Productivity of Western White Face Ewes Consuming Ruminally Degradable and Undegradable Protein During Flushing and Late Gestation

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Summary

Two studies were conducted at the New Mexico State University Corona Range and Livestock Research Ranch to determine if supplementation with ruminally undegradable intake protein would improve ewe productivity. These trials targeted two critical nutritional periods of the ewe, flushing (breeding) and late gestation. In both studies, three treatments were compared: non-supplemented control (CON), 150g·head^{-1}·day^{-1} of a low ruminally undegradable protein supplement (25.6% CP; Low), and 112g·head^{-1}·day^{-1} of high ruminally undegradable protein (44.2% CP; High). Supplements provided 22 and 20g/d of degradable protein and 14 and 30g/d of undegradable protein for Low and High, respectively. In Exp. 1, supplements were offered to primiparous ewes for 21 days pre-breeding and for the first 17 days of breeding. Also, treatments were administered the last 30 to 45 days of gestation in both experiments. Treatments did not influence ovulation rates, pregnancy rates, or weaning rates in Exp. 1. However, in Exp. 2 ewes (with twin lambs) fed the Low supplement produced heavier lambs at 50 d postpartum and at weaning. The advantage at 50 d was 2.1 kg over the CON treatment and 3.3 kg over the High treatment for ewes producing twins. Therefore, under the conditions described in these experiments (moderate to good rangeland conditions), supplementation only slightly improved range ewe productivity.

Introduction

On New Mexico rangelands, sheep productivity depends on quantity and quality of forage. Currently, the lamb crop percentage on New Mexico ranches averaged 84% (New Mexico Department of Agriculture). To increase lamb production, the two periods which have the most influence are pre-breeding (flush) and the last trimester of pregnancy. Ross (unpublished data) demonstrated that flushing (fall season) New Mexico range ewes could increase the number of lambs weaned by 5 to 9%. This was accomplished on two ranches when ewes were fed a 22% CP grain pellet at 227g head^{-1}·day^{-1} beginning 21 days before introducing the rams and continuing for 17 days of breeding. The last trimester of pregnancy (pre-partum) is most important for fetal development. However, ewes consuming mature, high roughage diets will experience a decrease in intake during this prepartum period (Forbes, 1970). This situation is acerbated when ewes are carrying multiple fetuses or large singles (Forbes, 1970). Poor nutrition during late gestation may result in pregnancy toxemia (ketosis) or in the birth of small, weak lambs that have a reduced chance of survival under range conditions (Huston et al., 1990). Typically in New Mexico, ewes lamb from April toMay and ewes are exposed to reduced quantity and quality of forage during late gestation. During mild winters when forage is available and ewes are in average condition, energy supplementation is cost effective (Thomas and Kott, 1995) When winters are harsh, conditions will prevent maximum forage utilization, causing ewes to be in poor condition and supplemental protein will benefit ewes (Thomas and Kott, 1995). Once the protein requirements of the rumen microflora have been met, providing the host animal ruminally undegradable intake proteins will supply additional amino acid composition to the small intestine that may be of value to the animal (Keery et al., 1993). Therefore, two experiments were conducted to determine if supplementing ewes with varying levels of ruminally degradable and undegradable intake protein during a flush and pre-partum period will increase ewe and lamb performance.

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Materials and Methods

Location

Two trials were conducted at the Corona Range and Livestock Research Center, Corona, NM at an elevation of approximately 1,850 m. The predominant forages include blue, black, and sideoats grama (Bouteloua gracilis, eriopoda, and curtipendula, respectively) (Renner, 1996). Grasses made up 95% of the forage cover with a combination of forbs, snakeweed, and cactus making up the remaining 5% (McFadin, 1997). During 1993, 1994, and 1995, 273, 422, and 237 mm of annual precipitation were recorded. During these years 48, 50, and 73% of precipitation, respectively, was recorded during June, July, August, and September. The yearly average for 1993 was 24% below normal, 1994 was 17% above normal, and 1995 was 35% below normal (McDaniel, personal communications). Average grass production was 786 kg/ha as measured in August, 1993. Production for other years was not measured.

Supplement Formulation

Supplements were formulated to contain 25.6% CP for the low ruminally undegradable intake protein (Low) treatment and 44.2% CP for the high ruminally undegradable intake protein (High) treatment (Table 1). The supplements were fed at 150 g·head^{-1}·day^{-1} and 112 g·head^{-1} day^{-1} for the Low and High supplements, respectively, to maintain nearly iso-degradable intake protein provided by the supplements. The Low and High supplements provided 22 and 20 g/d degradable intake protein, respectively, and 14 (38% of total protein) and 30 (60% of total protein) g of undegradable intake protein, respectively (Ruminant Nitrogen Usage, 1985). All procedures described in these experiments were approved by the NMSU Institutional Animal Care and Use Committee.

Table 1. Composition of protein supplements fed to ewes[a] during late trimester of pregnancy.

Ingredient	Diet[b] Low	High
Wheat middlings	54.2	26.8
Cottonseed meal	39.3	30.9
Molasses	4.0	5.5
Hydrl. poultry feather	0.02	7.0
Blood meal	0.0	4.0
Dicalcium phosphate	0.3	53.0
Vitamin A	0.1	0.13
Iron Sulfate	0.29	0.42
EDDI	0.0025	0.0035
Cobalt sulfate	0.005	0.0075
Manganese sulfate	0.05	0.09
Potassium chloride	0.0	1.5
Calcium carbonate	1.2	0.0
Sodium selenite	0.0	0.0005
Diet Composition[c]		
Crude protein, %	25.6	44.2
Acid detergent fiber, %	13.0	16.2
Neutral detergent fiber, %	31.6	41.3
Ash, %	10.7	10.4

[a]Supplements were fed to ewes twice weekly to provide 112g·head^{-1} d^{-1} for High and 150g·head^{-1}·d^{-1} for Low. Ruminally undegradable protein provided daily were: High, 30 g and Low, 14 g. Degradable protein were 22 and 20 g/d for High and Low, respectively.

[b]Values expressed on percentage as-fed basis.

[c]Dry matter basis.

Experiment 1:

A flushing study was conducted using 252 primiparous 18 month-old grade Rambouillet ewes. Initially, ewes were weighed (= 65 ± .8 kg) and body condition scored (= 2.5 ± .02). Body condition scores (BCS) were based on a 0 to 5 scale (SID, 1997). Scores were determined by estimating fat cover over the ribs and spinous and transverse processes. Body condition scores assigned, with 1 being emaciated and devoid of fat and 5 being obese.

The ewes were assigned to six pastures at a stocking rate of 5.3 ha/ewe. Pastures were then assigned randomly to treatments: 1) control receiving no supplement, 2) Low supplemented, and 3) High supplemented. All ewes had ad libitum access to trace mineral salt mixes and water throughout the study. Supplements were fed twice weekly from November 26 until December 30, 1993 for a total of 34 days. At the initiation of flushing, two vasectomized rams per pasture were turned out for 22 days to promote estrual activity in the ewes. On December 17, vasectomized rams were removed and fertile rams (two/pasture) with marking harnesses were joined with the ewes for a 34 day breeding season. Rams were rotated among pastures weekly. Twenty-one days following initiation of breeding, five ewes per pasture (10 ewes per treatment) underwent laparoscopy techniques to count number of corpora lutea for determination of ovulation rates.

Fecal Output

At shearing (April), 12 ewes from each pasture were administered orally a continuous release chromic oxide bolus (Captec Chrome; Nufarm Ltd., Manu St., Otahunu, Box 220-407, Auckland 6, New Zealand) for estimation of relative fecal output. Ewes continued to graze in their respective pastures. Ten days after the boli were administered fecal collections began. Daily fecal grab samples were taken for 6 d. Animals were gathered and penned, individually sampled, and immediately returned to their respective pastures to minimize grazing pattern interruption. Fecal samples were dried at 60° C for 24 h and ground through a Cyclone mill (1 mm screen). Daily fecal samples were composited by weight for each animal. Chromium was determined via atomic absorption spectroscopy (Williams et al., 1962). The formula for obtaining relative fecal output was calculated as (manufacturer's suggested Cr_2O_3 release rate x 0.6842)/(Cr concentration in feces x dilution factor)/(weight of sample x % dry matter) x 0.000001. The 0.6842 factor is the percentage of Cr in Cr_2O_3 on a molecular weight basis.

Diet Sampling

Assessment of diet quality was determined by collecting ruminal ingesta samples from 12 ruminally cannulated ewes (Table 2). Ewes were allowed to graze each of the six study pastures for sample collection. Total rumen evacuations were performed on ewes, after which they were allowed to graze for 45 minutes. After the 45-minute grazing period, ruminal ingesta samples were collected and original rumen contents replaced.

Intensive Ewe and Lamb Measurements

Prior to anticipated lambing date (May 15), 66 ewes (22/treatment) that were serviced by rams during the first week of breeding and did not return to estrus were moved to a separate pasture. At this time, ewes were paint branded on the side for ease of identification without disturbance during parturition. From this group of ewes, only those that lambed within a 5 d period with true single lambs were used for further data collection. Data collected on individuals included lamb birth weight, subsequent lamb weight, ewe weight and BCS, and milk production at days 4, 14, 24, and 34 postpartum. The number of ewes and lambs for this portion of the study consisted of 13, 15, and 14 for High, Low, and CON, respectively.

Lamb Weights

Ewes were observed for pending parturition and allowed to bond with lambs for 1 h before lamb birth weight was taken. This precaution was taken due to the nature of range ewes (especially first time lambing ewes) which tend to abandon newborn lambs when disturbed. Parturition occurred predominantly during daylight hours between 0800 and 1600 h. After birth weights and sexes were determined, lambs were paint branded for identification.

Ewe Weights and Body Condition Score

Ewe weights and body condition score (BCS) were taken on days 14, 24, and 34 following milking. Ewe weights and BCS were also obtained on d 150 postpartum (weaning). Day 4 weight and BCS had to be omitted due to severe weather.

Milk Production

At 1030 h on collection days, ewes were penned and separated from their lambs. Milk letdown was stimulated prior to handmilking by intrajugular injection of 5 USP (1 mL) of oxytocic principle (Oxytocin, Panhandle Serum Company, Dimmit, TX). Two to three minutes following injection, ewes were hand milked and the milk was discarded. Three hours later, the procedure was repeated and milk volume measured (Reynolds and Brown, 1991). This amount of milk represented 3 h milk production. Actual time between individual milking was recorded to adjust for differences among ewes. All milk production measurements were adjusted to a 3 h production period. Milk samples were frozen at -20° C until shipped to be analyzed. Samples were shipped frozen, packed in dry ice to Arizona DHIA (3414 S. 48th St., Suite #3, Phoenix, Arizona) for analysis of milk fat, lactose, protein, and solids non-fat.

Data Analysis

Statistical analysis for intensive group measurements used the General Linear Models repeated measures procedure of SAS (1988). First cycle conception, weaning weight, ewe weight, ewe BCS, intake, and lamb weaning weight were analyzed by the General Linear Models of SAS (1988). The statistical model used for ewe traits included fixed effects of treatments with initial weight and initial body condition score as covariates. Data for ewe weights, BCS, lamb weights, and milk produced were conducted as repeated measures with general linear models of SAS (1988). Ovulation rate was analyzed with Chi square analysis. However, the means and standard error (Table 2) were calculated through the general linear models of SAS (1988). The statistical model used for milk parameters included treatment and initial weight with date of birth (Julian Day) as a covariate. Ewe was the experimental unit except for first cycle conception and weaning percentage, in which pasture was the experimental unit.

Experiment 2:

Two hundred, 3-year-old grade Rambouillet ewes were assigned randomly to one of six pastures at a stocking rate of one ewe per 5 ha in a continuous grazing system. Ewes determined to be carrying twins via ultrasonography were equally distributed among pastures. Pastures were then allotted randomly to treatments, allowing two pastures per treatment group. The treatments were the same as previously described. Supplementation began April 10, 1995 and continued until May 10, 1995, which was the expected start of lambing. Supplement was offered in wooden feed bunks allowing .6 m linear space per ewe.

Two weeks after supplementation began, eight twin bearing ewes from each of the six pastures were administered a continuous release chromic oxide bolus as previously described to determine fecal output. Techniques were the same as previously described except in this study fecal samples were collected for only 4 d.

Intensive Ewe and Lamb Measurements

Five days before the expected start of lambing (lambing season was May 13 through June 20), eight ewes with twin fetuses, as determined by ultrasonography, were removed from each of their respective pastures, supplementation ceased and the 48 ewes were observed at dawn and frequently during the day for lambing. These were the same eight ewes used to determine fecal output. Parturition, ewe number, date of birth, birth weight, and sex of lamb were recorded. Lambs were ear tagged for identification at this time. Total time was usually under 5 minutes and lambs were watched from a distance until the ewe returned. These ewes lambed between May 13 and June 4. Ewe production parameters studied were milk production, BCS, and body weight. These data were taken on d 4, 14, 24, 34, and 50 after parturition. An additional BCS and body weight were taken at d 150 (weaning). Lamb weights were also taken concurrent with the ewe production parameters.

For all production data collected between lambing and 50 d postpartum, individual ewes and their lambs were gathered and penned on the collection days. Care was taken to ensure that ewes and lambs were not separated during the gathering process.

Due to reasons not related to treatments (predators, mastitis, etc.) ewes (3) and lambs (8) had to be removed from the study at various times. When the youngest lamb reached 50 days of age and the data collected for this period, all intensive ewes were returned to their original pastures.

Body condition scores (SID, 1997) were based on a scale of 0 to 5. Half scores were also used. At least two independent evaluators were used at any given time with one technician being the constant for all BCS assigned from days 4 through 150.

Milk data were taken on d 4, 14, 24, 34, and 50 in the same manner as described in Experiment 1. Data were collected between midmorning and early afternoon to allow the lambs to nurse in the morning and be reunited before dark. After the d 50 milking, ewes and lambs were returned to their original treatments pastures. At this time, all lambs were docked and males castrated.

Weaning

All lambs (twins and singles) were weaned at approximately 150 d of age (October). At this time lambs and ewes were weighed and a final BCS was assigned to all ewes including those giving birth to singles that remained in original pastures.

Data Analysis

Data for intensive measures were analyzed using repeated measures option of general linear models of SAS (1988). Ewe was the experimental unit. When a significant F-value was noted for treatment means, means were separated using pairwise comparisons with contrasts. Even though a treatment by period interaction was not indicated ($P > 0.10$), intensive production data were analyzed within period with age of lamb as a covariate.

Results and Discussion

Ovulation Rate (Experiment 1)

Ovulation rate is known to vary with breed as well as management practices (Gunn et al., 1991). No difference ($P = .8$) was found in number of ovulations (corpus lutea) among treatments (1.3, 1.2, and 1.1 ± .27 for UIP, DIP, and CON; respectively, Table 2). The process of "flushing" is well known for increasing ovulation rate in sheep. Flushing range ewes normally increases lambing rate 5 to 9% (Ross, unpublished data). However, much argument exists on the optimum BCS to elicit a positive response. Haresign (1981) reported an increase in ovulation rate from supplemented ewes in a BCS of 1.8 versus those at 2.6. This suggests ewes in good body condition will not respond to supplementation. Body condition scores (Table 3) of ewes at the beginning of flushing for this study were 2.7, with no difference among treatments ($P = .9$). However, BCS at breeding was higher ($P < .02$) for the two supplemented groups compared to CON ewes (Table 3). Also, body weights (Table 3) were similar at the initiation of the flush, whereas ewes consuming the Low supplement were heavier ($P < .02$) than CON or High ewes at the end of the flush.

Knight et al. (1975) indicated feeding ewes lupins during flushing increased ovulation rate, which may be the result of protein escaping rumen degradation. However, Meza-Herrera (1996) suggested flushing ewes in varying body condition with High did not alter ovulation rates. The supplements, rates, and time fed used in that study were the same used in the present study. Meza-Herrera (1996) found no difference in ovulation rates of ewes in BCS 2.5 compared with ewes in BCS 3.5.

First Cycle Conception

No differences ($P = .2$) were noted for first cycle conception rate between CON and High, and High versus Low ($P = .10$). However, CON ewes had a higher first cycle conception ($P = .05$) than Low-supplemented ewes (64.5 and 78.2 ± 2.4% for Low and CON, respectively, Table 2). Gunn et al. (1991) reported higher first cycle conception in ewes supplemented before mating.

Increased conception during the first cycle allows for better management of ewes as well as providing a more uniform lamb crop at time of marketing. The mechanism of fertilization failure or early degeneration of ova is not well understood. Very little experimental data exists that correlates nutrition and embryonic mortality (Brun-Bellut et al., 1990). However, Meza-Herrera (1996) found higher embryonic mortality in ewes flushed with High. He suggested that high protein decreased uterine pH, resulting in implantation failure. Also, research in dairy cows indicated feeding high amounts of ruminally degradable intake protein decreased conception rate (Jordan and Swanson 1979; Kaim et al. 1984). Other studies have reported decreased conception rate with increased CP levels but results have been inconsistent. Folman et al. (1981) demonstrated an increase in conception rate by replacing ruminally degradable protein with ruminally undegradable intake protein sources in isonitrogenous diets fed to dairy cows.

Table 2. Effects of feeding no supplement (CON) or supplements containing low rumen degradable (Low) and high undegradable (High) intake protein during the flushing period on ovulation rate, conception, and weaning percentage in ewes grazing native raglands.

	Treatments[a]			
Item	CON	Low	High	SE[b]
Ovulation[c]	1.1	1.2	1.3	.27
First cycle conception[d]	78.2[e]	64.5[f]	73.2[e]	2.4
Weaning percentage[g]	65.6	78.3	76.3	4.9
Adj. Weaning percentage[h]	65.6[e]	84.3[f]	88.2[f]	1.7

[a]Low contained 25.6% CP and High contained 44 2% CP. Supplements were fed at 150g·head^{-1}·d^{-1} and 112g·head^{-1}·d^{-1} for Low and High, respectively.
[b]SE = standard error 2 pastures per treatment and total 100, 96, 54 ewes for High, Low, and CON, respectively.
[c]Average number of Corpus Lutea per ewe; n=10/treatment
[d]Percentage of ewes bred that did not return to estrus
[e,f]Means with different subscripts differ (P = .01).
[g]Actual weaning percentages (P = 3). Included prepartum supplementation.
[h]Weaning percentage adjusted for lambs lost due to confirmed coyote kills.

Table 3. Effect of feeding no supplement (CON) or supplements containing low rumen undegradable (Low) and high undegradable (High) intake protein during the flushing period on body weight (kg) and body condition of ewes grazing native rangelands.

	Treatments[a]			
Item	CON	Low	High	SE[b]
Initial Weight[c]	65.2	65.0	65.3	8
Weight at Breeding[d]	64.2[f]	67 3[g]	64.0[f]	1.7
Initial Body Condition[e]	2.7	2.7	2 7	.02
Body Condition at Breeding[d]	2.3[f]	2.6[f]	2.5[g]	.06

[a]Low contained 25.6% CP and High contained 44.2% CP. Supplements were fed at 150g·head^{-1}·d^{-1} and 112g·head^{-1}·d^{-1} for Low and High, respectively
[b]Standard error: ewes per treatment were 100, 96, and 54 for High, Low, and CON; respectively.
[c]Body weight and body condition at initiation of the flush treatment.
[d]Body weight and body condition after the first estrous cycle of breeding (end of flush period).
[e]Body condition scores are based on a 1 to 5 scale with 1 being emaciated and 5 being fat.
[f,g]Row means with different superscripts differ (P < .02).

Weaning Percentage

No difference (P = .3) was detected among ewes fed the supplement treatment on actual lamb weaning percentage. However, weaning percentage was confounded in this study due to losses associated with predators. When lambs were approximately 35 days old, a coyote began killing lambs in two of the supplemented pastures. Taking the adjustments into account, High and Low were similar (P = .8). However, supplemented pastures had a higher weaning percent (P = .01) than CON (88.2, 84.3, and 65.6% ± 1.7% for High, Low, and CON; respectively, Table 2).

Several factors could cause the difference in weaning percentage: failure to conceive, embryonic mortality, and neonatal mortality. However, the intensive data collected on the subsample do not support any of these. However, Gunn et al. (1972) found that most embryo deaths occurred in the first 30 d of pregnancy and that nutrition had little or no influence of embryonic mortality unless ewes were in severe nutritional stress. Burfening and Kott (1993) reported improved neonatal survival when ewes were supplemented 21 d before lambing to 23 d post lambing.

Ewe Fecal Output (Experiments 1 and 2)

Following the initiation of supplementation during late gestation, fecal output was measured as an estimate of forage intake in both experiments. In experiment 1, protein supplementation did not (P = .20) influence fecal output (550 vs 532 ± 9.6 g/day for High and Low, respectively). However, fecal output was greater (P = .03) for CON versus Low (596 vs 532 ± 9 6 g/day) treatments. However, in experiment 2 with the mature ewes, no differences were found in fecal output among the treatment groups (P = .29; 838, 767, and 751 ± 40.9 g/day for CON, High, and Low, respectively). Harris et al. (1989) reported daily supplementation of .15 kg/head of an 18% CP supplementation had no effect on forage intake compared to non-supplemented ewes. Similarly, Huston (1983) reported fecal output during winter conditions was not affected by supplementation. However, Hatfield et al. (1990) reported decreased grazing time in supplemented ewes compared to non-supplemented controls which could result in reduced intake in supplemented ewes. In the present studies, supplementation had little effect on fecal output, which suggests that range forages were providing adequate protein to the ewes. In experiment 1, masticate forage samples collected from ruminally cannulated ewes averaged 8.5% CP, 50% ADF, and 71.7% NDF. Protein was not estimated in forage for experiment 2.

Ewe Body Weight and Condition (Experiments 1 and 2)

No differences (P > .10) were noted among treatments for ewe weights during the first 34 to 50 days of lactation in Exp. 1 and 2, respectively (Table 4). Thomas and Kott (1995) reported benefits of supplemental feeding on ewe weight in ewes that were losing weight. Huston et al. (1993) found that supplemental feeding increased gain in female Angora kids, but no differences were found between ruminal degradable and ruminal undegradable protein supplements. In the present study, range conditions were good to excellent and higher than normal ewe weights were to be expected.

Body condition is an estimate of the energy stores an animal has available (Sanson et al. 1993). These stores are comprised of lipids in adipose tissue and are important sources of energy for lactation. In experiment 1, a time by treatment interaction (P = .002) was found; so means will be discussed within time. At 14 days postpartum, High fed ewes had higher (P = .001) BCS than those fed Low or CON (Table 5). Furthermore, Low fed ewes had higher (P = .05) BCS than CON fed ewes. These differences continued through 24 days postpartum. However, by day 34, ewes receiving the supplements were in better condition than CON ewes (P = .05) but High and Low fed ewes were similar (P > .10). In experiment 2, differences in body condition were noted on day 14 postpartum (Table 5). Ewes fed Low supplement were in better body condition (P = .08) than CON ewes with High being intermediate. We do not have an explanation for the interaction in Exp. 1. However, the difference between supplemented ewes and controls could be the result of the protein being used as an energy source, thus reducing mobilization of body fat (Brendemuhl et al., 1987).

Table 4. Effects of feeding no supplement (CON) or supplements containing low rumen undegradable (Low) and high undegradable (High) intake protein during late gestation on body weight (kg) of ewes during lactation.

	Treatments[a,b]			
Day[c]	CON	Low	High	SE[d]
		Experiment 1		
14	60	61	62	1.6
24	61	62	62	1.5
34	58	64	61	4.0
		Experiment 2		
4	69	68	73	2.1
14	71	73	72	3.4
24	71	68	73	2.2
34	70	70	73	.9
50	72	70	73	2.0

[a]Low contained 25.6% CP and High contained 44.2% CP. Supplements were fed at $150 g \cdot head^{-1} \cdot d^{-1}$ and $112 g \cdot head^{-1} \cdot d^{-1}$ for Low and High, respectively.

[b]Treatment means within a row were similar (P > .10).

[c]Days postpartum.

[d]Most conservative standard error reported (Exp. 1: N=14, 13, and 15 for CON, High, and Low, respectively; Exp. 2: N=14, 14, and 11 for CON, High, and Low, respectively).

Table 5. Effect of feeding no supplement (CON) or supplements containing low rumen undegradable (Low) or high undegradable (High) intake protein during late gestation on body condition scores during the first 34 days of lactation.

	Treatments[a]			
Day[b]	CON	Low	High	SE[c]
		Experiment 1		
14	1.7^{d}	2.1^{e}	2.5^{f}	0.1
24	1.8^{d}	2.2^{e}	2.5^{f}	0.1
34	2.0^{d}	2.3^{e}	2.6^{e}	0.1
		Experiment 2		
4	2.6	2.7	2.9	.01
14	2.2^{h}	2.7^{i}	2.4^{h}	.11
24	2.2	2.2	2.3	.08
34	2.0	2.1	2.3	.09
50	1.8	1.8	2.0	.08

[a] Low contained 25.6% CP and High contained 44.2% CP. Supplements were fed at $150 g \cdot head^{-1} \cdot d^{-1}$ and $112 g \cdot head^{-1} \cdot d^{-1}$ for Low and High, respectively.

[b] Days postpartum

[c] Most conservative standard error reported (Exp. 1: N=15, 13, and 14 for CON, High, and Low, respectively; Exp. 2: N=14, 14, and 11 for CON, High, and Low, respectively).

[d,e,f] Row means with different superscripts differ (P = .05)

[h,i] Row means with different superscripts differ (P = .08)

Soder et al. (1995) reported that non-supplemented ewes lost more weight and had lower body condition scores than supplemented ewes. Hoaglund et al. (1991) reported ewes fed bloodmeal (ruminal undegradable protein source) combined with soybean meal gained more weight and lost less body condition than non-supplemented ewes or ewes fed soybean meal alone. However, Huston et al. (1993) found that supplemental feeding increased body weight but no differences in gain were found between High and Low supplemented ewes.

Table 6. Effects of feeding no supplement (CON) or supplements containing low rumen undegradable (Low) or high undegradable (High) intake protein during late gestation on milk production (mL/3h) in ewes during early lactation.

	Treatments[a,b]			
Day[c]	CON	Low	High	SE[d]
Experiment 1				
4	259	238	269	13.6
14	270	267	296	18.2
24	286	276	295	20.5
34	244	301	261	23.0
Experiment 2				
4	327	318	313	27.8
14	368	274	379	31.6
24	353	255	332	30.5
34	284	279	277	18.7
50	238	240	231	22.6

[a] Supplements were fed to ewes twice weekly to provide 112g head^{-1}·d^{-1} for High and 150g·head^{-1}·d^{-1} for Low. Milk production is reported for production in a 3 hour non-suckled period.
[b] Row means did not differ (P > .10).
[c] Days postpartum.
[d] Most conservative standard error reported (Exp. 1: N=14, 13, and 15 for CON, High, and Low, respectively; Exp. 2: N=11, 14, and 14 for CON, High, and Low, respectively).

Milk Production (Experiments 1 and 2)

Milk production data are expressed as production during a 3 hour non-suckled period. In both experiments, neither milk production (Table 6) nor milk constituents (Table 7) were affected by supplementation. Frey et al. (1991) reported supplemented ewes produced more milk than non-supplemented ewes, but milk composition did not differ. In dairy goats, milk production increased in prepartum does with increasing protein intake (Sahlu et al., 1995). Milk protein content was increased by prepartum supplemental protein to Holstein cows, especially when protein was undegradable intake protein (Van Saun et al., 1993). The lack of response to supplementation in the present study indicates that ingested forage was meeting the lactational needs of the ewes. The greater milk production in experiment 2 compared to experiment 1 is probably due to age of ewes and suckling intensity. Ewes in experiment 2 were 3 years old and nursing twin lambs, whereas ewes in experiment 1 were 2 years old nursing single lambs.

Table 7. Effects of feeding no supplement (CON) or supplements containing high rumen undegradable intake protein (High) or low undegradable intake protein (Low) supplement during last trimester of pregnancy on milk constituents from ewes during early lactation.

	Treatments[a]			
Item[b]	CON	Low	High	SE[c]
Experiment 1				
Fat, %	7.49	7.53	7.91	.37
Protein, %	4.05	4.17	4.04	.06
Lactose, %	4.98	5.02	5.03	.07
SNF, %[d]	9.71	9.86	9.74	.08
Experiment 2				
Fat, %	6.54	6.87	7.75	.50
Protein, %	3.69	3.94	3.74	.10
Lactose, %	4.53	4.61	4.43	.10
SNF[d], %	8.87	9.20	8.83	.15

[a] Low contained 25.6% CP and High contained 44.2% CP. Supplements were fed at 150g·head^{-1}·d^{-1} and 112g·head^{-1}·d^{-1} for Low and High, respectively. Row means do not differ (P > .30)
[b] Exp. 1 milk samples taken through the first 34 days of lactation, whereas Exp. 2 was through 50 days of lactation.
[c] Most conservative standard error reported. (Exp. 1: N=14, 13, and 15 for CON, High, and Low, respectively; Exp. 2: N=11, 14, and 14 for CON, High, and Low, respectively).
[d] Solids Non-Fat

Table 8. Effects of feeding no supplement (CON) or supplements containing rumen degradable (Low) or undegradable (High) intake proteins to ewes during late gestation on growth (body weight, kg) of their lambs.

	Treatments[a]			
Day of age	CON	Low	High	SE[b]
Experiment 1				
1	5.9	5.7	5.8	0.20
14	9.1	8.8	8.9	0.28
24	13.3	12.8	13.8	0.32
34	16.8	16.1	16.9	0.35
150[c]	45.4	47.3	47.3	0.99
Experiment 2				
1	5	5	5	1.1
4	5.9	5.8	5.7	.08
14	8.3	8.2	8.1	.47
24	10.8	11.7	10.9	.29
34	13.7	14.4	13.6	.50
50	18.3[d]	19.7[e]	18.1[d]	.27
150	40.7[d,e]	42.8[d]	39.5[e]	.72

[a] Low contained 25.6% CP and High contained 44.2% CP. Supplements were fed at 150g·head^{-1}·d^{-1} and 112g·head^{-1}·d^{-1} for Low and High, respectively.
[b] Most conservative standard error was used.
[c] Average of lambs at weaning.
[d,e] Row means with different superscripts differ (P < .10).

Lamb Weights (Experiments 1 and 2)

Lamb weights are reported in Table 8. Because no differences among treatments were found in milk production, one would not expect to see a difference in lamb weight gain. This was true 34 days postpartum in both experiments. However, in experiment 2, the lambs born to ewes consuming the Low supplement were heavier (P = .02) at 50 d than lambs born to ewes consuming the High supplement and CON. Also, at weaning (150 days) lambs born to ewes fed the

DIPsupplement were heavier (P = .09) than lambs born to ewes fed UIP with CON intermediate. We can speculate that ewes consuming the DIP supplement produced numerically less milk during the first 3 weeks of lactation. The lambs then could have begun grazing at an earlier age, supplementing milk intake with forage. This could also have increased the rate of rumen development leading to heavier weights at weaning. Ramsey et al. (1994) reported that lamb dry matter intake while nursing influenced weaning weights. These authors suggested that as milk intake decreases, lambs rely more on forage intake to meet nutrient needs.

Implications

Supplementing range ewes with high ruminally undegradable protein did not improve production under the range conditions outlined in these studies. As reviewed by Clark et al. (1992), the lack of increased production seen when feeding UIP may occur for the following reasons: 1) too much protein provided for the need of the ruminant, 2) the protein source may only provide a small amount of ruminally undegraded protein, 3) microbial synthesis may be depressed as a result of low ruminal availabilities of ammonia, AA, peptides, or energy, 4) the protein may not supply the limiting AA, 5) the protein reaching the small intestine may not be readily available, or 6) there may be unknown interactions with the utilization or mobilization of nutrients already stored in the body. We feel the lack of increased production seen in these trials was due to favorable pasture conditions, which supplied sufficient protein to the ewes to meet their protein and energy demands. When pasture conditions are in average to good condition, supplemental protein may not be necessary to ensure postnatal growth and survival of lambs born to mature ewes.

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