EFFECTS OF PREPUBERTAL GROWTH RATE OF EWE LAMBS ON THEIR SUBSEQUENT LAMB AND MILK PRODUCTION

David L. Thomas[1] and Yves M. Berger[2]
[1]Department of Animal Sciences and [2]Spooner Agricultural Research Station
University of Wisconsin-Madison
[1]Madison and [2]Spooner, Wisconsin, USA

Introduction

In many sheep production operations in the Midwestern and Eastern U.S., lambs are managed for maximum body weight gain and fed high-energy diets continuously from shortly after birth until they are marketed as slaughter lambs. Flock owners will replace 20 to 25% of the ewes in their flock each year with ewe lambs raised in their flock or purchased from other producers. Since all lambs in a flock generally are managed together, these replacement ewe lambs are often managed for maximum gains on high-energy diets along with the other lambs in the flock destined for slaughter. Management of all lambs as one group results in easier management and allows for more accurate selection of replacement ewe lambs for high average daily gain.

However, the practice of feeding replacement ewe lambs for maximum body weight gain may have detrimental effects on their milk production as ewes. While relatively little research has been conducted with sheep to address this issue, much has been conducted with cattle. The majority of well-designed studies have shown that high feeding levels for dairy heifers during the prepubertal period is detrimental to milk production as cows (reviews by Sejrsen and Purup, 1997 and Sejrsen et al., 2000 and the book by Akers, 2002). Increased feeding levels for beef heifers during their prepubertal period also has been shown to result in decreased milk production or decreased weaning weights of their calves (Holloway et al., 1973; Martin et al., 1981; Johnnson and Obst, 1984; Buskirk et al., 1996).

Studies evaluating the effects of prepubertal feeding level in ewe lambs on udder development, subsequent milk production, or lamb weaning weights are fewer in number and are less conclusive than the studies in cattle. Umberger et al. (1985), McCann et al. (1989), Johnsson and Hart (1985), and Johnsson et al. (1986) found slightly greater amounts of udder parenchyma (milk production tissue) in meat-type ewe lambs that had been fed at lower levels in the prepubertal period compared to ewe lambs that had been fed at higher levels, but the differences were not statistically significant. In contrast, McFadden et al. (1990) reported a non-significant increase in parenchymal udder tissue in full-fed compared to restricted-fed meat-type ewe lambs. In the studies of Umberger et al. (1985) and McCann et al. (1989), the ewe lambs fed at the lower levels had increased milk production in five out of six trials (differences were not always significant). Milk production in the latter two studies was estimated one or three times during the lactation period using the weigh-suckle-weigh technique (weighing lambs before and after suckling to estimate milk production) or by using an injection of the hormone oxytocin to remove milk. In a study with dairy sheep, milk production at first lactation was not different between levels of prepubertal feeding for Lacaune ewe lambs, but Manchega ewe lambs fed at the lower level produced 41% more ($P < 0.05$) milk than Manchega ewe lambs fed at the higher

level (Ayadi et al., 2002). Each of the above sheep studies was conducted with a relatively small number of animals, and only one study measured milk production over the entire lactation.

In their review of the cattle and sheep literature on the effects of prepubertal nutrition on milk production for application to the U.S. dairy sheep industry, Tolman and McKusick (2001) concluded that U.S. dairy ewe lambs should be restricted in energy intake to 65 to 75% of their ad libitum intake from 4 to 6 weeks of age through 20 weeks of age in order to increase the rate of mammary growth and to increase the total amount of epithelial tissue that will later develop into milk-secreting tissue.

The objective of this study was to estimate the effects of growth rate of dairy ewe lambs on their lamb and milk production as adult ewes. The study involves larger numbers of ewes than in previous sheep studies and measures milk production over the entire lactation in a commercial-like dairy sheep setting.

Materials and Methods

The study was conducted at the Spooner Agricultural Research Station of the University of Wisconsin-Madison. Two hundred fifty two ewe lambs born in the late winter and early spring of 2004 (n = 104), 2005 (n = 85), and 2006 (n = 62) were utilized in the study. The ewe lambs were of high percentage East Friesian (EF) or Lacaune (LA) breeding or various crosses of these two dairy breeds, with the exception of 18 ewe lambs born in 2004 that were sired by Dorset rams with less than ½ of their genetic composition from the EF and/or LA breeds.

Ewe lambs were removed from their dams at 1 to 2 days of age and raised on milk replacer and a high concentrate (22 % crude protein) ad libitum diet until approximately 30 days of age. They continued on the high concentrate ad libitum diet for an additional 2 to 3 weeks after weaning from the milk replacer and then were randomly assigned to one of two growth treatments – full feed (FULL) or restricted feed (REST). Both treatment groups were fed a 13 % crude protein grain mix of whole shelled corn and a high protein pellet in straw-bedded pens (2 pens of lambs on each treatment each year). A small amount of alfalfa hay was also provided – less than 0.50 lb. per head per day.

Ewe lambs in the FULL group received as much of the grain mix as they could consume, and average per head feed consumption was calculated daily. Each ewe lamb in the REST group received approximately 70 % of the average per head intake of the FULL group from the day before. The goal was to have REST lambs gain at 70 % the growth rate of FULL lambs. Lambs were weighted weekly. If the REST lambs were gaining markedly faster or slower than 70 % of the growth rate of FULL lambs, the proportion of the FULL intake that was fed to them was decreased or increased.

Ewe lambs remained on the nutrition treatments for approximately 100 days until they were approximately 5 months of age. After the end of the treatments, all ewes were managed together. They were fed alfalfa hay ad libitum and 2 lb. of corn/head/day. The corn was decreased to 1 lb./head/day about 2 weeks before the start of mating. Ewe lambs were first mated in October-November at slightly over 7 months of age and lambed in March and April. Yearling and older

ewes were bred approximately a month earlier to lamb in February and March. The vast majority of lambs were removed from these ewes at 1 to 2 days of age and raised on milk replacer, and the ewes were then placed on twice per day milking in the parlor. In 2005, 17 of the 2004-born ewes were allowed to raise their lambs for approximately 30 days before the lambs were weaned and the ewes placed in milking. Ewes were pastured on kura clover-orchard grass pastures during the grazing season, fed haylage at other times, and fed 2 lb. of concentrate per head per day in the milking parlor.

Results

Average per head feed consumption of the 12 pens of lambs over the years of 2004, 2005, and 2006 is presented in Table 1. As designed in the experiment, the REST group ate less ($P < 0.05$) of the grain mix than the FULL group (1.94 vs. 2.67 lb./head/day). Grain mix and total feed consumption of the REST group was 73 and 75 %, respectively, the consumption of the FULL group.

Table 1. Feed consumption least squares means for full- or restricted-fed dairy ewe lambs.

Treatment	No. pens	Grain/hd/d, lb.	Hay/hd/d, lb.	Total feed/hd/d, lb.
Full feed	6	2.67[a]	.45	3.12[a]
Restricted	6	1.94[b]	.41	2.35[b]
Restricted/Full		.73	.91	.75

[a,b] Means within a column and within a treatment group with no superscripts in common are statistically different ($P < 0.05$).

Figure 1 illustrates that the nutritional treatments were successful in creating weight differences between the FULL and REST ewe lambs with the REST lambs lighter than the FULL lambs at the end of the trial. By chance, the ewe lambs on the REST treatment were 1.8 lb. heavier ($P < 0.10$) than the ewe lambs on the FULL treatment at the start of the trial (Table 2). However, by the end of the trial period, REST ewe lambs were 14.3 lb. lighter ($P < 0.05$) than the FULL ewe lambs. The average daily gain of the REST ewe lambs was 75 % that of the FULL ewe lambs; somewhat greater than the 70 % sought in the study but still within the range recommended by Tolman and McKusick (2001).

Also presented in Table 2 are the effects of breed of ewe lamb. The ewe lambs were divided into two groups: a majority of East Friesian (EF) or Lacaune (LA) breeding. The 18 Dorset-sired ewe lambs in the study were from dairy cross ewes and were assigned to the dairy breed representing the greatest proportion of their genetic composition. Ewe lambs of a majority of EF breeding had greater ($P < 0.05$) end weights and slightly greater ($P < 0.10$) average daily gains than ewe lambs of a majority of LA breeding.

Figure 1. Body weights of ewe lambs during the treatment period.

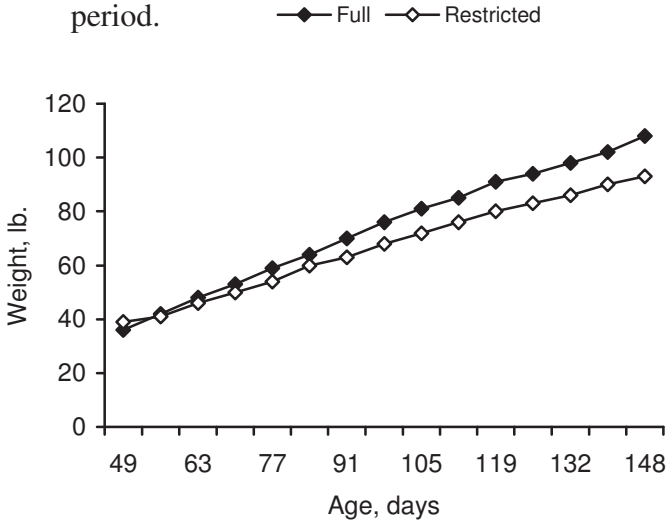

Table 2. Age, weight, and average daily gain least squares means for East Friesian- or Lacaune-sired and full- or restricted-fed dairy ewe lambs.

		Start		End		Average daily
Treatment	No. ewe lambs	Age, d	Weight, lb.	Age, d	Weight, lb.	gain, lb.
Breed:						
> 50% EF	126	49.9	38.9	147.4	101.6[c]	.64[a]
> 50% LA	126	50.3	37.5	148.0	98.3[d]	.62[b]
Nutrition:						
Full feed	129	50.8	37.3[a]	147.6	107.1[c]	.72[c]
Restricted	123	49.4	39.1[b]	147.8	92.8[d]	.54[d]
Restricted/Full						.75

[a,b] Means within a column and within a treatment group with no superscripts in common are statistically different ($P < 0.10$).
[c,d] Means within a column and within a treatment group with no superscripts in common are statistically different ($P < 0.05$).

An important finding from this study was that the lower weights of the REST ewe lambs at the end of the trial period did not have a long-term effect on their body weights. The REST ewe lambs had greater ($P < 0.05$) average daily gains from the end of the trial to their first mating approximately 2 months later and from their first mating to their first lambing at slightly over 1 year of age (Table 3). While the FULL ewes were still heavier ($P < 0.05$) than the REST ewes at first mating, the REST ewes more than compensated in the following 5-plus months and were actually slightly heavier ($P < 0.10$) than FULL ewes at first lambing (Table 3). Therefore,

restricting feed intake to 75 % of ad libitum intake in ewe lambs should not have any effect on adult ewe body weight.

By first lambing, the EF and LA ewes were of similar weights (Table 3).

Table 3. Least squares means for ewe lamb mating and lambing weights of ewes sired by East Friesian or Lacaune rams and full- or restricted-fed as ewe lambs.

Treatment	No. ewe lambs mated	Mating wt., lb.	ADG end of trial to first mating, lb.	Lambing wt., lb	ADG mating to first lambing, lb.
Breed:					
> 50% EF	121	135.5[a]	.43[c]	163.6	.17
> 50% LA	124	131.5[b]	.41[d]	163.1	.18
Nutrition:					
Full feed	127	135.5[a]	.35[b]	161.0[d]	.15[b]
Restricted	118	131.5[b]	.48[a]	165.7[c]	.20[a]

[a,b] Means within a column and within a treatment group with no superscripts in common are statistically different ($P < 0.05$).
[c,d] Means within a column and within a treatment group with no superscripts in common are statistically different ($P < 0.10$).

Reproductive and lactation performance was collected through the lactation in 2008. Therefore performance was available on the 2004-born ewes when lambing at 1, 2, 3, and 4 years of age, the 2005-born ewes when lambing at 1, 2, and 3 years of age, and the 2006-born ewes when lambing at 1 and 2 years of age.

As ewe lambs, there were no statistically significant differences in fertility (ewes lambing/ewes mated) or prolificacy (lambs born/ewes lambing) between FULL and REST ewe lambs (Table 4). EF-sired ewe lambs gave birth to approximately 14 more ($P < 0.10$) lambs per 100 ewes lambing than did LA-sired ewe lambs. We have shown an advantage of EF breeding over LA breeding for prolificacy in a previous study (Thomas et al. 2005).

Table 4. Least squares means for reproductive traits at approximately one year of age of ewes of a majority of East Friesian or Lacaune breeding and full- or restricted-fed as ewe lambs.

Treatment	No. ewes	Fertility, %	Prolificacy, no.
Breed:			
> 50% EF	120	88.3	1.56[a]
> 50% LA	124	88.2	1.42[b]
Nutrition:			
Full feed	126	85.7	1.48
Restricted	118	90.1	1.50

[a,b] Means within a column and within a treatment group with no superscripts in common are statistically different ($P < 0.10$).

Neither nutrition treatment nor breed had an effect on ewe fertility or prolificacy of older ewes (Table 5). Among ewes 2 years of age and older, at least 93 % of them lambed, and they gave birth to over 2 lambs per ewe.

Table 5. Least squares means for reproductive traits at two years of age and greater of ewes of a majority of East Friesian or Lacaune breeding and full- or restricted-fed as ewe lambs.

Treatment	No. ewes	No. exposures	Fertility, %	Prolificacy, no.
Breed:				
> 50% EF	99	184	93.7	2.07
> 50% LA	104	170	94.6	2.03
Nutrition:				
Full feed	102	176	95.5	2.03
Restricted	101	178	92.8	2.06

None of the differences between nutrition treatments for lactation traits were statistically significant, but mean values were actually slightly higher for FULL ewes compared to REST ewes (Table 6). The results of this study contradict the majority of the cattle data and the limited amount of sheep data that show increased milk production resulting from slower compared to higher prepubertal growth rates.

EF ewes had 57.9 lb. greater ($P < 0.01$) milk yield than LA ewes, but Lacaune ewes had greater ($P < 0.01$) percentages of milk fat and milk protein than EF ewes resulting in similar amounts of fat and protein yield for the two breeds (Table 6).

Table 6. Least squares means for lactation traits of ewes of a majority of East Friesian or Lacaune breeding and full- or restricted-fed as ewe lambs.

Treatment	No. ewes	No. lactations	Lactation length, d	Milk yield, lb.	Fat, %	Fat yield, lb.	Protein, %	Protein yield, lb.
Breed:								
> 50% EF	99	242	186.2	639.1[a]	5.52[b]	35.8	4.72[b]	30.7
> 50% LA	106	234	183.0	581.2[b]	6.06[a]	36.0	5.01[a]	29.9
Nutrition:								
Full feed	102	236	185.9	620.2	5.84	36.7	4.88	30.8
Restricted	103	240	183.4	600.2	5.74	35.2	4.85	29.8

[a,b]Means within a column and within a treatment group with no superscripts in common are statistically different ($P < 0.01$).

This study indicates that prepubertal ewe lambs that are fed for maximum body weight gains are at no disadvantage relative to ewe lambs fed for slower body weight gains (75 % of maximum gains) for lactation traits.

Two hundred forty five of the ewe lambs in the feeding trial were mated at seven months of age. Ewes left the flock through death or were culled for extremely unthrifty condition and severe mastitis, and in some cases, for failure to lamb or very high somatic cell counts. There was little or no culling on milk yield. Table 7 presents the proportion of ewes still in the flock on June 30, 2009 and the average age at which ewes left the flock.

There were no significant effects of breed or ewe lamb nutrition on survival of ewes in the flock (Table 7), although there was a tendency for LA-sired ewes to be leaving the flock at a faster rate than EF-sired ewes.

Table 7. Least squares means for measures of survival of ewes of East Friesian or Lacaune breeding and full- or restricted-fed as ewe lambs.

Treatment	No. ewe lambs mated	% remaining, 6/30/09	Average age when leaving the flock, months[a]
Breed:			
> 50% EF	121	48.1	39.6
> 50% LA	124	40.0	37.2
Nutrition:			
Full feed	127	45.9	37.5
Restricted	118	42.3	39.3

[a] Ewes still present on 6/30/09 were assigned their age on 6/30/09. If all ewes were still present on 6/30/09, these means would be approximately 53 months.

Conclusions

The two nutrition treatments in this study for prepubertal dairy ewe lambs (ad libitum intake of concentrate and 73 % of ad libitum intake of concentrate) resulted in no differences in reproduction, lactation performance, or survival of ewes through four years of age. Producers could save on feed costs on replacement ewe lambs by feeding them less feed separately from the full-fed market lambs or they could leave the ewe lamb replacements with the full-fed market lambs for convenience of management – whichever system they prefer.

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