Development and Reproductive Performance in Suffolk and Whiteface Ewe Lambs Consuming Medium-Quality Forage and Supplemented with Two Levels of Undegradable Intake Protein[1,2,3]

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Summary

Three experiments were conducted to determine the effect of undegradable intake protein (UIP) on growth and reproductive performance of Suffolk and whiteface range ewe lambs. Experiment 1 utilized 36 Suffolk ewe lambs (BW = 39.3 kg) assigned to 3 treatments; control (forage only), high UIP (forage plus 290 g/d of supplement high in UIP; 92.8 g/d CP, 76.1 g/d UIP, 16.7 g/d DIP), or low UIP (forage plus 290 g/d supplement low in UIP; 92.8 g/d CP, 34.3 g/d UIP, 58.5 g/d DIP). Ewe lambs were fed supplement treatments daily with ad libitum access to sudan grass hay (7.3% CP, 69% NDF). Supplements containing 32% CP and 2.75 Mcal/kg ME were fed to meet CP requirements for growing replacement ewe lambs. Variables measured were progesterone and serum urea nitrogen (SUN) concentrations, LH release from the pituitary via a GnRH challenge, growth, intake, and pregnancy rates. Forage intake was less ($P < .10$) for control than low and high UIP supplemented ewe lambs, but when calculated as % BW, intake was similar ($P > 10$). Gains, pregnancy rates, and SUN were greater ($P < .01$) for the supplemented ewe lambs than controls with no differences between low and high UIP. Lutenizing hormone concentrations were similar ($P > .10$) among treatments. Experiment 2 and 3 were conducted utilizing native range during two consecutive years. Experiment 2 consisted of 60 and Exp. 3 consisted of 83 whiteface ewe lambs assigned to either low UIP or high UIP treatments. Breeding began when the average age of the ewe lambs was 240 d. Supplement intake for Exp. 2 was 290 g/d and for Exp. 3 was 560 g/d. No differences ($P > .10$) were noted for pregnancy in either experiment. In Exp. 2, weight gains were similar ($P > .10$) between treatments, but ewe lambs fed low UIP gained more ($P < .10$) than high UIP for Exp. 3. Results from these three experiments suggest minimal differences between protein type. However, supplementing ewe lambs with a protein and energy supplement when they are consuming a medium quality forage or dormant native range will increase growth and reproductive performance when compared to forage alone.

Key words: Sheep, Reproduction, Protein, Growth, Puberty

Introduction

A ewe's lifetime production is determined in part by her prolificacy and the number of lambings that occur during her lifetime. Factors affecting age of puberty in ewe lambs include the month of birth (Forcada et al., 1991; Chappell, 1993), age (Hulet et al., 1969), weight (Kemp et al., 1991), nutrition (Laster et al., 1972), and breed (Dyrmundsson, 1981). A ewe's lifetime productivity could be increased if she gave birth to her first lamb at or near one year of age, returned to estrus, and bred her second and each subsequent year for the remainder of her productive life. Briggs (1936) found that ewes bred first as lambs produced 14.0 kg more lamb and gave birth to .69 more lambs in the first six years of life. Spencer et al. (1942) found similar results with ewes bred first as lambs producing more lamb with only a slight decrease in wool production. Similarly, Hulet et al. (1969) conducted a 10 year experiment (1952-1962) which deter-

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mined the production of ewes bred as lambs compared to ewes bred as yearlings, and found that ewes which lambed as yearlings (bred as lambs) had greater lifetime production. Rambouillet ewes showing estrus as lambs produced an average of 20.4 kg of lamb more than those that did not show estrus their first year (Hulet et al., 1969). Also, heavier ewe lambs were more likely to breed than lighter ones and had greater lifetime productivity (Hulet et al., 1969).

"Undernutrition delays puberty in both the male and female in most species and, if severe, it may cause retrogressive changes in the sex organs after they are fully developed" (Maynard et al., 1979). For young growing females, adequate protein and energy are a must for growth to be such that reproduction is possible (Church, 1993; Grings et al.,1998). Generally protein is deficient in dormant range forages (Wallace, 1988) and is provided to grazing ruminants in high protein supplements fed in relatively low amounts (Knox, 1967). Koster et al. (1996) reported increased forage utilization with increasing DIP up to 11% of the supplement. Sawyer (1998) reported a similar response in thin cows consuming low quality forage and fed relatively small amounts of UIP. Other increases in performance have been demonstrated by Miner et al. (1990) in pregnant, winter-grazing beef cows and Salisbury et al. (1997) for growing Rambouillet rams.

Most range sheep production is in the western United States. Profit margins are continually decreasing and producers are interested in ways to decrease overhead without sacrificing production. In any given flock of sheep, 20% of the herd is non-productive because a producer will generally keep enough replacement females to equal 25% of their mature herd. These ewe lambs are then grazed until they are about 19 months of age before they are bred. Therefore, if a producer can economically increase growth and development of his ewe lambs so that ewes can be bred as lambs and give birth to healthy lambs as yearlings, they can increase flock productivity without increasing the total number of ewes in their flock. Therefore, studies were conducted investigating the effects of protein type (undegradable intake protein, UIP or degradable intake protein, DIP) on the development and breeding of Suffolk and whiteface range ewe lambs post-weaning.

Materials and Methods

All procedures contained in this manuscript were approved by and conducted in accordance with the Institutional Animal Care and Use Committee of New Mexico State University.

Experiment 1. Thirty-six commercial Suffolk and Suffolk crossbred ewe lambs were used in a completely randomized design. All ewe lambs were born between mid-February and mid-March. Beginning 2 wk after birth, ewe lambs had ad libitum access to creep feed (13% CP) and were provided uniform, conventional management until weaning at 60 d of age (±10 d). At weaning (60 d ±10 d), BW were recorded and ewe lambs were maintained on alfalfa hay until the initiation of the experiment.

Average BW and age of the ewe lambs at the beginning of the experiment were 39.3 ±3.6 kg and 120 d ±10 d, respectively. Ewe lambs were then assigned randomly to one of three treatments and one of 18 pens (2 lambs/pen and 6 pens/treatment). The treatments consisted of 1) control (forage only), 2) high UIP (forage plus a supplement high in UIP), and 3) low UIP (forage plus a supplement low in UIP and high in DIP). Supplements were fed at a rate of 290 g/d which would meet the NRC (1985) requirements for growing replacement ewe lambs. Supplementation continued for 106 d. Supplement nutrient compositions are reported in Table 1. Forage consisted of sudan grass hay (7.3 % CP) chopped to 7 cm in length. Forage was fed daily at 1700 h and was provided in excess so that each pen of ewe lambs had ad libitum access to forage. Orts were collected twice weekly and intake was calculated weekly. Ewe lambs had ad libitum access to clean fresh water, shade, and a trace mineral mix. Body weights were taken on 28-d intervals to monitor BW change.

One ewe lamb from each pen was chosen randomly to monitor serum progesterone to determine when they reached puberty. Blood samples were collected two times per week until d 64 via jugular venipuncture and allowed to clot at room temperature for 30 minutes. Blood samples were centrifuged at 1,500 x g for 15 minutes at 4 °C. Serum was then harvested and stored in vials at -20 °C until analyzed for serum progesterone by a radioimmunoassay described by Schneider and Hallford (1996). All samples were quantified in one assay and the intra-assay C.V. was 9.8%. A ewe lamb was considered pubertal when she had progesterone concentrations above 1 ng/ml for two consecutive sampling days.

A GnRH challenge was also conducted on these same 18 ewe lambs to determine the effect of treatments on LH release as an indicator of reproductive activity. Estrus was synchronized in the ewe lambs (average age = 184 d) with Syncro-mate-B (Sanofi Animal Health, Overland Park, KS). One half of a cattle implant was placed under the skin in one ear of each ewe lamb on d 64 (d 0 = initiation of experiment) and left in place for 13 d. Nine days after the implants were removed a GnRH challenge was conducted. Blood samples were collected and serum harvested as previously described. Blood samples were collected at -15 and 0 min to establish a baseline serum LH concentration and ewe lambs were then immediately injected intravenously with 12.5 mg of GnRH (Cystorelin, Rhode Merieux, Inc., Athens, GA). Blood samples were then collected at 15 min intervals for 2 h then at 30 min intervals for an additional 2 h. Serum LH concentrations were quantified by RIA using procedures described by Hoefler and Hallford (1987). All samples were analyzed in one assay and the intra-assay C.V. was 12.5%. All ewe lambs used in the sampling responded to the GnRH injection.

Serum urea nitrogen (SUN) concentrations were determined on the same 18 ewe

lambs 30 d after the initiation of the experiment and 30 d before breeding. Blood samples were collected and prepared as previously described at 0, 6, 12, 18, and 24 h after supplementation to measure SUN concentrations. Serum urea N concentrations were determined (inter-assay C.V. = 8.6%, intra-assay C.V. = 10.1%) by the method described by Richards (1999). On d 106 (226 d – 10 d of age), ewe lambs were combined into one group, treatment supplementation stopped, and a fertile ram fitted with a marking harness was placed with them to begin the breeding period. Following the 34-d breeding period, ewe lambs were fed an alfalfa hay diet with corn supplementation (136 g/d) to meet both energy and protein requirements for a gestating ewe lamb. Seventy-five days after joining with rams, pregnancy was determined by ultrasonography (Aloka 500v) using a 5 MHz flank transducer. At lambing, ewe lambs were monitored frequently to observe for lambing difficulty and lamb birth weights were recorded.

Table 1. Ingredient and nutrient composition of protein supplements used in all experiments.

Item[b]	Treatment[a] Low UIP	High UIP
Corn (fine ground)	14.68	44.55
Hydrolyzed feather meal	0.0	30.0
Hi protein soy meal	79.09	14.0
Blood meal (flash dry)	0.0	5.0
Potassium	0.0	1.0
Calcium carbonate	0.75	0.0
Ferrous sulfate, 30%	0.36	0.36
Cobalt carbonate, 46%	0.005	0.002
Manganese sulfate	0.09	0.09
Vitamin A	0.006	0.002
Carmel-molasses blend	5.0	5.0
Composition[c]		
Crude Protein, %	32.0	32.0
UIP, % of CP	37.0	82.0
DIP, % of CP	63.0	18.0
ME, Mcal/kg	2.9	2.6
Calcium, %	0.553	0.312
Phosphorous, %	0.553	0.328
Potassium, %	2.132	1.2
Vitamin A, IU/Kg	4000	4000

[a]High UIP (supplement high in UIP), Low UIP (supplement low in UIP).
[b]All ingredients are in percent as-fed.
[c]Nutrient values (DM Basis) represent calculated values except crude protein (DM basis) which is actual.

Experiment 2. Sixty commercial whiteface range ewe lambs were used in an on the ranch experiment testing the previously described protein supplements. The experimental area (Corona Range and Livestock Research Center, New Mexico State University) is located 20 km northeast of Corona, NM at an elevation of 1850 meters. Predominant forages of the experimental area include blue, black, and sideoats gramma (*Bouteloua gracilis, eripoda*, and *curtipendula*, respectively), sand dropseed (*Sporobolus crypandus*),

Table 2. Forage CP, NDF, forage production and rainfall for the pastures used in the range experiments, Exp. 2 and 3[a].

Month	CP, %[b]	NDF	Forage, kg/ha	Rainfall, mm Year 1	Year 2
January	7.3	75.9	—	4.8	0.0
February	6.1	74.0	736	27.2	5.1
March	—	—	—	1.5	25.9
April	—	—	—	52.8	12.9
May	9.6	73.4	—	31.7	0.8
June	—	—	—	90.9	0.3
July	18.2	68.7	—	12.7	68.8
August	—	—	—	0.0	95.2
September	—	—	—	0.0	37.3
October	9.3	74.1	753	0.0	128.9
November	8.4	76.2	—	0.0	5.1
December	8.3	75.1	—	0.0	8.4

[a] Crude protein and NDF were determined from diet samples collected from ruminally cannulated wethers in the experimental pastures.
[b] Crude protein, NDF, and forage production values are averages of both years.

and threeawn (*Aristida spp.*; Renner, 1996). Monthly rainfall amounts and estimated diet quality and standing crop are shown in Table 2. Diet CP and NDF contents were determined by collecting diet samples from ruminally cannulated wethers. Throughout the experiment, three cannulated wethers were managed with the experimental animals. Collection of diet samples occurred at the beginning of each month by ruminal evacuation. Wethers were fasted overnight and emptied of ruminal contents the morning of sampling. Wethers were then released into their respective pastures and allowed to graze for 45 min. At the end of the 45 min grazing period, wethers were gathered and forage consumed was collected, avoiding the highly saliva contaminated contents. Samples were then placed in plastic bags and frozen until analyzed for CP and NDF contents. At the time of analysis, samples were air dried and ground in a Wiley mill to pass through a 2 mm screen. Crude protein was determined by the micro-Kjehldahl procedure (AOAC, 1990) and neutral detergent fiber was analyzed by the procedure described by Goering and Van Soest (1970). Additionally, forage availability was determined at the beginning and end of the experiment by standing crop double sampling procedures described by While and Richardson (1988). The 60 whiteface ewe lambs were born between May 15 and June 15 and were weaned October 15. At weaning, ewe lambs were weighed and randomly assigned one of two treatments. Treatments were the same as treatments 2 and 3 of Exp. 1. Preliminary data collected over 2 yr (Ross unpublished data) indicated that ewe lambs maintained on forage alone at the current research area will result in less than 5% of the ewe lambs lambing. Therefore, we felt it was unnecessary to include a non-supplemented control in the current experiment. Body weights were taken at 45-d intervals to monitor BW change. Ewe lambs were fed their respective treatment twice weekly at a daily rate of 290 g/d. Amount of supplement fed was based on CP requirements for ewe lambs and an assumed forage intake of 2.5% of BW (NRC, 1985). Huston et al. (1998) found that less frequent supplementation resulted in more uniform intakes of supplement by ewes in a group. Supplement was fed in a linear feeder with one pasture per treatment. Each ewe lamb had 36 cm linear feeder space available and the supplement was uniformly spread the length of the feeder. Ewe lambs were placed with fertile rams (d 109 after initiation of supplementation), fitted with marking harnesses, when the average age of the ewe lambs was 240 d (February 1). Ram to ewe ratio was 1:15 (2 rams/treatment). Breeding marks were recorded once per week and rams were rotated every 14 d. Rams were left with the ewe lambs for a 34-d breeding period. Experimental treatments were continued for 2-wk after breeding, at which time ewe lambs were shorn and placed in one group and maintained until pregnancy was diagnosed by ultrasound at 75 d after ram introduction. Pregnant ewe lambs were then separated and transported to the New Mexico State University Livestock Research Center at Las Cruces, NM where lambing data were recorded.

Experiment 3. Eighty commercial whiteface ewe lambs were assigned randomly to one of two treatments. Treatments were the same as in Exp. 2, except supplements were fed in bulk self feeders so that each ewe lamb had ad libitum access to the supplement. In Exp. 2, forage intake was estimated to be 2.5% of BW (NRC, 1985). In contrast, Ramsey (1995) determined that 18-24 mo old ewes on the same experimental area would consume 2.0% of their BW. In addition, results from Exp. 1 suggested that ewe lambs would consume approximately 2.0% of BW when fed forage of similar quality as the rangeland pastures. Therefore, we felt forage intake was overestimated in Exp. 2. In experiment 3, the ewe lambs actually consumed 560 g/d of supplement (mean for entire experimental period).

All other procedures and management were similar to Exp. 2 except the ram to ewe ratio during breeding was 1:20 instead of 1:15, and ewe lambs were maintained on the ranch, during lambing, in a small pasture close to working facilities.

Statistical Analysis

Experiment 1. Weight gain and forage intake data were analyzed as a completely random design with pen of two ewe lambs serving as the experimental unit using the GLM procedure of SAS (1989). However, pregnancy rates were analyzed using the CatMod procedure of SAS (1989) with individual ewe lamb as the experimental unit. For LH, SUN, and progesterone concentrations, ewe lamb was also the experimental unit because only one ewe lamb was sampled from each pen. Serum urea nitrogen and LH were analyzed as a split-plot in time and the model included treatment and animal within treatment in the main plot and time and time x treatment interactions in the subplot. Treatment differences were tested with animal within treatment as the error term. Also, LH release was analyzed as area under the response curve (0 min to 240 min) by trapezoidal summations (SAS, 1989) and the resulting area under the curve units were analyzed using the GLM procedure of SAS (1989). Estral activity was analyzed using the CatMod procedure of SAS with the response being yes (progesterone concentrations were greater than 1 ng/ml for two consecutive samplings) or no (progesterone concentrations did not reach 1 ng/ml for two consecutive samplings).

Experiments 2 and 3. For all analyses individual ewe lamb was considered the experimental unit and the experimental design was completely random. Pregnancy rates were analyzed using the CatMod procedure of SAS (1989) and gain data were all analyzed using the GLM procedure of SAS. Diet samples were not considered variables affected by treatments and were only used to monitor forage quality and quantity and to describe the experimental area, therefore, results were not analyzed statistically.

Results and Discussion

Forage Intake

Dry matter intake is one of the most important factors affecting growth and de-

Table 3. Dry matter intake of Suffolk ewe lambs consuming sudan grass hay and receiving no supplement or supplement with two levels of UIP, Exp. 1[a]

	Treatments[b]			
Item	Control	Low UIP	High UIP	SE[b]
n	6	6	6	
Forage intake, g/d	750.00[d]	580.00[e]	570.00[e]	20.00
Total intake g/d	750.00[d]	870.00[e]	860.00[e]	20.00
Intake,% BW	2.01	2.02	1.98	0.04

[a]Completely random design with pen of two ewe lambs as the experimental unit (2 ewes/pen and 6 pens/ treatment).
[b]Control (forage only), Low UIP (forage + 26.1 g/d UIP,) High UIP (forage + 57 8 g/d UIP). Both supplements were fed at 290 $g.h^{-1}d^{-1}$.
[c]SE– standard error of the mean.
[de]Means in the same row without a common superscript are different ($P < .01$).

Table 4. Body weights and body weight change of Suffolk ewe lambs consuming sudan grass hay and receiving no supplement or supplement with two levels of UIP, Exp. 1[a]

	Treatments[b]			
Item, kg	Control	Low UIP	High UIP	SE[c]
n	6	6	6	
Initial BW	38.5	39.5	40.2	1.3
BW at breeding	33.6[d]	45.8[e]	46.1[e]	1.4
BW at the end of breeding	36.5[d]	46.1[e]	46 5[e]	1.5
BW change pre-breeding	-4.9[d]	6.3[e]	5.9[e]	0.6
BW change during breeding	2.9[d]	0.3[e]	0.4[e]	0.4
Overall BW change	-1.9[d]	6.6[e]	6.3[e]	0.7

[a]Completely random design with pen of two ewe lambs as the experimental unit (2 ewes/pen and 6 pens/ treatment).
[b]Control (forage only), Low UIP (forage + 26.1 g/d UIP) High UIP (forage + 57.8 g/d UIP). Both supplements were fed at 290 $g.h^{-1}d^{-1}$.
[c]SE= standard error of least squares means.
[de]Means in the same row without a common superscript are different ($P < .01$).

velopment of an animal. Forage intake is regulated by bulk density, digestibility, and rate of passage (Weston, 1989). The NRC (1985) suggests that replacement ewe lambs must consume 2.5 – 3.0% of their body weight in DM daily, and Ramsey (1995) reported that yearling ewes consumed 2.0% of their BW in forage when grazing native range. In Exp. 1, ewe lambs from all three treatments consumed less DM daily (Table 3) than reported by NRC (1985) to be required by growing ewe lambs. However, ewe lambs fed high UIP and low UIP consumed more ($P < .01$) total DM (forage plus supplement) than control ewe lambs, but when DMI was expressed as a percentage of the ewe lamb's BW, all treatments were similar ($P > .50$).

Weight Gain

Kemp et al. (1991) and Spencer et al. (1942) reported that ewe lamb body weights are one of the most important factors in reaching puberty. Spencer et al. (1942) further reported that ewes bred as lambs were 14 kg heavier than ewes not breeding. These authors suggested that growth and attainment of puberty are directly related to nutrient intake. In our Exp. 1, the low UIP and high UIP ewe lambs were heavier but the difference was less than the 14 kg suggested by Spencer et al. (1942). Supplemented ewe lambs were heavier ($P < .01$; Table 4) at breeding and at the end of breeding than control ewe lambs. However, no difference ($P > .10$) in total weight gains were noted for the high and low UIP ewe lambs (6.3 kg and 6.6 kg, respectively). In the range experiments (Exp. 2 and 3), we did not include a forage only control because of previous work (2 yr) conducted at the experimental site (Ross unpublished data) in which ewe lambs maintained on forage alone had minimal weight gains or weight losses during the dormant season (October to March). However, no differences ($P > .10$) in BW or BW gain were noted between the supplementation treatments for Exp. 2 (Table 5). In Exp. 3, when supplements were fed ad libitum, the low UIP ewe lambs gained more than high UIP ewe lambs ($P < .10$; Table 6). In all three experiments, weight gains are not as high as those reported in the literature for grow-

Table 5. Mean body weights, body weight change, and pregnancy rates of whiteface ewe lambs consuming native range in central New Mexico and receiving supplement with two levels of UIP during the first year (1997-1998) of a range experiment (Exp. 2)[a]

	Treatment[b]		
Item	Low UIP	High UIP	SE[c]
n	30	30	
Initial wt, kg	38.1	38.5	
Final wt, kg (at breeding)	42.0	40.3	2.01
ADG, kg	0.06	0.03	0.02
Weight change, kg	3.89	1.84	2.01
% pregnant	16.6	10.0	

[a]Completely random design with ewes managed in one pasture per treatment. Individual ewe was used as the experimental unit. Final weight, ADG, and weight change were analyzed as a one way analysis of variance and pregnancy rates were analyzed using CAT-mod. No differences for any variable were found.
[b]Low UIP (forage + 26.1 g/d UIP) High UIP (forage + 57.8 g/d UIP). Both supplements were fed at 290 $g \cdot h^{-1} d^{-1}$ in a linear feeder as one pasture/treatment.
[c]SE= standard error of least squares means.

Table 6. Mean body weights, body weight change, and pregnancy rates of whiteface ewe lambs consuming native range in central New Mexico and receiving supplement with two levels of UIP during the second year (1998-1999) of a range experiment (Exp. 3)[a]

	Treatment[b]		
	Low UIP	High UIP	SE[c]
n	42	41	
Initial wt, kg	35.8	35.9	
Final wt, kg (at breeding)	62.3[d]	45.4[e]	4.8
ADG, kg	0.19[d]	0.07[e]	0.03
Weight change, kg	26.8[d]	9.5[e]	4.8
% diagnosed pregnant	33.0	29.3	
% lambing	19.0	19.5	

[a]Completely random design with ewes managed in one pasture per treatment. Individual ewe was used as the experimental unit. Final weight, ADG, and weight change were analyzed as a one way analysis of variance and pregnancy rates were analyzed using CAT-mod. No differences for any variable were found.
[b]Supplements were fed in a bulk self feeder and intakes were measured every 14 days. Mean intakes for the entire experiment were 560 g/d.
[c]SE= standard error of least squares means.
[d,e]Means in the same row without common superscripts are different $P < .10$.

ing ewe lambs except for low UIP ewe lambs in Exp. 3 which were similar to gains reported by Spencer et al. (1942) and Briggs (1936). It is not completely clear why gains were lower in these experiments for the supplemented ewe lambs than those previously reported. One explanation may be that ewe lambs in our experiments were consuming medium quality forage or dormant range as their basal diet and gains reported in the literature were from ewe lambs consuming improved pasture, irrigated forage, or a complete ration.

Reproduction

In Exp. 1 two ewe lambs had progesterone concentrations above 1 ng/ml but this occured only once for one sample day. This may suggest that no ewe lambs obtained puberty; however, the sampling stopped more than one month before breeding in order to conduct a GnRH challenge.

No differences ($P > .01$) were found among treatments for mean serum LH concentrations or for area under the response curve (Table 7). However, the inability to detect any differences may have been due to high standard errors indicating a wide range of responses to the challenge within treatment. Additionally, progesterone data indicates ewe lambs were prepubertal and this may have influenced

Table 7. Mean serum LH concentrations and area under the response curve of Suffolk ewe lambs consuming ad libitum Sudan grass hay and receiving no supplement or supplement with two levels of UIP during a GnRH challenge on d 84, Exp. 1[a]

		Treatments[b]		
Item	Control	Low UIP	High UIP	SE[c]
n	6	6	6	
LH, ng/ml	3.96	4.16	5.32	1.23
AUC[d]	923.6	1006.0	1319.9	327.3

[a]Individual lamb was the experimental unit. Data were analyzed as a split-plot. No treatment x time interactions were found; therefore, only main effects are reported.
[b]Control (forage only), Low UIP (forage + 26.1 g/d UIP,) High UIP (forage + 57.8 g/d UIP). Both supplements were fed at 290 $g.h^{-1}d^{-1}$
[c]SE= standard error of least squares means.
[d]AUC=area under the curve, AUC units. Area under the curve was calculated using the trapezoidal summation method and the resulting areas were analyzed as a one way analysis of variance. Area was calculated from 0 min to 240 min post GnRH injection.

Table 8. Pregnancy and lambing rates of Suffolk ewe lambs consuming Sudan grass hay and receiving no supplement or supplement with two levels of UIP, Exp. 1[a]

		Treatments[b]	
	Control	Low UIP	High UIP
No. ewes exposed	12	12	12
No. pregnant	2	9	6
No. lambs born	2	10	7
No. live lambs	2	9	4

[a]Completely random design and each ewe lamb was used as experimental unit and pregnancy was analyzed using CATmod and treatments were separated using contrast statements of all possible combinations.
[b]Control (forage only), Low UIP (forage + 26.1 g/d UIP,) High UIP (forage + 57.8 g/d UIP). Both supplements were fed at 290 $g.h^{-1}d^{-1}$.

the LH results.

Pregnancy rates were highest for low UIP ewe lambs (75%) and lowest for control ewe lambs (16.7%) with high UIP being intermediate (50%; Table 8). One half of the ewe lambs from each treatment were used in the GnRH challenge, and it might be speculated that the synchronization protocol and the GnRH injection induced puberty and ovulation. However, in all treatments the ewe lambs that were pregnant were equally distributed between the challenged and unchallenged ewe lambs. One ewe lamb from each supplemental treatment gave birth to twins, but two ewe lambs from the high UIP treatment had premature births. An additional ewe lamb in this treatment had a uterine prolapse at birth and she and her lamb died. One ewe lamb from the low UIP treatment gave birth to an extremely weak lamb that died within 18 h after birth. The difference in lambing rates between unsupplemented and supplemented ewe lambs is in agreement with Ramsey (1995). Meza-Herrera (1996) found lower pregnancy rates in ewes supplemented with UIP than those consuming DIP. The author also observed lower uterine pH in the UIP supplemented ewes.

Experiments 2 and 3 were in agreement with Exp. 1 except the pregnancy rates were lower. No differences were found between treatments (Tables 5 and 6). Pregnancy rates followed the same trend as gains with Exp. 3 having higher pregancy rates than Exp. 2.

The inability to detect cyclicity or a difference in pituitary response after a GnRH challenge is interesting considering the fact that 47% of all the ewe lambs became pregnant and that a three-fold or greater difference in lambing rates occurred between the control and supplemented treatments. One explanation may be that the progesterone measurements and the GnRH challenge were completed more than 3 wk before breeding began and breeding lasted for 34 d. During this time, the ewe lambs that bred reached puberty and began cycling. At the time of blood sampling, the ewe lambs may have been in their transitional stage which may also be an explanation for the high standard errors in the LH data. Table 6 shows a difference between the number of ewe lambs diagnosed pregnant after ultrasound and the number of ewe lambs actually giving birth to lambs. This difference is not completely understood be-

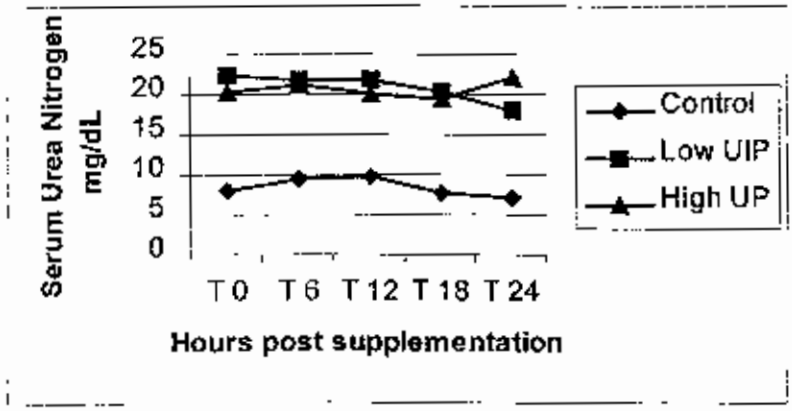

Figure 1. Serum urea nitrogen concentrations (mg/dL) of Suffolk ewe lambs consuming sudan grass hay and receiving no supplement or supplement with two levels of UIP on d 30, Exp. 1. Completely random design with one ewe from each pen sampled. Therefore, lamb was the experimental unit and serum urea nitrogen concentrations were analyzed using split-plot in time in SAS. At all sample times, control ewes were lower ($P < .01$) than both low and high UIP treatments.

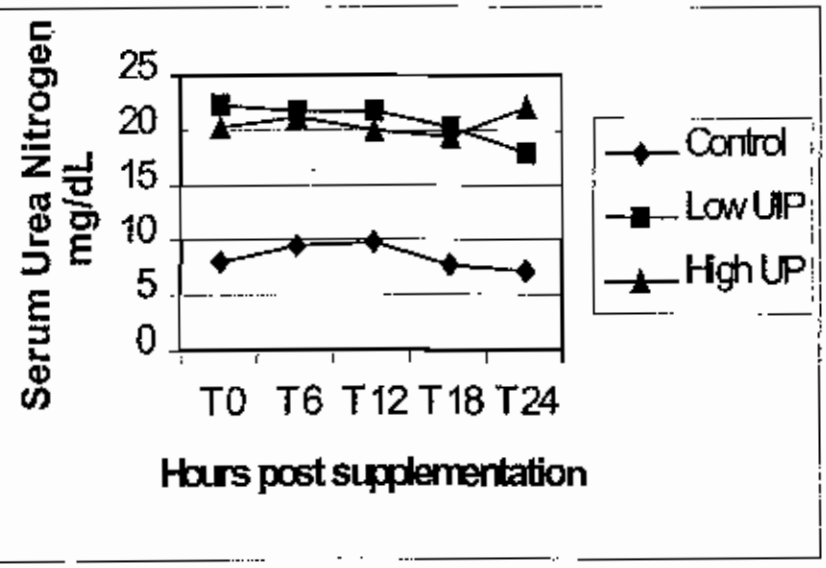

Figure 2. Serum urea nitrogen concentrations (mg/dL) of Suffolk ewe lambs consuming sudan grass hay and receiving no supplement or supplement with two levels of UIP thirty days before breeding, Exp. 1. Completely random design with one ewe from each pen sampled. Therefore, lamb was the experimental unit and serum urea nitrogen concentrations were analyzed using split-plot in time in SAS. At all sample times, control ewes were lower ($P < .01$) than both low and high UIP treatments.

cause ultrasounding was conducted twice by two different technicians, and each technician was blind to the results of the other. Both agreed on the ewe lambs diagnosed pregnant. Possibly several late term abortions may have occurred, but no visible signs were detected. Another possible explanation is embryo reabsorption. The latter does not seem possible because pregnancy was diagnosed on d 75 ,which would mean that it was more of fetal reabsorption than embryonic reabsorption. As a result of this discrepancy, we are currently monitoring embryonic and fetal changes throughout pregnancy in range and farm flock ewes.

Serum Urea Nitrogen

No differences ($P > .10$; Figures 1 and 2) were found in SUN between the low and high UIP treatments during both intensive bleeds, but supplemented ewe lambs had greater ($P < .01$) SUN concentrations than control ewe lambs during both sampling periods. These results are in agreement with Albertini-Baumgarten (1997) who reported no differences for SUN between UIP and DIP, but concentrations are around 4 mg/dL higher in the present experiment than in Albertini-Baumgarten's. This difference is most likely the result of supplementation rates being higher in the present study or that our experiment was with sheep and Albertini-Baumgarten's was with cattle.

Conclusions

Under the conditions of these experiments, no conclusive evidence was found to show that using DIP or UIP is more beneficial for weight gains or reproductive performance when ewe lambs were consuming a medium-quality forage or dormant native range. However, providing a protein and energy supplement, regardless of source of protein, increased gains and reproductive performance, but not to a level to successfully breed ewe lambs under a range environment. With these results in mind, price of protein may be the determining factor of which source of protein to use.

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