The effects of different grazing pasture systems and spring turn-out date on growth and development of lambs

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ABSTRACT

This experiment examines the effects of different turn-out dates and grazing systems on lamb performance. The experiment followed a 2 x 2 factorial arrangement of treatments, with one factor representing different turn-out time of ewes and lambs (A: indoors 4 weeks after lambing vs. B: indoors 2 weeks after lambing) and a second factor representing different summer grazing methods, lowland mire with access to cultivated pasture or rangeland (1 vs. 2). The lambs with the later turn-out date grazing rangeland (A1) had the lowest average daily gain (ADG). The final live weight (FLW) was 35.2, 37.6, 38.1 and 38.2 kg in groups A1, A2, B1 and B2 respectively, and carcass weight 14.2, 15.0, 15.5 and 15.6 kg. Greater differences were observed due to turn-out date than grazing system, and lambs that were turned-out later and grazed the cultivated pasture along with the lowland mire had the greatest loin muscle and fat gain from the beginning of June until slaughter (17 August). It was concluded that grazing lambs on lowland mire with access to cultivated pasture during the summer can substitute for grazing on hill land range. Also, that turn-out date in the spring is critical.

Keywords: cultivated pasture, growth, nutrition, rangeland, sheep

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Áhrif mismunandi beitarkerfa og tímasetningar þegar ám og lömbum er hleypt út á vorin á vöxt og þroska lamba til sumarslátrunar

Markmið þessarar tilraunar var að kanna áhrif mismunandi tímasetningar þegar ám og lömbum er hleypt út á vorin annars vegar og mismunandi beitarkerfa hins vegar, á vöxt og þroska lamba. Tilraunin var sett upp sem 2 x 2 þáttatilraun þar sem annar þátturinn stendur fyrir hvenær ám og lömbum var hleypt út (A: 4 vikum eftir burð vs. B: 2 vikum eftir burð) og hinn þátturinn stendur fyrir mismunandi beitiland, úthagi eða láglendismýri með aðgang að túni (1 vs. 2). Helstu niðurstöður voru þær að lömb sem fóru seint út um vorið og gengu á úthaga yfir sumarið voru lökust. Lokalífþungi var 35,2, 37,6, 38,1 og 38,2 kg í hópum A1, A2, B1 og B2 í þessari röð, og fallþunginn var 14,2, 15,0, 15,5 og 15,6 kg. Beitilandið hafði minni áhrif á vöxt lambanna heldur en meðferð að vori. Þau lömb sem hleypt var seinna út og var beitt á láglendismýri með aðgang að túni bættu mest við sig í bakvöðva og fitu frá byrjun júní fram að slátrun 17. ágúst. Af niðurstöðum tilraunarinnar má draga þá ályktun að beit á framræsta mýri með aðgang að ræktuðu landi skili sambærilegum vexti lamba og beit á hálendari úthaga. Einnig undirstrika niðurstöðurnar það að ef flýting sauðburðar á að skila góðum árangri er mikilvægt að góð beit sé tiltæk eins fljótt og mögulegt er.

INTRODUCTION

Sheep meat production in Iceland relies greatly upon grazing highland range during the summer months. Cultivated lowland pastures are mainly used for extending the grazing season in the spring and autumn, as they are used as hayfields in the summer. The main lambing season in Iceland is in May and at that time rangeland pastures are not ready for grazing. Thus, sheep graze on fertilized cultivated land before rangeland grazing. Following maturation, often around the middle of August, nutritive value of the rangeland plants declines and becomes lower than desirable in late August (Thorsteinsson & Ólafsson 1965, 1969). Grazing on cultivated pastures at that time is necessary to avoid a decline in lamb growth (Gudmundsson & Dýrmundsson 1989). However, autumn and, especially, spring grazing on cultivated hayfields decreases the hay production of on average 700 kg DM ha^{-1} $year^{-1}$ during the subsequent summer (Brynjólfsson 1990).

There is little information available on summer grazing of sheep on cultivated pastures in Iceland. However, Pálsson & Thorsteinsson (1964) and Pálsson (1965 & 1966) conducted summer grazing experiments during the summers of 1963-1965. Ewes with twin lambs were grazed on lowland mire with access to cultivated pasture from the middle of June until the middle of September. The lambs were weaned in the middle of September and were given access to a field of forage rape, where they grazed until slaughtered in the beginning of October. These lambs had heavier carcasses, a better carcass conformation score and higher dressing percentage than the lambs grazed on the highland range during the summer (traditional method). This grazing method seemed more profitable than the traditional method, because it was also possible to take one hay harvest from the cultivated pasture. In spite of this effort there was very little interest among Icelandic farmers during the next decades in utilizing cultivated lowland pastures for summer grazing of sheep.

In recent years, lamb slaughtering in late summer (August) is becoming more common. Consumers like to buy fresh meat all year around and to fulfill these requirements slaughterhouses started to offer higher prices for summer lambs. To produce heavy lambs in August the ewes have to lamb in April and graze good quality pastures near the farm so it is easy to gather the lambs for slaughter. The rangeland pastures around many farms in Iceland are lowland mires and in some cases dry grassland. Few farmers have access to highland range that is near the farm (Bjarnadóttir et al. 2004). Experiments have shown greater performance of grazing lambs on highland range than on lowland mires (Gudmundsson & Thórhallsdóttir 1999, Gudmundsson 1988), mostly because the forage in the mire contains more cellulose and hemicellulose. This causes lower intake and lower average daily gain of the lambs on the lowland mire (Gudmundsson 1998). Grass species used in cultivated grassland are usually leafy plants with smaller amounts of cellulose and hemicellulose and a high digestibility until defoliation (Parsons & Chapman 2000). Thus, intake or nutritive value of the grass should not be a limiting factor for lamb growth and it can be expected that their growth rate is faster on cultivated grassland than on rangeland.

The summer grazing occurs when the lamb's growth potential is highest, the first 3-4 months after birth. Then the pasture has to be of a high quality to meet both the requirements for growth and development of the lamb and also for the ewe's milk production. Access to cultivated pasture along with the lowland mire should increase the lambs' growth rate compared to rangeland grazing alone. The present experiment was inspired by the experiments

Table 1. The experimental design.

A	B
1 Indoors 4 weeks after lambing. Rangeland from 7 June until 17 August.	**1** Indoors 2 weeks after lambing. Rangeland from 7 June until 17 August.
2 Indoors 4 weeks after lambing. Cultivated lowland pasture and mire from 7 June until 17 August.	**2** Indoors 2 weeks after lambing. Cultivated lowland pasture and mire from 7 June until 17 August.

done by Pálsson & Thorsteinsson (1964) and Pálsson (1965 & 1966). Here, however, the objective was to evaluate different options in spring and summer grazing with respect to early slaughtering (i.e. in the middle of August).

MATERIALS AND METHODS

Experimental design

The experiment took place at the Hestur sheep experimental farm of the Agricultural University of Iceland, during the spring and summer of 2004. The experiment followed a 2 x 2 factorial arrangement of treatments, with one factor representing different turn-out dates of ewes and lambs (A vs. B) and a second factor representing different summer grazing systems, rangeland or lowland mire with access to cultivated pasture (1 vs. 2). An overview of the experimental design is given in Table 1.

Animals

The ewes were of the native Icelandic breed and were synchronized by hormones so they would all lamb on a similar date (around 20 April). In January 2004, the experimental group consisted of 51 ewes ranging in age from 2-6 years that had an index for mothering ability between 1.9-7.0 points (average index = 4.6 points; 5.0 is the overall herd's average). Four ewes were excluded from the experiment due to abortion or disease, leaving 47 at the onset of the experiment. Each group included 12 ewes except group B2 with 11. These 47 ewes lambed 91 lambs in total and 80 of them are included in the results. Lambs were excluded for several reasons. Two lambs died at birth. One lamb broke a leg in May. One lamb had a low ADG because of diarrhea that was not diagnosed. Two lambs had a low ADG because the ewe had warts on her teats. Five lambs were not located at slaughtering. At the beginning of the experiment one single lamb ewe was in each group, otherwise they all raised two lambs.

The lambs were weighed at birth (initial live weight; ILW) and then weekly until they were placed on pasture. Then they were weighed on 7 and 26 June and 17 August (final live weight; FLW). Ultrasound scanning was conducted to determine the depth of *longissimus dorsi* (*l. dorsi*) muscle, subcutaneous fat thickness over the *l. dorsi* and *l. dorsi* shape. This was assessed on the 3rd sacral vertebrae (Thorsteinsson 1995) on 7 June and 17 August.

All the lambs were injected with selenium and vitamin E 2 days and 2 weeks after birth to prevent deficiency of these nutrients. When the lambs were moved outside in May, they all received the anthelmintic Zerofen (1 ml lamb^{-1}). On 7 June, lambs received Zerofen (1 ml lamb^{-1}) and the Coccidiostats Vecoxan (7 ml lamb^{-1}). The ewes received the anthelmintic Oravek (5 ml ewe^{-1}).

Feed

During the first 2 weeks after lambing, ewes were fed dry hay in the morning (1.3 kg ewe^{-1} d^{-1}) and second cut round bale haylage in the afternoon (1.5 kg ewe^{-1} d^{-1}). When group B was moved outside all the ewes in both groups were fed with dry hay (2.6 kg ewe^{-1} d^{-1}). All forage was weighed towards the ewes and the orts from them during the feeding period. From lambing until 17 May (when group A was turned outside) all the ewes were fed 300 g d^{-1} of concentrate per ewe. The composition of the

Table 2. Chemical composition and feed values of the roughages offered to the ewes.

	Dry matter, %	Energy, FE_m kg^{-1} DM	Crude Protein, g kg^{-1} DM	AAT, g kg^{-1} DM	PBV, g kg^{-1} DM	Digestibility, kg^{-1} DM
Dry hay	81	0.74	146	80	5	66
Haylage	69	0.79	178	79	40	69

FE_m = Milk feed units; AAT = Amino acids absorbed in the small intestine; PBV = Protein balance in the rumen.

Table 3. Chemical composition and feed values of the concentrate offered to the ewes.

Concentrate	
Dry matter, %	88
Energy, FE_m kg^{-1} DM	1.14
Crude protein, g kg^{-1} DM	500
AAT, g kg^{-1} DM	200
PBV, g kg^{-1} DM 1	68

FE_m = Milk feed units; AAT = Amino acids absorbed in the small intestine; PBV = Protein balance in the rumen.

hay and haylage is shown in Table 2 and the concentrate in Table 3.

The chemical analysis and calculation of feed values of the roughage was conducted at the Agricultural University of Iceland. Feed energy was calculated using the method of van Es (1978). Feed protein was calculated using the method described by Hvelplund and Madsen (1993). The concentrate was bought mixed from a feed factory and its chemical composition and feed values were analysed by the feed factory.

Grazing

The rangeland was a mixture of mire and dry hill land with various kinds of grass, sedge and shrub species, and its size was around 400 ha. The lowland pasture was made up of 1.7 ha that was sown 1 year prior to the grazing period, 2.6 ha of older cultivated pastures and approximately 8 ha of drained lowland mire. The vegetation of the cultivated pastures included mostly timothy grass (*Phleum pratense* L.) and meadow grass (*Poa pratensis* L.), whereas the mire consisted of sedge and rangeland grass species. The 1.7 ha field and half of the older field were cut on 16 June and harvested on 19 June. Fertilizer was spread over the fields at the rate of 200 kg ha^{-1} of N-P-K 20-12-8 % fertilizer after harvest. The latter half of the older field was cut on 8 July.

Slaughtering

All lambs were slaughtered on 17 August at a commercial abattoir. Hot carcass weight and fat thickness at the 12^{th} rib were measured and recorded. Hot carcasses were assessed for conformation and fatness using the EUROP carcass classifying system (MLC 1993). Conformation and fat score were converted to numerical values representing a 15-point scale (Lewis et al. 1996), for analysis, as shown in Table 4. Dressing percentage was calculated as: hot carcass weight/pre-slaughter live weight x 100.

The carcasses were chilled at 4 °C with a low air speed for 24 hours. External measurements including length of tibia (T), depth of crutch (F), thorax depth (Th) and thorax width (W) were recorded on cold carcasses. Conformation of shoulder and leg was scored on a scale of 1-5 (Pálsson 1939).

Table 4. Numerical values for carcass conformation and fat score.

Conformation class	Numerical value	Fat class	Numerical value
E	14	5	14
U	11	4	11
R	8	3+	9
O	5	3	8
P	2	2	5
		1	2

Data analysis

The data were subjected to analysis of variance with covariates to examine the effects of grazing group (treatment), sex and possible interactions. The data were analysed using the unstructured treatment design option in the General Analysis of Variance procedure in Genstat Version 7.1 (Laws Agricultural Trust 2003). Treatment and sex differences were tested for significance at the 0.05 probability level, based on the least significant difference (LSD) method (Snedecor 1980). Age, in days from birth, and initial live weight (ILW) were used as covariates in the model for all analysis except for average daily gain (ADG). The model used was:

$$Y_{ijkl} = \alpha_i + \gamma_j + \tau_k + \alpha\tau_{ij} + \alpha\tau_{ik} + \gamma\tau_{jk} + \beta_{ILW}I_{(ijkl)} + \beta_{age}A_{(ijkl)} + \varepsilon_{ijkl}$$

where Y_{ijkl} is the record of the l^{th} animal assigned to the i^{th} (i = 1,2) and j^{th} (j = 1,2) treatments, α_i is the effect associated with the ith treatment (day when turned out), γ_j is the effect associated with the j^{th} treatment (grazing treatment), τ_k is the effect associated with the k^{th} sex (k = 1,2), $\alpha\gamma_{ij}$ is the two way interaction between treatment i and j, $\alpha\tau_{ik}$ is the two way interaction between treatment i and sex, $\gamma\tau_{jk}$ is the two way interaction between treatment j and sex, $\beta_{ILW}I_{(ijkl)}$ is the linear regression on covariate ILW, and $\beta_{age}A_{(ijkl)}$ is the linear regression on covariate age and ε_{ijkl} is the residual effect.

RESULTS

Age and ILW had significant effects ($P < 0.001$) on all live weight measurements, as expected. A significant difference ($P = 0.027$) was observed between males and females in FLW (38.1 kg and 36.3 kg respectively). There were no other significant differences between sexes. No interactions were found between turn-out times (A *vs.* B) and grazing systems (1 *vs.* 2). Lambs in treatment A had lower final live weight than lambs in treatment B, where lambs in group A1 differed significantly from the other groups. Otherwise there were no differences between treatment groups in live weight (Table 5).

Average daily gain (ADG) differed between treatment groups during different time periods (Table 6). Lambs in group A1 typically had a lower ADG than lambs in the other groups. Interactions between time groups and grazing system were detected in the growth period from 7 - 26 June. During that growth period the difference between grazing systems (1 *vs.* 2) was greater in turn-out treatment A than in turn-out treatment B. Male lambs had a significantly higher ADG over the entire experimental period than female lambs ($P = 0.017$; 283 vs. 267 g d^{-1} for male and females respectively).

Lambs in group B1 had significantly thicker loin muscles (*l. dorsi*) on 7 June than lambs in group A2, but in August this difference had disappeared (Table 7). Back fat thickness on 17

Table 5. Mean values of live weight (kg) by treatment groups, adjusted for effects of sex and age of lambs.

Date	Treatments				P-values		
	A1	A2	B1	B2	A vs B[1]	1 vs 2[2]	Interaction
27 Apr	6.49	6.43	6.54	6.60	NS[3]	NA[4]	NA
3 May	8.22	7.94	8.17	8.17	NS	NA	NA
17 May	12.1	11.5	12.4	12.3	NS	NA	NA
7 Jun	18.1	17.6	18.5	18.1	NS	NA	NA
26 Jun	24.4	24.1	25.3	23.9	NS	NS	NS
17 Aug	35.2^a	37.6^b	38.1^b	38.2^b	0.01	NS	NS

a,b values with a different superscript within a row are different ($P<0.05$).
1 A = placed on cultivated pasture 4 weeks after lambing, B = placed on cultivated pasture 2 weeks after lambing.
2 1 = rangeland grazing, 2 = pasture grazing.
3 NS = not significant, $P > 0.05$.
4 NA = not analysed.

Table 6. Mean values of average daily gain (g d^{-1}) for different time periods by treatments, adjusted for effects of sex and age of lambs.

Period	Treatments				P-values		
	A1	A2	B1	B2	A vs B[1]	1 vs 2[2]	Interaction
Birth - 27 Apr	287	291	298	291	NS[3]	NA[4]	NA
27 Apr - 3 May	284	258	269	262	NS	NA	NA
3 - 17 May	275[ab]	255[a]	306[b]	294[b]	0.008	NA	NA
17 May - 7 Jun	291	287	293	273	NS	NA	NA
7 - 26 Jun	312[a]	352[b]	351[b]	321[ab]	NS	NS	0.007
26 Jun - 17 Aug	221[a]	248[b]	256[b]	265	<.001	0.014	NS
Birth - 17 Aug	259[a]	278[b]	284[b]	282[b]	0.011	NS	NS

[a,b] values with a different superscript within a row are different (P<0.05).
[1] A = placed on cultivated pasture 4 weeks after lambing, B = placed on cultivated pasture 2 weeks after lambing.
[2] 1 = rangeland grazing, 2 = pasture grazing.
[3] NS = not significant, P > 0.05.
[4] NA = not analysed.

August was greatest in lambs in groups A2 and B1, least for group A1, with group B2 intermediate. Lambs in group A2 had significantly lower muscle shape score than lambs in group B1 in June, but in August this difference had disappeared. No difference was found between sexes in ultrasound measurements except for the fat thickness in August, when the females had increased back fat (P = 0.010) as compared to males (3.00 and 2.46 mm respectively; data not shown). Interactions between grazing system and sex were detected for the subcutaneous fat thickness in August (P = 0.029). In grazing system 1 (rangeland), subcutaneous fat thickness of male lambs was 2.54 mm and 2.61 mm for female lambs, whereas in grazing system 2 (cultivated), subcutaneous fat thickness was 2.38 and 3.42 mm for male and females, respectively. There were also interactions between grazing system and turn-out time groups in subcutaneous fat thickness on 17 August, where A1 lambs had significantly lower fat thickness than A2 lambs.

Carcasses of lambs in group A1 were significantly lighter than in the B1 and B2 groups (Table 8). The groups did not differ in carcass conformation score, but group A1 had a significantly lower fat score than the other groups.

Table 7. Mean values of measurements of ultrasound scanning by treatment, adjusted for effects of sex and age of lambs. Depth of *l. dorsi* and subcutaneous fat is in mm, and shape of muscle assessed on a scale of 1-5.

Group	A1	A2	B1	B2	P-values		
7 Jun					A vs B[1]	1 vs 2[2]	Interaction
l. dorsi	18.7[ab]	18.5[a]	20.1[b]	19.2[ab]	0.044	NA[4]	NA
Fat	1.32	1.23	1.34	1.40	NS3	NA	NA
Shape	3.29[ab]	3.07[a]	3.58[b]	3.24[ab]	NS	NA	NA
17 Aug							
l. dorsi	25.0	26.3	25.9	25.6	NS	NS	NS
Fat	2.24[a]	2.98[b]	2.96[b]	2.78[ab]	NS	NS	0.025
Shape	3.23	3.56	3.62	3.29	NS	NS	NS

[a,b] values with a different superscript within a row are different (P<0.05).
[1] A = placed on cultivated pasture 4 weeks after lambing, B = placed on cultivated pasture 2 weeks after lambing.
[2] 1 = rangeland grazing, 2 = pasture grazing.
[3] NS = not significant, P > 0.05.
[4] NA = not analysed.

Table 8. Mean values by treatment groups of carcass weight, conformation and fat score according to the EUROP system, and carcass external measurements. Adjusted for effects of sex and age of lambs.

	Treatment				P-values	
	A1	A2	B1	B2	A vs B[1]	1 vs 2[2]
Number of lambs	23	20	18	19		
Carcass weight, kg	14.2[a]	15.0[ab]	15.5[b]	15.6[b]	0.012	NS[3]
Carcass conformation score[4]	8.15	8.41	8.73	8.48	NS	NS
Fat score	5.29[a]	6.63[b]	6.44[b]	6.84[b]	NS	0.035
Rib fat thickness (J), mm	6.61	8.08	7.77	8.01	NS	NS
Thorax score (1-5)	3.77	3.88	3.90	3.89	NS	NS
Leg score (1-5)	3.74	3.83	3.86	3.74	NS	NS
Dressing out percentage, %	40.4	39.9	40.7	40.7	NS	NS
Depth of crutch (F), mm	239	244	242	245	NS	NS
Length of tibia (T), mm	179	180	178	178	NS	NS
Muscle thickness of leg (F-T)	60.1	64.3	63.7	66.7	NS	NS
Thorax width (W), mm	168[a]	178[b]	176[ab]	179[b]	NS	0.039
Thorax depth (Th), mm	245[a]	249[ab]	253[b]	255[b]	<.001	NS
W/Th ratio	0.69	0.71	0.70	0.70	NS	NS

[a,b] values with a different superscript within a row are different (P<0.05).
[1] A = placed on cultivated pasture 4 weeks after lambing, B = placed on cultivated pasture 2 weeks after lambing.
[2] 1 = rangeland grazing, 2 = pasture grazing.
[3] NS = not significant, P > 0.05.
[4] Numerical values defined in Table 4.

Lambs in group A1 also had numerically lower fat thickness on the 12th rib than the other groups, although not significantly. The dressing percentages of the carcasses were similar among the groups. Males and females were similar in all slaughter measurements except for fat score and fat thickness on the 12th rib. The fat score of male and female lambs was 5.83 and 6.71, respectively, and the fat thickness was 6.71 and 8.50 mm for males and females respectively (data not shown). No significant interactions among groups were detected in the slaughter data.

DISCUSSION

The growth capacity of young lambs is high, thus it is essential to supply them with enough protein and energy to maintain adequate growth. The lamb depends on its mother's milk during the first weeks of its life. It can be expected that it starts to seek additional energy from nutritious herbage, if available, between 2-4 weeks of age. At the onset of growth in the spring the grass absorbs a vast amount of nutrients from the soil to use immediately. Therefore young plants are rich in most nutrients, especially nitrogen as they absorb most of it in early growth (Vallentine 1990). Nitrogen is an essential element of amino acids that are needed for growing tissues in young animals (Oddy & Sainz 2002). The grazing ewe receives also a better nutrition that improves her milk production. Therefore, the performance of young grazing suckled lambs in the spring can be expected to be better than non-grazing suckled lambs. In the present experiment, lambs in group B could start grazing at two weeks of age, while the lambs in group A had to wait for two more weeks. During these two weeks (3 - 17 May) the lambs in group A had a lower ADG than the lambs in group B (Table 6). Thus, the length of the indoor feeding period had a greater effect on FLW than the different pastures grazed. This is in agreement with results published by Thorsteinsson & Pálsson (1975) which reported that lambs had a higher ADG, LW and carcass weight if they were placed on cultivated pasture with their dams

4 days after birth rather than staying indoors until the rangeland vegetation was ready for grazing. Also, the greatest ADG difference between the two groups was during the period when the groups were receiving different treatments (grazing outside and fed inside). The same was found with the A lambs in this experiment. Both groups, in the experiment by Thorsteinsson & Pálsson (1975), were fed the same amount of hay and concentrate until both groups were outside.

Grass species on cultivated land are mainly selected for high digestibility and nutrient content, yield and persistence. It is possible to control their nutrient value with cutting as the grass reaches maturity and re-fertilize the pasture. By using this approach it is possible to keep the nutritive value of the grass adequate throughout the summer grazing season. On the rangeland, however, there are many plant species with different nutrient contents and digestibilities. There is no way of controlling their nutritive value with cutting, but they can be fertilized to increase the amount of herbage produced with high energy value for a short time period. However, this has not proven to be profitable due to the high price of fertilizer (Arnalds & Rittenhouse 1986). The difference in the plants' nutritive value might explain why lambs in group A1 had a lower ADG, FLW, carcass weight and fat score than the lambs in the other groups. In addition, voluntary intake of plants by sheep is related to organic matter digestibility and it is generally higher on cultivated plant species than rangeland grasses and sedges (Armstrong & Hodgson 1986, Milne et al. 1979). Thus the cultivated pasture grazing was more beneficial for the lambs in group A2 than B2 because of the two weeks of growth restriction that lambs in group A2 experienced in the middle of May.

Even though the lambs in group A1 had a lower FLW and carcass weight, their carcass dressing percentage was not different from the lambs in the other groups. Growth and development of lambs in the A groups may have been slower than in the B groups until 7 June as indicated from the ultrasound measurements. The lambs in group A2 had the greatest loin muscle gain during summer grazing. This suggests that the grasses on well-managed cultivated grassland were of high nutritive value and would result in a high ADG for the entire summer season. By contrast, rangeland herbage from mountains and hill areas in Iceland supports fast growth of lambs during the peak growing season (approximately from beginning of July until middle of August) as its nutritive value is highest at that time (Gudmundsson 1993). The absolute intake of good quality herbage would be expected to be lower on rangeland than cultivated grass pasture, as its availability is generally poorer on the rangeland.

There are limited grazing experiments with suckled lambs and ewes as compared to grazing experiments with weaned lambs and wethers. Therefore, it is difficult to compare the results from this experiment to other grazing experiments. However, a series of grazing experiments with suckled lambs and ewes on different grazing pastures was conducted in Iceland over a ten year period (1975-1985). Those experiments compared mountain rangeland, highland range, hill land, lowland mires and dry lowland (Gudmundsson & Dýrmundsson 1989), but not cultivated pastures. The results indicated that lambs grazing on mountain rangeland, highland range and hill land had improved performance compared to lambs grazing lowland mire and dry lowland (Bjarnason & Gudmundsson 1986). This suggests that access to cultivated pasture is required with lowland grazing to get acceptable lamb performance. During the summers of 1975-1979 a series of grazing experiments was conducted with twin lamb ewes and calves on cultivated pasture (Dýrmundsson et al. 1996). There the sheep and calves were grazed separately or mixed, and did not have access to rangeland. Acceptable performance of both lambs and calves was not reached until the summers of 1978 and 1979 with organised alternate grazing and with strategic dosing of anthelmintics. In the present experiment, lambs and ewes had access to both cultivated pasture and rangeland mire with the stocking rate of 1.8 ewe ha^{-1}, which was much lower than in the experiment by Dýrmundsson et al. (1996). However, infection of parasites is always a risk on cultivated pasture because of more intensive grazing than on the rangeland.

In the experiment reported by Bjarnadóttir et al. (2006) it was beneficial to wean lambs at the age of 86, 101 and 114 days and graze them on forage rape the last 4-8 weeks before slaughter. It might thus be advantageous to wean the lambs in late July (average age 100 days) for slaughter in late August. This would result in greater carcass weights, possibly higher carcass conformation scores, and the producer also could still receive a premium price, which is still in effect in late August.

It can be suggested that the performance of lambs grazing on cultivated pasture along with lowland mire during the summer season is greater than grazing only lowland mire (Bjarnason & Gudmundsson 1986). Rangeland, like the one in this experiment, usually supports a high ADG of lambs during the summer because of the vegetation's diversity (Gudmundsson & Dýrmundsson 1989).

CONCLUSIONS

It can be concluded that lowland mire grazing with access to cultivated pasture is a suitable substitute for rangeland grazing in a summer slaughter production system. Further it can be concluded that after 2 weeks from birth suckling lambs and their dams benefit from grazing, along with access to forage feeding.

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