calves fed the LB diet had significantly lower daily DM intake ($P<0.01$). They also had lower live weighr gain (not significant), greater losses of carcass weight and fat in the abdominal cavity relative to those offered the HB diet. During the second period of the study the remaining animals offered the HB diet showed no signs of ill-health and increased live weight, carcass weighr, and fat in the abdominal cavity. The results of the presenr experiment indicate that when silage of the investigated quality is fed to reindeer calves rhe proportion of silage should not exceed 40% of the DM.

Key words: *Rangifer tarandus tarandus*, feed intake, weight gain, dressing percentage, visceral organs, abdominal fat.

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Introduction

Previous studies have shown that silage is not to be recommended as the sole feed to reindeer for extended periods (Syrjälä-Qvist, 1982a; 1982b; Aagnes & Mathiesen, 1995; Nilsson, 1994; Nilsson *et al.*, 1996a). However, the lack of suspiousness towards the silage may facilitate adaptation to feeding and the rather high water content of silage might affect maintenance of the water balance. Also there is the possibility to produce a feed close to the reindeer herding areas. Experiments in Alaska have shown that barley can serve as a useful supplement to grazing when given to both calves and adult reindeer (Blanchard *et al.*, 1983). The utilization of locally produced feeds, such as silage and barley in Northern Sweden, is of interest as a means of maintaining an open landscape.

Previous studies starting in early December (Nilsson, 1994) or in mid-October (Nilsson *et al.*, 1996a) have shown that the health and condition of the animals at the start of the experiment has a major effect on the subsequent outcome. A facilitated adaptation to a silage-based diet may be expected if animals are introduced to the feed in early autumn when their natural intake of pasture would be dominated by grasses and herbs. The heaviest male calves may actively participate in rutting and thereby lose weight (Petersson & Danell, 1993). Thus, for male reindeer calves intended for slaughter, separation from the herd and an introduction to feeding in early autumn may be advantageous in improving performance and reserving grazing area for the breeding stock. As a part of a three-year study where silage-based diets were studied for fattening reindeer, the present study evaluated the performance of calves offered different proportions of barley to silage in the diet.

Material and methods

Animals, feeds and feeding

A total of 75 approximately four-month old male reindeer calves (*Rangifer tarandus tarandus*), were taken from a gathering of the Semisjaur-Njarg herd in Merkenäs on September 2, 1994. The calves were randomly allotted into five groups, each comprising 15 calves. One group of calves was slaughtered at the gathering place on September 2, in a mobile reindeer slaughter plant, in order to record the initial status of the animals. Four groups were taken by truck for about 150 km to the reserach station in Vuolda, Arjeplog, where they spent the night penned together. The station is situated in the coniferous forest area at latitude 66°N. The following day these groups of animals were randomly allotted to four experimental pens. Two groups were offered a high barley diet (HB), 60% barley dry matter (DM) and 40% silage DM, and the other two a low barley diet (LB), 30% barley DM and 70% silage DM. From mid-October the calves, especially those on the LB-diet, lost live weight and condition and the experimental feeding of the LB-diet was terminated. Eight calves from each pen offered the LB-diet were randomly allotted to slaughter on November 1. The remaining calves from the LB-diet were taken off the experiment. From the HB-diet, three animals from each pen were allotted to slaughter in November while the remaining calves were slaughtered on March 23.

The area of each experimental pen was about 5000 m^2. Initially, only about one-third of the area was available to the calves but they were given free access to the whole area after 10 days. During the first 15 days of the experiment, the reindeer were given a mixture of lichens (*Cladonia* spp.) and the experimental diets. On the first day at the station, a total of 0.2 kg DM, of which 0.03 kg DM was lichens, was offered to each calf. On the second day, the reindeer calves were fed twice and the total amount of feed was doubled. From the third day, the silage and barley allowances were increased whereas the lichens were gradually decreased. The animals were given free access to the rations and the allowances were increased by a maximum of 0.03 kg DM per animal and day. The amounts were adjusted in order to obtain 5 - 10% residues. After a period with health problems, many of the animals, especially those offered the LB-diet, seemed inert and apathetic. In an attempt to stabilize the rumen functions and increase the energy intake of the animals, 0.1 kg DM of lichens per animal and day was mixed into both rations from October 21 to November 21.

The silage was made from primary growth of a predominantly meadow-fescue and timothy based sward which also contained minor amounts of red clover. The herbage was harvested in Northern Sweden, wilted and ensiled untreated in plastic-wrapped big bales with eight layers of plastic and stored outdoors. The silage was chopped to about 10 cm lengths with a tractor-powered bale shredder prior feeding. Samples of the silage were taken daily, frozen and bulked for periods of one or two weeks. The chemical composition and metabolisable energy (ME) content of the samples were estimated as described by Nilsson *et al.* (1996a). The barley was rolled prior to feeding and samples were taken daily, bulked for periods of two or three weeks and analysed for DM, crude protein (CP), crude fat, crude fibre and ash (Anon., 1966). The ME content of the barley was calculated from the chemical composition as described by Axelsson (1941), using digestibility coefficients according to Spörndly (1993). The lichens were assumed to contain 7.6 MJ ME and 3% CP per kg DM (Spörndly, 1993).

The calves were fed twice daily and refusals were removed daily and recorded. The chopped silage and the rolled barley were mixed manually and offered in two wooden cribs with a total number of sixteen feeding places in each pen. The diet was supplemented with 25 g per kg DM of a mineral mixture (Mineral Låg, Lactamin, Stockholm, Sweden). Each pen had access to a lick-stone with salt and minerals (Viltsten, AB Hanson & Möhring, Halmstad, Sweden). The animals had free access to temperated water (about 10-18°C). The water was replaced every day and consumption was recorded.

The calves were dewormed on September 14 and 21 using ivermectin (Ivomec pour on®, MSD Agvet).

Outdoor temperature

Outdoor temperature was recorded daily at 10 a.m. using a thermometer placed in the shade. The maximum and minimum temperatures during the previous 24 hours were recorded at the same time.

Weighings

All calves were weighed prior to the experiment at the gathering place and once weekly at the same time of the day during the experiment. Live weight (LW) at slaughter was determined as the weight the day preceding slaughter.

Slaughter

The animals slaughtered in September and November were slaughtered in specialized mobile reindeer slaughter plants. The slaughter in March took place in a stationary reindeer slaughter plant (Stenudden, Arjeplog). The calves slaughtered in September waited for about eight hours before slaughter in a separate pen after being caught. In November and March the calves were not fed on the morning of slaughter. They were transported by truck for about one hour and waited for about one hour in a separate pen prior to slaughter.

After slaughter, the reticulo-rumen and its contents, the kidneys, liver, lungs and heart and fat in the abdominal cavity (kidney-knob and omentum) were examined and weighed. Samples from organs with a macroscopial divergent appearance were examined histologically. The carcasses were classified according to the EUROP system. The carcasses were weighed two days after slaughter for the determination of cold weight. The pH-value in *M. longissimus dorsi* was measured two days after slaughter using a KNICK Portamess 651-2 pH-meter (Knick Elektronische Mess-geräte Gmbh & Co, Germany) equipped with a Xerolyte electrode (lot 406 M-6, Ingold Messtechnik AG, Switzerland).

Statistical methods

Due to the sample slaughter technique used, not only feed intake but also gain in weight were based on pen means. As there was only a total of two groups per diet in the experiment, the means for each group are presented in the Tables, rather than the treatment means. Student's *t*-test was used to evaluate treatment differences in feed intake and gain in LW. When comparing the results from the different slaughter occasions, the following model, where r_i is the effect of ration (LB and HB-diet), t_j is the effect of slaughter time (September, November and March) and e_{ijk} is the random error, was applied using the General Linear Models (GLM) procedure described by SAS (1988):

$$Y_{ijk} = \mu + r_i + t_j + e_{ijk}$$

Contrasts were calculated for the effect of initial status compared with status after a feeding period on either of the rations (September *vs.* LB November and September *vs.* HB November), effect of ration (LB November *vs.* HB November), and for the effect of time on feeding (HB November *vs.* HB March). The weight option in the GLM procedure was used to compensate for the differences in number of animals slaughtered per group on each slaughter occasion. All probabilities greater than 0.05 were denoted not significant (NS).

Results

Nutritional value of the feed

The chemical composition of the silage and barley are presented in Table 1. The mean DM content of

Table 1. Dry matter (DM), crude protein (CP), digestible CP (DCP), ash, water soluble carbohydrates (WSC), neutral detergent fibre (NDF), acid detergent fibre (ADF) and metabolisable energy (ME) content and pH and ammonia-N of total nitrogen (TN) of the silage and barley, as mean ± standard deviation.

	Silage	Barley
Number of analyses	19	14
DM, %	43.2±1.8	86.3±0.4
CP, g/kg DM	120±7	125±2
DCP, g/kg DM	81±6	95±1
Ash, g/kg DM	73±4	25±2
WSC, g/kg DM*	55±7	-
NDF, g/kg DM*	588±15	-
ADF, g/kg DM*	334±9	-
ME, MJ/kg DM	10.9±0.1	13.3±0.1
Ammonia-N, g/kg TN	66±10	-
pH	5.5±0.04	-

* Based on 13 analyses of silage.

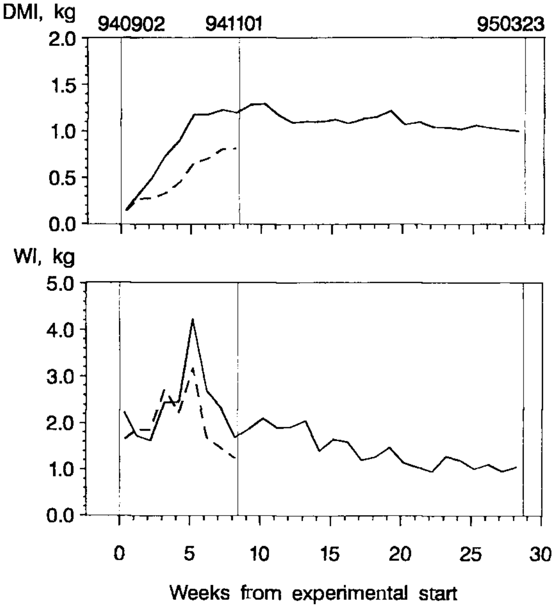

Fig. 1. Weekly means for the daily dry matter intake (DMI) and drinking water intake (WI) of reindeer calves fed diets with low, 30% (LB, --), or high, 60% (HB, –), proportions of barley in the dry matter. The slaughter occasions are indicated by vertical lines.

the silage and barley were 43.2% and 86.3% respectively. The silage was of good hygienic and preservative quality. The mean DM content of the lichens was 75.4%.

Animal health

The calves adapted well to pen life and most of the animals started to eat and drink within two days. However, one of the groups offered the HB-diet, which had better grazing conditions, did not start to eat the offered rations regularly until about ten days after the start.

Severe health problems and even deaths occurred during a two-week period five weeks after the start of the experiment. On September 30, one calf offered the HB-diet, which had a progressing abdominal hernia was slaughtered. From October 4 to October 19 eight calves fell ill and died or were slaughtered. A total of eight calves, four from the HB-diet and four from the LB-diet, were excluded during this period. The illness and deaths were rapid and occurred among calves of all sizes. The post mortem investigations showed rumen indigestion and emaciation and also that the animals were infected, some of them heavily, with parasites particularly *Nematodirella longissimesspiculata* and *Moniezia*. On February 17, one calf offered the HB-diet was slaughtered as he was not eating properly and loosing LW due to several teeth were lacking and those remaining were loose.

Feed and water intake

Feed intake for the two main periods are presented in Table 2. The mean daily DM intakes for each week of the experiment are shown in Fig. 1. The calves on the HB-diet increased their daily feed intake from 1.34 kg during the first period to 1.81 kg per animal during the second period. The corresponding daily intakes of DM were 0.82 kg and 1.11 kg. The peak intake of the HB-diet was 1.3 kg DM per day and occurred nine weeks after the start of the experiment (Fig. 1). From week 10 there was a small but consistent decrease in the daily intake. Since the intake of energy and protein follows DM intake the average intake of ME and CP on the HB-diet increased, from 10.0 MJ and 97 g during the first period to 13.5 MJ and 135 g respectively, during the second period.

Until slaughter in November the animals offered the LB-diet had significantly lower daily feed, 0.96 kg, and DM, 0.49 kg, intakes, than animals on the HB-diet. Also, the daily intakes of DM per kg LW, 12.3 g, were significantly lower on the LB-diet than on the HB-diet (19.6 g). The daily intakes of energy, 5.6 MJ ME, and CP, 56.0 g, were significantly lower on the HB-diet.

During the first period from September to November, the mean daily drinking water consumption of the calves fed the HB-diet was 2.4 litre and it decreased to 1.4 litre during the latter part of the experiment (Table 2). During the first period, calves fed the LB-diet drank less, 2.0 litre, than calves fed the HB-diet. The daily water intake for each week of the experiment is shown in Fig. 1. Initially, the water intake seemed to be correlated to the DM-intake. When a covering layer of snow was established in late September - October the water intake was reduced by 30-40%. Despite the different feed intakes and DM contents of the rations, the daily water intake via the ingested feed was the same, 0.5 l per day on both rations, during the first period.

Gains and losses in live weight and carcass weight

The mean initial LW in September was 39.6 kg with a range from 23 to 51 kg. There were no significant differences in LW between the treatments at the start of the experiment. The mean LW for the

Table 2. Number of animals and mean daily intakes per animal of feed, dry matter (DM), crude protein (CP), metabolisable energy (ME) and drinking water and daily dry matter (DM) intake per kg live weight (LW) in groups of reindeer calves fed either a ration of 30% barley and 70% silage (LB) or 60% barley and 40% silage (HB).

Ration	LB		HB		Effect of ration
Group number	1	2	3	4	*P*≤
Number of animals:					
940902	15	15	15	15	
941031	14	12	13	12	
950322	-	-	9	9	
Feed, kg:					
940902-941031	0.93	0.99	1.30	1.38	0.02
941101-950322	-	-	1.77	1.85	-
DM, kg:					
940902-941031	0.48	0.51	0.80	0.84	0.007
941101-950322	-	-	1.08	1.13	-
DM, g/kg LW;					
940902-941031	12.0	12.6	19.5	19.6	0.002
941101-950322	-	-	23.6	22.9	-
CP, g:					
940902-941031	54	58	94	99	0.006
941101-950322	-	-	132	138	-
ME, MJ:					
940902-941031	5.4	5.8	9.7	10.2	0.005
941101-950322	-	-	13.2	13.8	-
Water, l:					
940902-941031	1.98*	1.98*	2.51	2.23	
941101-950322	-	-	1.40	1.41	

* The two groups shared water trough.

calves on the HB-diet at slaughter in November was 43.4 kg (Table 3), corresponding to a daily LW gain (LWG) of 45 g from September. During the period from November until slaughter in March the remaining calves gained 39 g per day and the mean LW at slaughter for those calves was 49.4 kg. The mean LW of the groups on the HB-diet changed slightly due to the slaughter of three animals from each group in November. In order to illustrate the development of LW in relation to the initial LW of the intact groups, a corrected LW was calculated for each week based on the mean LW of the intact groups at slaughter in November and the LWG of the remaining calves for the subsequent weeks (Fig. 2). The corrected LW at slaughter in March was 49.0 kg. The LW gain (LWG) of the calves fed the LB-diet until slaughter in November, when they weighed 41.4 kg, was 19 g per day. The difference in LWG between the LB-diet and HB-diet was not significant.

The dressing percentage of the calves slaughtered from the HB-diet in November, 44.9%, was lower (not significantly) than that of the calves slaughtered in September, 47.2% (Table 4). However, the dressing percentage of the HB in March, 50.7%, was significantly ($P<0.01$) higher than in November. The dressing percentage of the LB calves slaughtered in November, 37.9%, was lower ($P<0.001$) than in September and lower ($P<0.01$) than that of the HB calves. However, it must be

Table 3. Number of animals, live weight (LW) at start and slaughter and daily live weight gain (LWG) in groups of reindeer calves (cf. Table 2). Group number 0 was slaughtered at the start of the experiment.

Ration		LB		HB		Effect of ration
Group number	0	1	2	3	4	$P\leq$
Number of animals:						
940902-941031	15	14	12	13	12	
941101-950322	-	-	-	9	9	
LW 940902, kg	36.4	39.9	40.6	40.2	41.3	
LW 941031, kg	-	41.2	41.5	42.2	44.4	
LW 950322, kg	-	-	-	47.3	51.4	
Corrected LW[1)] 950322, kg	-	-	-	48.4	49.6	
LWG, g/day:						
940902-941031	-	23	15	37	54	NS
941101-950322	-	-	-	42	36	-

[1)] Corrected LW is explained in the text.

recognized that only six animals for the HB treatment were slaughtered in November and the individual dressing percentages varied between 39.3 and 50.0%.

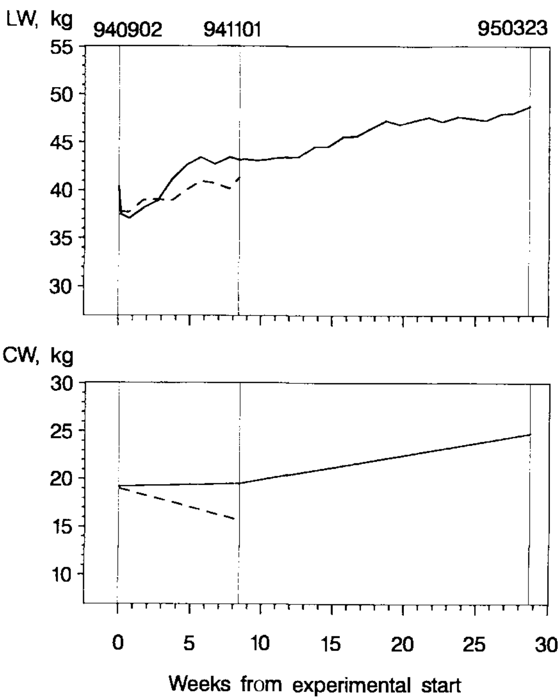

Fig. 2. Evolution of live weight (LW) and carcass weight (CW), respectively, for reindeer calves fed diets with low, 30% (LB, --), or high, 60% (HB, –), proportions of barley in the dry matter. From November 1 corrected LW are used (see text). The slaughter occasions are indicared by vertical lines.

The dressing percentage for the calves slaughtered in September was applied on the LW at start for the calves slaughtered in November and March to calculate the CW at start. The mean CW's of the animals in November and March were likewise calculated from the dressing percentage of the calves slaughtered in each group and the mean LW or corrected LW at slaughter. Animals on the HB-diet lost 2 g CW per day until slaughter in November but gained about 37 g CW per day from November until March, while the calves from the LB-diet lost 54 g CW per day until November. Fig. 2 illustrates the evolution of carcass weight.

Reticulo-rumen and its content

The relative weight of the reticulo-rumen tissue decreased ($P<0.01$) with time on the HB-diet, from 61 g per kg CW in September to 53 g and 39 g in November and March respectively (Table 4). The reticulo-rumen tissue weight of the calves on the LB-diet slaughtered in November and September, 61 g, did not differ significantly. The difference in the relative weight of the reticulo-rumen tissue in November between the HB-diet and the LB-diet was significant ($P<0.01$).

The weight of the reticulo-rumen content per kg CW was higher (not significantly) on the HB-diet at slaughter in November, 273 g, compared with September, 160 g. In March the relative amount of the reticulo-rumen content had decreased (not sig-

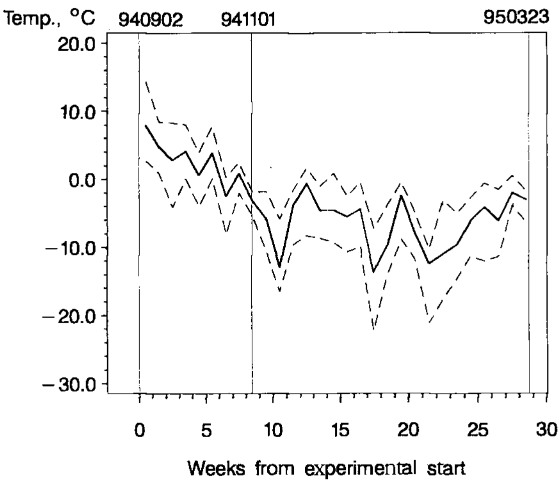

Fig. 3. Weekly means of outdoor temperature (°C) recorded at 10 a.m. (–) , and minimum and maximum (--), during the experimental period at the research station in Vuolda, Arjeplog.

nificantly) to 180 g. At the slaughter in November the reticulo-rumen content of the calves fed the LB-diet weighed clearly more (P<0.01), 546 g, than on the HB-diet. This was also higher (P<0.001) than the initial weight in September.

Fat in the abdominal cavity

The amount of fat in the abdominal cavity of the calves slaughtered in September was 7 g per kg CW (Table 4). A similar amount was found for the calves slaughtered from the HB-diet in November, 7 g, while the amount was higher (P<0.01), 19 g, in March. However, the figure for November only relates to six calves, of which one had considerably more fat than the others, 18 g. The mean amount of fat for the other five calves was 4 g, which might better reflect the mean for the groups. From the animals offered the LB-diet, a smaller (not significantly) amount of fat, 3 g per kg CW, was found in November compared with the animals slaughtered in September.

Liver, kidneys, lungs and heart

The weights of the liver, lungs and kidneys per kg CW decreased from September to March, while the weight of the heart remained constant (Table 4). There were no significant treatment differences in the relative weights of these organs. As a consequence of the differences in CW it must be emphasized that the absolute weights of the livers, kidneys and lungs were higher in March than in November, despite the lower relative weights.

Divergent appearances were found in 16 livers and 2 kidneys. Histological examination showed that the injuries were caused by healed parasite attacks.

Carcass assessment

The highest grading of the carcasses was achieved in March, when they got a mean score of R for the conformation. In September the mean score was R- while in November when the calves on the HB- and LB-diet had mean scores of P+ and P respectively. All carcasses were estimated in the lowest fat-group, 02, at slaughter in November while in September and March the mean scores were 03. The ultimate pH-values of *M. longissimus dorsi* were found to be highest in November and lowest in September (Table 4).

Outdoor temperature

During the experimental period, the outdoor temperature at 10 a.m. varied between 10°C and -24°C. During September - November the outdoor temperature varied between 10°C and -6°C and during November-March between 5°C and -24°C. The maximum temperature recorded was 20°C and the lowest was -35°C. The mean temperature for each week of the experiment is presented in Fig. 3.

Discussion

Since health problems occurred in animals on both diets at the same time it is possible that performance was influenced by a common factor such as the season for the start of feeding, or the time that had elapsed from separation from the females. Under natural conditions, the reindeer calves follow the females another two or three weeks until the beginning of the rutting period. During the rutting period, the calves commonly are rejected by the females but after this period the calves usually resume suckling and will not be weaned until November (Skjenneberg & Slagsvold, 1968). In contrast, male reindeer calves taken from a herd on September 9 and fed concentrate until November 7 did not show any signs of digestive disturbances or animal health problems (Jacobsen & Skjenneberg, 1981). The emaciation and disturbances in rumen functions found at *post mortem* investigations and the great losses of abdominal fat until November on both diets, clearly indicated that the calves had not been

Table 4. Slaughter data for groups of reindeer calves (cf. Table 2). Group number 0 was slaughtered at the start of the experiment.

Ration		LB		HB				Contrasts			
Group number	0	1	2	3		4		Sep. *vs.*	Sep. *vs.*	LB-Nov. *vs.*	HB-Nov. *vs.*
Slaughter time	Sept.	Nov.	Nov.	Nov.	Mar.	Nov.	Mar.	LB-Nov. $P\leq$	HB-Nov. $P\leq$	HB-Nov. $P\leq$	HB-Mar. $P\leq$
Number of animals slaughtered	15	8	8	3	9	3	9				
CW, kg	17.2	15.2	16.7	19.2	23.9	18.1	26.3	NS	NS	NS	0.03
Dressing percentage	47.2	37.5	38.4	43.6	50.4	46.3	50.9	0.001	NS	0.007	0.01
Content in reticulo-rumen, g/kg CW	160	569	523	236	177	311	182	0.001	NS	0.005	NS
Tissue of reticulo-rumen, g/kg CW	60.8	61.5	60.6	53.2	40.4	52.1	38.5	NS	0.008	0.007	0.002
Kidney-knob, g/kg CW	2.6	0.8	0.8	3.7	7.2	2.2	8.1	0.04	NS	NS	0.007
Fat in the abdominal cavity, g/kg CW[1)]	7.2	3.2	2.4	8.7	17.9	4.7	20.3	NS	NS	NS	0.008
Liver, g/kg CW	41.4	31.9	32.1	32.3	27.1	32.6	25.1	0.002	0.005	NS	0.01
Kidneys, g/kg CW	7.2	7.0	7.1	6.5	4.7	5.6	4.6	NS	0.03	NS	0.02
Lungs, g/kg CW	26.4	25.2	26.0	25.0	20.5	22.3	19.8	NS	NS	NS	0.05
Heart, g/kg CW	18.4	18.3	18.2	19.0	18.1	18.4	18.1	NS	NS	NS	NS
pH, *M. longissimus dorsi*	5.41	5.98	5.87	5.64	5.54	5.67	5.46	0.002	0.05	0.03	NS

[1)] Fat in the abdominal cavity is the sum of the kidney-knob and the omentum.

able to adapt to the rations properly and that they were in a negative energy balance. As concluded from earlier studies (Syrjälä-Qvist & Salonen, 1983; Nilsson *et al* , 1996a), a high proportion of roughage in the diet restrict feed intake and thus contribute to an explanation to the worse performance on the LB-diet. The lack of illness and the gain in LW, CW and the amount of fat in the abdominal cavity until March, showed that the calves were able to adapt to the HB-diet in a prolonged feeding period.

The fact that many animals died on both treatments during a short period may indicate that health problems were fortified by some hygienic problems of the feed. Although the silage was checked carefully before feeding, and no evidence was found in the analysis of the silage, it can not be excluded that the acute disturbances were caused by contaminations in some silage bales.

The calves were given free access to the diets in order to explore their intake capacity. However, for the evaluation the amounts of the residues allowed are critical. The feed intake was calculated assuming that the compositions of the residues were the same as in the fed rations. This assumption may overestimate the silage intake and underestimate the barley intake since the major part of the residues, from both the LB-diet and the HB-diet, consisted of silage. According to the actual amounts of the residues and the different ME contents of the silage and the barley, the ME intake may at the most be underestimated by about 0.08 MJ ME per day in the LB-diet and 0.2 MJ ME in the HB-diet. Since the calves most likely preferred and selected the finest and the most nutritious parts of the silage, the nutritional value of the consumed silage might have been slightly higher than predicted by the analyses. However, this will not alter the general conclusions with respect to rhe difference in feed and ME intake between the diets. It must also be recognized that the values used for the ME content of the feeds primarily predict the ME contents for cattle and sheep.

As shown in Fig. 1, the feed intake decreased slightly from about 10 weeks of feeding until slaughter in March. In contrast, LW and CW increased from about 13 weeks of feeding (Fig. 2). In accordance with studies by, e.g. Suttie *et al.* (1991), one explanation might be that the time of the year and the increasing day length influenced the growth patterns of the reindeer calves.

In comparison with freely grazing reindeer, calves and adults, who may lose about 20% of their weight during a normal winrer (e.g. Jacobsen *et al* , 1976), the results on the HB treatment were quite satisfactory, especially those of the calves slaughtered in March. Data collected from another twelve calves from the same herd slaughtered at a gathering in January indicated that their LW, dressing percentage and fat deposition was similar to what was found at the gathering in September and for the HB-diet in November (Nilsson *et al.*, 1996b).

The fact that the calves initially drank such large amounts of water, with maximum intakes of 4.3 litres and 3.2 litres per day for the HB-diet and the LB-diet, respectively, stresses the great importance of giving reindeer free access to fresh water in a feeding situation, especially when the access of fresh snow is limited.

The outdoor temperature measured at 10 a.m. in Vuolda from September to November was about average for this area of Sweden (Alexandersson *et al.*, 1991) while rhe temperature from December to March was about 5°C higher than average. At the research station, there were possibilities to store the silage indoors during cold periods in order to thaw the silage bales before handling, but due to the mild winter this was not always necessary. However, this possibility certainly facilitated the handling of silage and must be considered in a practical feeding situation.

Post mortem investigations showed that the calves that died or were slaughtered due to health problems were infected by parasites, despite having been dewormed twice. One explanation of this might be that the calves were kept in the same pen throughout the experiment, also during the deworming period, and thus the deworming might have been less effective due to reinfection of the pens and the animals. The infection of parasites was probably an energy burden for the calves but as there was no untreated control it is not possible to evaluate it further.

The experiences obtained from this experiment, compared to our previous studies from the same research station, do not suggest that adaptation to a silage diet is facilitated if the calves are still on grass pasture when the diets are introduced. The ultimate reasons for this and for the poor performance during the first part of the experiment could not be fully established. The composition of the diets, the early weaning, the season and perhaps the parasite burden, might all have contributed to the result. Since both calves and 17-month-old males lost abdominal fat and showed clear signs of negative energy balance when fed solely on silage (Moen, 1994; Nilsson *et* *al.*, 1996a) or, as in the present study, silage together with a minor amount of barley, those diets might be questionable even for short periods and especially for reindeer calves. The lack of suspiousness towards the feed and the increase in weight and fat deposition after a prolonged feeding period still indicates that there might be advantages to give diets containing silage to reindeer. When fed to reindeer calves, silage should be well mixed with an energy-rich feed and the amount of silage of this quality should probably be restricted to less than 40% of the diet DM.

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