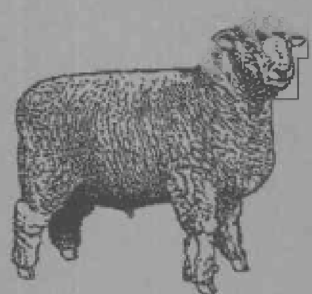
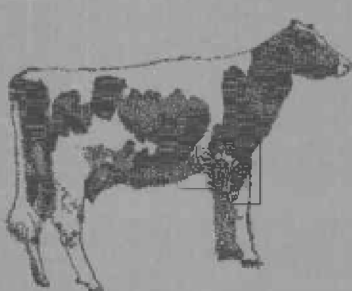
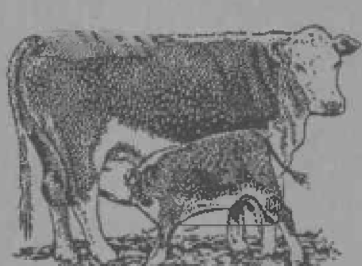
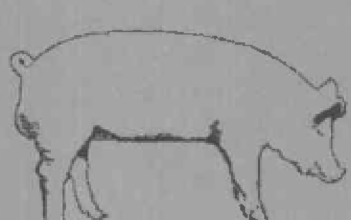
SUMMARY OF REPORTS

1990 OSU LIVESTOCK DAY









Special Report 853
April 1990
Agricultural
Experiment Station,
Extension Service
Oregon State University
Corvallis

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SECTION I.

PROCEEDINGS PAPERS

FURTHER EVALUATIONS OF BARLEY-BASED STARTER RATIONS FOR WEANLING PIGS: A COOPERATIVE REGIONAL RESEARCH PROGRAM

David C. England

ABSTRACT

Comparisons were made among five nutritionally equivalent barley-based starter diets for pigs weaned directly onto the test rations at 25 to 31 days of age. Energy supplement components compared were corn oil, black cod fish-oil, canola oil, extruded whole soybeans, and tallow. Three replicates of four pigs per treatment are completed. Results show best numerical average gains on the tallow and corn oil supplement diet within the range of 0.67 to 0.56 pounds average gain per pig per day. One more replicate is in progress and data from other cooperating researchers will be available.
(Key words: pigs, barley, diets, energy, fats.)

INTRODUCTION

Barley is often not recommended in starter rations because of its somewhat lower palatability and its 15-17% lower available energy compared to corn or wheat. As a participant in USDA Western Regional Research Project W-166 which is designed to evaluate use of barley and other western-produced feedstuffs for swine rations, England (1988) reported equivalent performances by 35-day-old pigs fed either corn-based or barley-based diets; the barley based diets included 20 percent dried whey. Similar findings were reported by other participating researchers in the region-wide cooperative experiment.

The 1979 National Research Council publication, Nutrient Requirements of Swine, points out that it is not possible to formulate barley rations that have recommended concentration of digestible energy without providing supplemental energy by addition of fat or oil.

METHODS

The current report of continuing research compares five barley-based rations, each having equal nutrient content in which the major supplemental fat or energy source is different. The barley used had analyzed crude protein content of 11.2 percent. Pigs weighing 16 to 21 pounds at 25 to 31 days of age were weaned directly onto the test rations. Each ration contained 20 percent dried whey; all rations were fed in meal form.

Each ration test group consisted of four pigs per pen; each ration group was replicated three times for a total of 12 pigs per ration. Ration formulas are shown in Table 1. No antibiotic was fed. Pigs were individually weighed weekly and feed consumed per pen group was measured weekly. Duration of the test was 28 days for each replicate. Performance data are shown in Tables 2, 3 and 4. Feed intake responses are shown in Table 3.

RESULTS AND DISCUSSION

A marked difference between results in this experiment and the one reported earlier (England, 1988) is the low feed intake during the first week. This difference can be attributed to beginning the test period immediately upon weaning at 28 days of age whereas in the earlier experiment a one-week adjustment period was allowed before testing began.

Present data are not adequate for statistical analysis purposes. Current data do indicate, however, that each source of energy supplementation is nutritionally useable for energy augmentation. An additional replicate is in progress. This replicate and the results from the other participating research will allow legitimate interpretation of comparative production responses to the five different rations.

LITERATURE CITED

England, D.C. 1988. Evaluation of barley vs. corn in pig starter rations. Oregon Agricultural Experiment Station Special Report 8216.

Table 1. Percentage composition of barley-based starter rations utilizing different fat/oil sources.

	Rations[a]				
Ingredients	1	2	3	4	5
Barley	45.28	47.48	40.41	56.90	45.28
Soybean meal	27.72	7.77	16.59		27.72
Soybeans, whole-ext		21.75			
Canola meal			10.00		
Canola seed			10.00		
Black Cod meal				20.00	
Dried whey	20.00	20.00	20.00	20.00	20.00
Corn oil	4.00				
Beef tallow					4.00
Dical. phos.	1.00	1.00	1.00	1.00	1.00
Limestone	0.85	0.85	0.85	0.85	0.85
Salt	0.30	0.30	0.30	0.30	0.30
TM premix	0.10	0.10	0.10	0.10	0.10
Vit. premix	0.25	0.25	0.25	0.25	0.25
Calculated analysis					
C.P.	20.00	20.01	20.00	20.05	20.00
LYS	1.16	1.13	1.16	1.13	1.16
Supp. Fat	4.00	4.00	4.00	4.00	4.00
TOTAL Fat	5.24	5.09	5.21	5.17	5.24

[a] Sources of supplemental fat are corn oil, full fat extruded soybeans, ground full-fat double-low canola seed, black cod meal and tallow (yellow grease), respectively.

Table 2: Initial average weight per pig in each replicate of each ration.

	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
Replicate 1	19.5	19.3	19.5	18.8	19.3
Replicate 2	19.3	18.5	19.0	19.0	19.8
Replicate 3	19.5	18.8	18.8	18.5	18.8
Average	19.4	18.9	19.1	18.8	19.3

Table 3. Average feed intake per week by each test group.

	Week 1	Week 2	Week 3	Week 4	Total
Ration 1					
Rep 1	8.0	21.6	39.4	40.4	109.4
Rep 2	12.5	19.5	37.5	38.5	98.0
Rep 3	19.0	27.0	53.0	66.0	165.0
Average	13.2	22.7	43.3	45.0	112.4
Ration 2					
Rep 1	13.5	24.0	40.6	51.5	129.3
Rep 2	11.0	26.5	41.5	48.5	127.5
Rep 3	14.5	23.5	42.0	40.5	121.0
Average	13.0	24.7	41.3	46.8	125.9
Ration 3					
Rep 1	9.9	25.1	38.7	36.2	109.0
Rep 2	7.0	23.5	39.0	46.5	116.0
Rep 3	10.0	20.0	41.5	53.5	125.0
Average	9.0	22.9	39.7	45.3	117.0
Ration 4					
Rep 1	15.0	30.7	40.5	39.0	125.2
Rep 2	16.5	27.0	43.0	47.0	133.5
Rep 3	9.0	13.5	34.0	40.0	96.5
Average	13.5	23.7	39.2	42.0	118.0
Ration 5					
Rep 1	12.8	26.4	40.1	39.4	118.7
Rep 2	13.0	38.0	30.5	59.5	141.0
Rep 3	3.0	25.0	31.5	55.0	117.5
Average	9.6	29.8	34.0	51.3	126.0

Table 4. Total pounds of gain per 28 day test period.

	Ration 1	Ration 2	Ration 3	Ration 4	Ration 5
Rep 1	60	69	59	67	69
Rep 2	65	65	64	70	84
Rep 3	91	64	67	54	72
Av total gain	72	66	63	64	73
Av daily gain	0.64	0.59	0.56	0.57	0.67

INCREASING OUTPUT BY BREEDING EWE LAMBS

Terry, Bill, Pete and Gina Wahl
Wahl-3 Ranch, Langlois, OR

Breeding ewe lambs is not a feasible or profitable management practice for everyone; however, it can increase production efficiency under some management systems. At Wahl-3 Ranch, we have made it a routine part of our system. In fact, every potential replacement ewe must lamb in her first year or she is off to slaughter!

We farm along the coast near Langlois, Oregon. Ewe numbers have fluctuated over the past few years and are presently down a little, but 1989 lambing ewe numbers stand close to 5,000 including 750 ewe lambs. Grazing area consists of an irrigated ranch bordering the Pacific Ocean and a dryland hill ranch several miles inland. Production is based almost entirely upon forage, so a lot of continuing effort is going into pasture improvement. Our feed costs occur primarily from fertilizer purchase, reworking of pastures and reseeding them with improved grasses and clovers and pasture subdivision for better grazing management. We farm out our ewe lambs to graze grass seed fields over winter and supplement ewes on pasture during late gestation when necessary.

Our replacement policy focuses on three important points:

1. Increase lambing rate by selecting only twin-born ewe lambs from reproductively superior ewes;

2. Manage replacements to get high conception rates in ewe lambs;

3. Manage ewe lambs to get high rebreeding as yearlings and to keep them producing in the flock for as long as possible.

Our system for breeding ewe lambs will not work for everyone, but the following outline of our approach may give other producers ideas of assistance.

Identifying potential replacements

All of our ewes carry individual identification. In addition, they carry a colored tag indicating past reproductive performance. Ewes with a lifetime lambing performance above 150% are given purple tags.

To be eligible as a potential replacement, ewe lambs must be born as twins or triplets to a ewe lamb, yearling or purple-tag mature ewe. If they have no entropion or other deformities and are of good size and vigor they receive their identification eartag in the right ear. All others are tagged in the left ear. Such identification and record keeping is made easier because all lambing is done through a slatted floor barn. Ewes are jugged with their lambs after birth (3-4 days for singles, 4-5 days for twins depending on weather, etc.).

Ewes going to pasture with twins go to the best available feed; singles go to the average feed. The aim is to grow all lambs as well as possible and this is especially important for the twin-born ewe lambs intended to be bred at 8-9 months of age.

Selection and breeding of ewe lambs

Selection of potential replacements is a continuous process with poor-doers, footrot cases, etc. being cülled as they occur. It is expected that of 2,000 ewe lambs leaving the lambing barn as potential replacements, only 1,000 will be exposed to rams. Much of the pre-mating culling is based on size, and twins from ewe lambs or yearlings are at a disadvantage.

Rams are placed with the ewe lambs in October, about 60 days after initiation of mating for mature ewes and 30 days after yearlings. Rams have painted briskets for marking ewes. After each 3 days of mating, marked ewes are given an interchangeable blank colored eartag coded for the mating period. Mating continues for a maximum of 6 weeks so there could be as many as 14 tag colors used.

Ram ratios are one ram to 75 ewe lambs, and rams are rotated for introduction of fresh rams every 6 days (2 tag color periods). All rams are home-bred ram lambs selected for growth and reproduction. Marked ewe lambs are trucked to the Willamette Valley as numbers reach truckload lots and as valley feed conditions dictate. There they are grazed without supplement on grass seed fields. Rams remain with the ewe lambs, but no attempt is made to collect further mating information after the first ram marking.

Ewe lambs are managed on grass fields as a single flock, and grazing fees are paid on the basis of weight gained. Ewe lambs going to the valley after mating in 1988 averaged 107 pounds (our best ever) and those returned averaged about 135 pounds.

We want ewe lambs returned 10-14 days pre-lambing. They are sorted for return based on their colored ear tags and udder development. Open ewes go to slaughter.

Returned ewe lambs go to grass pastures and receive about 1 pound of supplement (13% protein grass seed base pellets) per day fed on the ground. The supplement is the same as the ration to be fed in the lambing barn. We have found that supplying a small amount of supplement prior to mating seems to condition the ewe lambs to rapidly accepting the feed when they return for lambing.

Lambing management

Ewe lambs enter the barn 3-5 days pre-lambing (based on ear tag color) and are group-penned until lambing. The group pens are surrounded by lambing jugs, so ewes are gently steered into jugs as they begin parturition. Most lamb in jugs.

Ewes receive pellets ad libitum while in the barn. They leave the barn and go to single/twin pastures based on number of lambs. Singles are not supplemented on pasture, but ewe lambs with twins may be supplemented. Since these ewes lamb in March and April, pasture quantity and quality are both very good.

Lambs are weaned in June at about 3 months of age or younger.

Re-breeding as yearlings

After early weaning of their lambs, the young ewes are given some of the best available feed to support continued growth. They may also receive supplement if pasture growth slows over summer. They are mated in September, after the mature ewes, to give them a little more time for growth and conditioning. We find that our yearlings re-breed just as well as if they were yearling ewes being mated for the first time. Our yearlings, because of their previous mothering experience, are nearly as good mothers as the mature ewes.

Putting it all together

We invest a lot of extra effort and feed into our ewe lambs to insure that they reproduce well; their production is part of the flock output, not a "bonus". We apply a lot of selection pressure and produce replacements that are tops under our conditions.

Although we have no direct data, we believe our lambs weaned from ewe lambs average about 10-15 pounds lighter than lambs from mature ewes, depending on the year. The lambs are younger at weaning, but are higher in the proportion of singles and have been growing when both feed and weather conditions are very good.

We mate ewe lambs later to get best conception and lamb them after the main lambing rush so that we can give a little extra attention and have the best feed and weather.

Breeding ewe lambs works for us because we provide the inputs necessary for success. We give them the best available treatment and remove the ones that don't perform within our system.

SECTION II.

RESEARCH REPORTS

ASSESSMENT OF EPISTASIS IN SWINE CROSSES

P. T. Bellatty and D. C. England

ABSTRACT

Crossbreeding studies conducted with Berkshire, Yorkshire, and a composite breed developed from equal proportions of the two parent breeds were used to produce 632 litters of these breeds and 12 crossbred combinations. These data were analyzed to evaluate heterosis, epistasis and scaling effects on reproductive performance. Estimates by traditional methods agree with traditional reports. Use of the epistatic model resulted in much closer agreement between expectations and results.
(Key Words: Swine, Heterosis, Epistasis, Scaling, Reproduction.)

INTRODUCTION

Phenotype results from the combination of genetic inheritance, environmental influences and the interaction between the environmental and genetic components. The genetic influence on phenotype is controlled by a multitude of genetic factors including heterosis and epistasis. Genes, which represent a pair of alleles originating from each parent, determine the potential for heterosis and epistasis. When alleles within a gene originate from different breeds, heterosis results. When alleles from different genes interact, epistasis results. Thus, heterosis is intragene allelic interaction and epistasis is intergene allelic interaction.

If particular combinations of breeds A and B produce 2 more piglets per litter but not with other allelic combinations of the same breeds, epistasis could be apparent. Subsequent offsprings resulting from combinations of breeds A and B would only manifest these production levels if the same particular alleles were inherited in combination. Breaking of favorable epistatic effects created through generations of selection have been called recombination loss. Negative epistatic effects eliminated through generations of crossbreeding would probably be misconstrued as heterosis.

Heterosis has been extensively studied and "crossbred advantages" have become fairly predictable with common breeds of livestock. Lowly heritable traits, such as reproductive characters, are most responsive to crossbreeding while the more highly heritable traits tend to be less responsive. The measurement of heterosis is the difference between the crossbred performance and the average of the purebred performance.

Epistasis has extensively been studied in many species using qualitative characters. The agouti hair color in the mouse is an example of epistasis involving qualitative characters. Epistatic interactions among alleles associated with qualitative traits do not manifest the expected frequencies and types of offspring recognized with traditional dominance-recessive inheritance. Despite extensive evaluation of epistasis with qualitative characters, less research has been conducted to assess epistasis with quantitative characters. Quantitative analyses of genetic data generally assume interactions among genes to be negligible.

TRIAL DESIGN

Evaluation of epistatic effects requires considerable data incorporating many genetic combinations and breed types. The Oregon State University Swine Unit has conducted crossbreeding experiments to estimate genetic parameters involving combinations of Yorkshire, Berkshire and a composite breed derived from equal proportions of Berkshire and Yorkshire genes. These three purebreds and twelve crossbred breed combinations involving 632 litters have provided the basis for evaluating heterosis, epistasis and scaling effects of reproductive characters in swine. Scaling effects determine the appropriateness of metric weights and count data when measuring reproductive characters in swine. The best genetic models and scales are determined by assessing the congruence between actual and expected breed means.

RESULTS AND DISCUSSION

Estimates of heterosis were calculated using traditional methods which assume epistatic effects to be negligible. Estimations of individual and maternal heterosis are similar to those reported in the literature. Estimated individual heterosis estimates for numbers born and weaned per litter are 5 and 11%, respectively. The average maternal heterosis estimates were 11% and 22% for the numbers born and weaned per litter, respectively. Thus estimates of individual and maternal heterosis calculated using traditional methods are similar to those reported in other studies.

Two statistical analyses were conducted: 1) An analysis using traditional models which assume negligible epistatic effects, and 2) analysis capable of assessing epistatic effects. Genetic parameter estimates calculated using traditional models are similar to those cited in the literature. Conclusions would imply that moderate genetic progress would result from artificial selection for any single reproductive trait evaluated. Additionally, individual and maternal heterosis would be manifested with most crossbreeding schemes.

A two-locus epistatic interaction model using transformed data was determined to provide the best genetic estimators for most reproductive characters evaluated. Conclusions derived from using the epistatic model would imply that the traits are lowly heritable, and heterosis estimates of litter size are negative at birth and weaning. However, despite negative heterosis estimates, actual litter size is expected to increase as negative epistatic effects are broken using a crossbreeding system.

The epistatic model deemed more appropriate than the traditional model is the simplest epistasis model available. The model assumes only a two-locus interaction and does not account for genetic interactions between sire and dam, sire and offspring, or dam and offspring. Higher order interactions involving three or more loci and linkage could not be estimated with this data. Model appropriateness is determined by comparing actual breed means with those expected breed means; most differences are 2% or less with the largest difference being 6%. In addition to estimating genetic parameters capable of being employed in breeding systems to maximize productivity, such a model can be used to predict new breed means for combinations not currently available. Accurate estimation of new breed means would require the same genetic interactions and relationships for tested breed combinations.

Thus, analyses reveal genetic parameter estimation which assumes that assuming negligible epistatic effects may be inappropriate for breed crosses involving Berkshire and Yorkshire breeds of swine. Conclusions from traditional analyses assuming no epistasis are that reproductive traits are moderately heritable and sensitive to heterosis. Conversely, conclusions derived from analysis with the two-locus epistatic model reveals traits to be lowly heritable and influenced by epistasis.

Estimates derived using the traditional model negating epistatic effects are similar to literature estimates. Statistical analyses imply that ignoring the effects of epistasis may result in inappropriate conclusions. Future crossbreeding studies calculating heterosis and heritability estimates should consider the influence of epistasis and not assume that effects of gene interactions are negligible.

BY-PASS PROTEIN SUPPLEMENTATION OF PASTURE AND LOW QUALITY ROUGHAGE FOR STOCKER CATTLE

C. R. Brose, P. R. Cheeke and Dale W. Weber

INTRODUCTION

Recent efforts to better define the protein requirement for beef cattle rations are in part concerned with by-pass protein or escape protein. These two terms have been used synonymously for that portion of the protein in a ruminant's ration that by-passed or escaped the rumen without being digested, or significantly broken down.

The rumen microbial population is quite diversified, and it can vary significantly for many reasons. Protein or other nitrogenous source ingested by the ruminant can be: 1) broken down and restructured as a protein that fits a microbial requirement, or 2) it is not, or is only partially broken down before by-passing or escaping the rumeno-reticulum portion of the stomach.

The microbes and some of their products, such as enzymes, eventually pass through the omasum, abomasum and small intestine where they are usually the major source of proteins that are digested and absorbed by the ruminant. Thus the proteins that reach the abomasum (the so-called true stomach) come from products of rumen fermentation or from by-pass protein (BPP). It is known that the proteins from products of rumen fermentation do not always optimally meet the ruminants' needs. This is especially true during periods of high production.

It is common in the Willamette Valley, as elsewhere, to over-winter calves on locally grown grass hay until they can be turned out on spring pastures. This trial was conducted to evaluate the response to protein supplements differing in their by-pass potential, for stocker cattle wintered on grass hay and during the subsequent spring grazing season.

MATERIALS AND METHODS

The trial was conducted using sixty (steers of mixed breeding that averaged 227.6 kg at the start of the trial period which consisted of the wintering period followed by the spring grazing season. The maternal traits came from cows of mixed breeding of seven breeds. The paternal traits came from purebred bulls of four of these same breeds; Angus, Brangus, Polled Hereford or Simmental.

The steers were randomly assigned to groups of 5 animals, with some adjustments for sire type. The groups were randomly assigned to one of twelve pens at the OSU Ruminant Nutrition Barn. Then the pens were randomly assigned one of four different rations. Thus there were three pens each for the four different rations. The plan was to feed average quality grass hay for all four treatments and to supplement three of the four treatments. These supplements would provide different levels of BPP.

Willamette Valley grass hay averages about 9% crude protein (CP), with lows near the 5% CP range and highs near the 14% CP range. Different protein sources have varying levels of fermentable protein (that portion which is not BPP). Forage generally has high fermentable protein, especially fresh forage. Protein supplements used in this trial included low fermentability fishmeal (approx. 26% fermentability), medium fermentability cottonseed meal (approx. 44%), high fermentability canola meal (approx. 80%), and very high fermentability urea (essentially 100%).

All steers were fed hay ad libitum twice a day and supplemented once a day each morning. Three pens were supplemented with canola meal at a rate of 378g/head/day. Another treatment group was supplemented with cottonseed meal at a rate of 342g/head/day. The third supplemental group received 76.4g/head/day of fishmeal and with 229.6g/head/day of cottonseed meal. The control group received no supplement. All supplements contained the same amounts of CP. All supplements were introduced into the rations over a two week pre-trial period.

The steers were weighed at the start of the feed lot trial period, the end of the feedlot portion of the trial, and the end of the pasture portion of the trial. The steers were also weighed every two weeks while in the feedlot to monitor their progress. It was estimated that the groups would average approximately 0.455 kg/head/day of gain while in the feedlot. The first two weeks of the trial (Dec. 16-30, 1988) the steers averaged 0.435kg/head/day which was acceptable. The next two weeks the quality of the hay available was poor. This coincided with about ten days of sub-normal temperatures. The steer weight on 1-13-89 indicated an average drop in weight of the control group of 0.13kg/head/day and severe drops in the average daily gain (ADG) for the other three groups. Since another source of hay was not available at that time, it was decided to supplement all groups with steam-rolled barley at a rate of 1kg/head/day; increase the protein supplement for all supplemented groups and add a protein supplement to the control group ration. The added supplements (grain and protein sources) were introduced over the next two weeks. They were also divided into two feedings per day (morning & evening). The new protein supplements were: canola group- 608g/head/day canola meal, cottonseed group- 549g/head/day cottonseed meal, fishmeal group 112g/head/day fishmeal plus 335g/head/day cottonseed meal, and the control group- 304g/head/day canola meal plus 40g/head/day of urea.. Thus the control group received one-half of its supplemented CP from urea and the other half from canola meal.

After the steers were weighed on 3-31-89 they were transported to pastures at OSU's Soap Creek Ranch. All three pens of a feeding regime were placed together on one pasture. Thus there were four groups of fifteen steers each, on four different pastures. The groups were rotated on pastures each week to minimize the effect of any variation in pasture quality. The steers were supplemented on pasture once a day, at mid-day, with a group feeding equivalent to 0.91kg/head/day of steam-rolled barley and 15g/head/day of magnesium oxide. In addition the canola group received 608g/head/day of canola meal; the cottonseed group received 549g/head/day of cottonseed meal; the fishmeal group received 112g/head/day of fishmeal plus 335g/head/day of cottonseed meal. The control group did not receive a protein supplement. All steers were weighed off pasture on 6-1-89.

RESULTS AND DISCUSSION

Analyzed crude protein contents of the feedstuffs and pasture are shown in Table 1. Average daily gains are presented in Table 2. Gains of the animals receiving protein supplements were superior ($P<0.05$) to those of the control group during the wintering period. Responses to the three protein supplements were almost identical. During the grazing period, the gains were significantly greater ($P<.0.01$) for the canola-fed steers than for the other groups. Over the total trial period, the gains were greatest for the canola fed group, but not significantly different than for the other groups. Canola meal has high rumen fermentability and low by-pass potential. The response to this supplement may indicate that rumen fermentable nitrogen was the first limiting factor, rather than by-pass protein. During the grazing season the pasture contained 21.3% protein (DM basis), and 9.2% soluble protein. Assuming that soluble protein correlates reasonably well with fermentable nitrogen and insoluble protein correlates with by-pass protein, of the total protein in the pasture, about 43% was fermentable and 57% by-pass. Thus the response to highly fermentable canola meal may reflect this protein distribution in the pasture. Although the urea provided completely fermentable nitrogen, the one feeding per day likely did not provide a sustained source of fermentable nitrogen over the 24 hour period.

Numerous reports in the literature suggest that forage-fed cattle may have an abundance of fermentable nitrogen, but a deficit of protein reaching the intestine. In this situation, animals respond to supplementation with by-pass protein. In the present trial, there was no response to by-pass protein, and the best results were obtained with canola meal which is highly fermentable.

The significant response to canola meal, especially during the grazing period, suggests that further work with this protein supplement under western Oregon conditions is warranted.

Acknowledgement

We thank Mr. Paul Bright, of Ocean-Proteins, Charleston, Oregon, for donation of the fish meal used in this study.

Table 1. Dry matter and crude protein contents of feedstuffs used (DM basis).

Feedstuff	% Dry Matter	% Crude Protein
Barley	88.6	11.8
Canola Meal	88.2	39.9
Cottonseed meal	91.8	44.0
Fishmeal	92.9	72.8
Urea	10.0	287.0
Grass hay	87.8	5.7
Pasture	23.0	21.3

Table 2. Performance of steers fed protein supplements varying in rumen degradability.

	1st Portion Feedlot (28 days)	2nd Portion Feedlot (70 days)	Total Feedlot (105 days)	Pasture Portion (62 days)	Total Trial (167 days)
Control group	0.12	0.93	0.67[c]	0.98[a]	0.75[c]
Canola group	0.31	0.94	0.79[d]	1.13[b]	0.92[d]
Cottonseed group	0.38	0.95	0.78[d]	1.00[a]	0.86[d]
Fishmeal group	0.21	0.94	0.78[d]	1.05[a]	0.88[d]

Note: [a] different than [b] ($p<0.01$)
[c] different than [d] ($p<0.05$)

SECRETION OF LUTEINIZING HORMONE IN MELATONIN-TREATED BEEF COWS AFTER EARLY WEANING OF CALVES

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ABSTRACT

An experiment was conducted to examine the effect of melatonin implants on the pattern of secretion and serum concentrations of luteinizing hormone (LH) on days 30 and 35 postpartum after early weaning of calves on day 28 postpartum.
(Key Words: Beef cows, Melatonin, LH, Postpartum)

INTRODUCTION

The objective of this research was to determine whether exogenous melatonin could regulate LH secretion during the postpartum period of beef cows.

Following parturition, beef cows experience a period of anestrus prior to the resumption of regular estrous cycles. It has been demonstrated that systemic concentrations of LH are low early in the postpartum period (Humphrey et al., 1976). During the first 30 days postpartum serum LH concentrations are lower in suckled versus non-suckled beef cows (Carter et al., 1980), and weaning of calves at day 20 postpartum significantly increases LH pulse frequency as compared with that of suckled cows (Walters et al., 1982). The effect of season on reproductive function in the cow is unclear. Evidence suggesting fall- or winter-calving cows have shorter postpartum intervals as compared with spring- or summer-calving cows has been reported (King and Macleod, 1984). Conversely, Hansen and Hauser (1983) concluded that cows calving in the spring or summer have shorter postpartum intervals than those calving during the fall or winter. Initiation of the breeding season in some animals (sheep, deer, mink) appears to be regulated by the pineal gland, however, it is not known whether the pineal gland plays a role in regulating the reproductive cycle of the cow.

The pineal gland is located to the extreme posterior of the roof of the third ventricle of the brain. Melatonin, the primary hormone secreted by this gland has been shown to mediate the photoperiodic control of reproduction in long- and short-day breeders. In most mammals, melatonin is secreted in a diurnal rhythm with maximal systemic concentrations occurring during the dark period. Cattle exhibit a marked rise in plasma melatonin concentration at the onset of darkness which is sustained throughout the dark period (Rollag and Niswender, 1976; Kennaway et al., 1977). The pineal gland is believed to mediate photoperiodic control of ovine reproduction through modification of the pattern of LH release (Bittman et al., 1985), however, scant research has been conducted to investigate the effect of melatonin on LH secretion during the anestrous period of beef cows.

It is clear that regulation of the postpartum period in cows is a complex system involving many hormones that ultimately affect the secretion of LH.

Environmental factors such as suckling and nutrition also appear to act by altering the secretory pattern of LH. Even more poorly understood is the effect of season or melatonin on the secretion of LH during postpartum anestrous. Further understanding of factors that regulate LH secretion during the postpartum period is needed if we are to improve the reproductive performance of beef cows.

METHODS

Hereford x Angus x Shorthorn heifers were assigned to a control (n=7) and treatment group (n=5) in pairs by calving date. Melatonin treatment consisted of one implant containing 1 g melatonin in silastic tubing placed subcutaneously (SC) in the neck. Implants were inserted on day 2 postpartum (pp) and remained for the duration of the experiment. Control animals did not receive implants. Calves were weaned from both melatonin-treated and control cows on day 28 pp. Jugular veins of cows were cannulated and blood was collected at 15 min intervals for 4 hr beginning 48 hours after calf removal (day 30 pp) and again 5 days later (day 35 pp). Sera were analyzed for LH by radioimmunoassay (RIA). Additionally, cows were palpated per rectum on the day of calf removal, ten days later and weekly thereafter for the presence of corpora lutea (CL). Cows were monitored twice daily for estrous behavior using a vasectomized bull.

RESULTS AND DISCUSSION

Mean concentrations of LH released over the 4 hr sampling period on days 30 and 35 pp did not differ significantly (P>.05) between control (2.40 ± .43; 2.28 ± .53) and melatonin-treated (2.75 ± .45; 2.42 ± .45) cows. Statistical analysis failed to demonstrate a significant difference in the number of LH pulses occurring during this time period in the two groups of cows on either of the two days. Cows treated with melatonin experienced 3.4 ± .51 and 3.0 ± .71 pulses whereas control animals exhibited 2.43 ± .69 and 2.80 ± .35 pulses of LH during the 4 hr sampling period on days 30 and 35 pp, respectively. There was, however, a trend for melatonin-treated cows to exhibit slightly higher concentrations of serum LH as well as a greater number of LH pulses following early weaning of calves as compared with control animals. This trend was also observed in the number of days from parturition to first estrus. Melatonin-treated cows, on the average, had a shorter postpartum interval (42 ± 5.2 days) as compared with that of control cows (47 ± 3.9 days); however, this difference was not significant statistically (P>.05).

Palpation data (presence or absence of CL) were consistent with the occurrence of estrus. Three cows (2 melatonin-treated and 1 control) not observed in estrus before day 47 pp were determined to have ovulated during this time, based on the presence of palpable CL, without exhibiting behavioral estrus.

These data suggest that exogenous melatonin in the form of a constant release implant may only have a permissive effect on LH secretion in the postpartum cow. It must be noted, however, that the daytime concentrations of melatonin present in the serum over the course of the experiment have not yet been determined. It is possible that the formation of excessive connective tissue around the implant could have hindered the release of melatonin from the implant and thereby prevented (or diminished) the elevation of daytime melatonin concentrations in the serum. It is also possible that melatonin may exert its affects by altering the secretion of other hormones such as prolactin or by acting directly on the ovary. The samples obtained during the 4 hr sampling period will be analyzed for prolactin and estradiol-17ß at a later date.

Further research in this area may provide insight into the function of the pineal gland in the postpartum cow and may aid in unravelling the complex interaction of environmental and endocrine events that determine the length of the postpartum interval. Additional information regarding the effects of season on bovine reproduction could lead to the development of new management practices that could increase the efficiency of beef cattle production.

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EFFECT OF PASTURE AND MANAGEMENT VARIABLES ON FORAGE INTAKE BY GRAZING SHEEP

Robert D. Lewis and Howard H. Meyer

ABSTRACT

Grazing experiments were conducted in summer, autumn and winter to assess the effect of stock density, grazing duration, pre-grazing pasture mass and stock type on forage intake by sheep grazing at high stock densities for short durations. In summer and winter, sheep were stocked at 200 sheep/ha on 0.1 ha plots for 9 and 4 days, respectively. Total dry matter (TDM) and green dry matter (GDM) were estimated each day by clipping 0.2 m^2 plots to ground level. In autumn, ewes and lambs separately grazed 0.033 ha pastures at stock densities of 270, 540 or 810 sheep/ha for 1, 2, or 3 days. Pre- and post-grazing TDM were estimated with a single probe capacitance meter. The percent GDM of TDM was estimated using a spectophotometer. In each study TDM and GDM pasture mass were analyzed using a non-linear (negative exponential) multivariate regression model. Intake was estimated from results of pasture mass analysis. In autumn, ewes and lambs consumed similar amounts of TDM, but ewes consumed 43% more GDM ($P<.05$) than lambs; differences between treatments at the same grazing pressure (stock density X grazing duration) in intake of both TDM and GDM were not significantly different. In all analyses regression coefficients for grazing pressure, i.e. instantaneous rates of forage decline per stock day, were significant ($P<.01$). Instantaneous rates per stock day in TDM analyses were 0.0007, 0.0001 and 0.0002, and in GDM analyses were 0.0019, 0.0003 and 0.0010 for summer, autumn and winter, respectively. A simulation model was also developed which predicted intake of GDM and DDM by sheep grazing at high stock densities for short durations. Model predictions of intake agreed favorabley with summer and winter observations, but the model overestimated intake during autumn. In agreement with previous studies, the model predicted intake would increase at a decreasing rate as forage allowance (kg/sheep/day) increased.
(Key Words: Grazing, Intake, Sheep, Forage, Stocking Rate.)

INTRODUCTION

The relationship between nutrient intake and resulting animal performance is quite well-defined for livestock species. Under grazing conditions, however, it is very difficult to determine nutrient intake because forage available is not uniformly consumed and forage consumton is not readily measurable. The situation is made even more difficult by the likely decline in intake as selective grazing reduces the quality of remaining available forage.

The Oregon sheep producer grazing animals on fenced pastures is left in a dilemma: high ewe nutrient requirements during late gestation coincide with a time of low forage production but large quantities of residual dead material may be remaining from the previous growing season. Intensive grazing to remove the residual overburden will benefit forthcoming forage browth but nutrient intake under such management is unlikely to meet nutrient requirements.

Previous studies of intensive grazing management overseas have limited intake estimates to the average daily forage removed between the start and finish of the grazing period. While daily intake likely declines as residual forage is reduced by each subsequent day's grazing, very little direct daily measurement has been done. Efforts to estimate daily intake response to factors such as stock density, feed on offer and forage composition have largely consisted of computer modeling based on limited available information.

This multifaceted trial examined the effect of several pasture and management factors on daily forage intake by grazing sheep. The data collected were then used for testing and validation of a simulation model developed to predict forage intake under a range of conditions.

TRIAL DESIGN

Two intensive grazing trials were conducted on 3 replicates of .1 ha with ewes stocked at 200 sheep/ha for 9 days in September and 4 days in January. Stock intake was assumed to equal pasture forage disappearance as estimated by daily clipping of random sample plots to ground level. Sampled forage was analzyed by photospectrometry to estimate its green vs. dead dry matter makeup and thereby allow estimation of the composition of forage removed by grazing.

A third grazing trial was conducted in November utilizing ewes vs. 7-month-old lambs stocked at 270, 540 or 810 sheep/ha for 1, 2 or 3 days in a 2 X 3 X 3 array of treatments replicated three times. Each grazing plot comprised .033 ha. Pre-grazing and post-grazing residual dry matter were estimated for each plot both by clipping to ground level and by use of a probe capacitance meter.

RESULTS AND DISCUSSION

Summer (early September) pastures contained approximately 6000 kg total DM/ha with about 15% being green dry matter. The finite rate of decline for total dry matter was consistently about .88, i.e. animal consumption each day removed about 12% of total DM available at the start of the day. Green dry matter declined at a much higher rate with approximately 50% of initial green dry matter removed in the first 24 hours, and very little remained at the end of the trial.

During winter (January) grazing, initial total dry matter was about 1500 kg/ha with 36% green. Forage removed in winter was essentially all green matter and the finite rate of decline for total dry matter increased from .38 for the first day of grazing to .99 for the last day. This means that sheep were more selective of green matter in winter and virtually stopped eating when they could no longer select green material from the available pasture.

The difference between summer and winter intakes may have been due to the physical nature of the dead dry matter present. During September the dead material was upright and brown in color. During January, the dead material was weathered, gray in color and matted closer to the ground. Hence, intake was determined by factors other than either total or green dry matter available.

The third grazing trial, conducted in November, compared intakes of ewes vs. 7-month-old lambs on pasture averaging about 3000 kg total DM/ha. Ewes and lambs consumed approximately equal amount of total dry matter but ewes consumed on average 0.1 kg more green dry matter. Pre-grazing total DM was composed of 31% green DM, while ewe and lamb diets were composed of 60% and

45% green DM, respectively. At the same grazing pressure (i.e. stock density X days), animals at the lower stock density tended to be more selective in removal of green dry matter. Average daily intake/animal declined in a curvilinear fashion as grazing pressure increased.

The grazing model derived was based upon the negative exponential function to describe the decline in green dry matter mass over time. The model closely predicted forage intake for the summer and winter grazing trials but consistently overestimated green forage intakes under autumn grazing when tested over the wide range of grazing pressures.

ADIPOCYTE DEVELOPMENT FROM STROMALVASCULAR CELLS IN SERUM-FREE MEDIUM

Suryawan, A. and C.Y. Hu

ABSTRACT

Porcine stromalvascular cells were cultured in a serum-free medium to examine their development in vitro. Serum-containing medium was used as a control. Stromalvascular cells were isolated from subcutaneous adipose tissue of barrows by collagenase digestion. Isolated cells were cultured in DMEM/F-12 medium supplemented with 10% fetal calf serum for 24 hours to facilitate cell attachment. Subsequently culture medium was replaced by test media every 3 days for 12 days. All plates were stained with oil red O and hematoxylin and cell number counted. Increasing calf serum from 2.5% to 10% induced a higher rate of cell proliferation but did not stimulate differentiation of pig preadipocytes. In the serum-free medium more than 40% of the cells differentiated into adipocytes. Addition of calf serum to serum-free medium reduced cell differentiation. It is likely that serum contains factors which inhibit adipocyte differentiation, and a high rate of differentiation of pig preadipocytes can be achieved in the serum-free medium. This medium will be useful for examination of factors regulating pig preadipocyte development in vitro.
(Key Words: Porcine, adipose tissue, stromalvascular cells, primary culture)

INTRODUCTION

Serum-containing media have been used to study adipocyte development in primary culture (Ramsay et al., 1989). Although such media were adequate to support the proliferation and differentiation of preadipocytes in the rat primary culture, they tended to inhibit preadipocyte differentiation in swine stromalvascular (SV) cell culture (Ramsay et al., 1989a,b; Hausman et al., 1984). Most SV cell culture systems use serum-containing media. This confounds its usefulness in defining the role of individual factors in adipocyte proliferation and differentiation in vitro. The objective of this study was to examine pig preadipocyte development in a serum-free medium and serum-containing medium.

METHODS

Growing barrows (25-30 kg) were anesthetized with Biotal (3 mg/kg) and adipose tissue biopsied from the subcutaneous depot (Hu et al., 1987). Stromalvascular cells were isolated using collagenase digestion procedure under aseptic condition (Novakofski and Hu, 1987). Aliquots of the SV cells were stained with Rappaports stain and counted on a hemacytometer. SV cells were plated on 16 mm wells or on 35 mm wells in a plating medium consisting of Medium DMEM/F12 plus 10% fetal calf serum for 24 hours. This medium was replaced by a serum-free medium consisting of DMEM/F-12 supplemented with 850 nM insulin (I), 0.2 nM T_3, 10 μg/l transferrin (T) and 50 ng/l hydrocortisone (C) according to Deslex et al. (1987) or by DMEM/F-12 supplemented with 2.5%, 5% and 10% calf serum. These media were changed every 3 days for 12 days. All cultures were terminated at the end of 12th day and cells stained for lipid with oil red O and for nuclei with hematoxylin (Novakofski and Hu, 1987). Total number of oil red O positive and negative cells were counted in five microscopic fields at 100X.

RESULTS AND DISCUSSION

The effects of serum-supplement (2.5%, 5% and 10% calf serum) and serum-free media on porcine preadipocyte differentiation are shown in table 1. The number of differentiated cells per mm^2 area was significantly higher in ITTC medium than that in medium containing 2.5% calf serum. In addition, the number of total cells was significantly higher in serum containing media than in medium supplemented with ITTC. The result demonstrates that serum-supplemented media were able to support cell proliferation but failed to stimulate differentiation of porcine preadipocytes. Medium supplemented with ITTC was less mitogenic, but it was successful in stimulating porcine preadipocyte differentiation.

Table 1. Differentiation of porcine stromalvascular cells maintained in serum supplemented medium.

Medium	Fat cells/mm^2	Nuclei/mm^2
ITTC	143 ± 15	341 ± 59
2.5% calf serum	16 ± 2	700 ± 38
5.0% calf serum	14 ± 2	902 ± 45
10.0% calf serum	15 ± 1	1145 ± 97

Effect of serum addition to medium supplemented with ITTC on porcine preadipocyte differentiation is presented in table 2. The data show that addition of calf serum to medium supplemented with ITTC stimulated cell proliferation and inhibited differentiation. Preadipocytes typically differentiated into individual fat cells in the serum-free medium. The addition of 2.5% calf serum to the ITTC supplemented medium caused the formation of large fat cell clusters with larger cells within each cluster. This implies that ITTC stimulates adipocyte proliferation and differentiation, however, factor(s) in the serum promote the formation of the clusters. With the system we have developed it is possible to study individual factors such as growth hormone and insulin-like growth factor 1 on adipocyte development in a chemically defined environment.

Table 2. The effect of addition of serum to medium containing ITTC on differentiation of porcine stromalvascular cells.

Medium	Fat cells/mm^2	Nuclei/mm^2
ITTC	122 ± 12	281 ± 29
ITTC + 2.5% CS	82 ± 12	445 ± 60
ITTC + 5.0% CS	67 ± 8	697 ± 41
ITTC + 10.0% CS	53 ± 9	823 ± 75

SECTION III.

REVIEW ARTICLES

SUPPLEMENTATION OF POOR QUALITY ROUGHAGES

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Introduction

One of the distinct advantages of ruminants over other livestock species is their ability to effectively utilize high-fiber, low-quality roughage resources. In a recent review, Males (1987) estimated that if one-half of the crop residue from wheat, barley and oat straw were properly supplemented and fed to beef cows, 17.5 million brood cows could be wintered for a 5-month period. This represents about 50% of the total beef cow herd in the United States. Likewise, low-quality hays and dormant range forages are additional feed resources available for ruminant livestock production providing appropriate steps are taken to improve their nutritive value.

One of the future challenges facing ruminant nutritionists as well as producers, however, is how to most efficiently utilize high-fiber, low-quality feedstuffs. Numerous approaches have been taken to improve the nutritive value of poor-quality roughages. Physical modification such as grinding, pelleting and high pressure steam, chemical modification such as use of anhydrous ammonia, urea and alkaline hydrogen peroxide, and supplementation strategies have all been effective in increasing the use and nutritive value of poor quality roughages. This review will focus on supplementation strategies to improve the intake and utilization of poor-quality roughages.

Protein Supplementation

In general, when low-quality roughages are not limited in quantity, protein is the most beneficial supplement. Responses to supplemental protein are usually observed when the crude protein (CP) content of forages are less than 6 to 8 % (Campling, 1970; Kartchner, 1981). As the digestibility of the forage declines, however, the availability of the CP to the microbial population and host animals also declines (Allden, 1981). Likewise, if forage availability is limited, responses to supplemental protein are often not observed because of the animal's inability to express increased intake. Therefore, forage availability, digestibility and CP content of the forage must be considered when predicting performance responses to supplemental protein.

Numerous researchers have observed increases in beef cattle performance with the addition of supplemental protein to high fiber, low-quality roughage diets. With mature cows, the benefits are often observed as decreased loss in body weight and condition during the winter feeding or grazing period (Clanton and Zimmerman, 1970; Lusby and Wetteman, 1988; DelCurto et al., 1990a). Adequate maintenance of cow body weight and condition, in turn, tends to promote greater reproductive efficiency and calf weaning weights (Clanton, 1982; Wallace, 1987).

The primary mechanism in which supplemental protein improves ruminant performance is by increasing the intake of the low-quality roughage (Church and Santos, 1981; McCollum and Galyean, 1985). The increased intake is generally accompanied by improved or maintained level of digestibility of the basal diet. Therefore, in addition to the nutritive value of the protein supplement, increased intake and use of the low-quality roughage are additive benefits.

Energy Supplementation

In contrast to protein supplements, energy supplements have been reported to depress both the intake and digestibility of low quality forage. Supplementing low-quality native grass hay, Chase and Hibberd (1987) reported a linear decrease in forage intake with increasing quantities of corn. Likewise, with beef cattle grazing dormant forage, supplementation with corn, barley or sorghum decreased forage digestibility and intake (Cook and Harris, 1968; Lamb and Eadie, 1979; Kartchner, 1980; DelCurto et al., 1990b). Energy supplements tend to replace or substitute for the intake of low quality forages. As a result, energy supplementation of low-quality forages often exerts little or no influence on beef cattle performance (Clanton and Zimmerman, 1970; DelCurto et al., 1990b).

Energy supplements should be discouraged if your goal is to optimize the beef cattle performance with the utilization of the high-fiber, low-quality roughage. However, if the availability of the low-quality forage is limiting, energy supplementation becomes a viable alternative.

Likewise, some consideration of the supplemental protein to energy ratios is also warranted. In a series of studies evaluating yearling heifer gains as influenced by supplemental protein versus energy, Clanton and Zimmerman (1970) reported variable results from year to year. In year 1, heifer gain was increased with the addition of supplemental protein but was unaffected by supplemental energy. In year 2, a protein by energy interaction was observed with the addition of energy at the low protein level depressing heifer gain, whereas energy addition at the high levels of protein increased gain. In digestion studies, increasing energy at low levels of supplemental protein has been observed to decrease low-quality roughage intake and digestibility. At high levels of supplemental protein, increasing energy typically has little effect on intake and digestibility of the low-quality roughage (Elliot, 1967; Hennessy et al., 1983; DelCurto et al., 1990b).

Physical Form of Supplemental Protein

There is limited information available in terms of the efficacy of various types of feed sources which might be used as supplemental protein sources. The most common supplemental protein feed sources are derived from oilseed byproducts such as soybean meal and cottonseed meal. These feed sources, however are expensive at times and, as a result, identifying cheaper alternative feed sources to provide supplemental protein would be beneficial to ruminant livestock producers.

Work from eastern Montana (Cochran et al., 1986) and New Mexico (Judkins et al., 1987) have indicated that alfalfa pellets or cubes are as effective as cottonseed cake when fed on an equal protein basis. DelCurto and coworkers (1990c) found that sun-cured alfalfa pellets promoted higher forage intake and better maintenance of mature cow weight and body condition compared to long-stem alfalfa hay or soybean meal/sorghum grain supplements. Additionally, wheat middlings have also been successfully used as supplemental protein sources for beef cattle consuming low-quality roughages.

Although there is some difference in beef cattle response to various types of supplemental protein sources, most are effective as long as the CP content is adequate. It is also important to compare costs of supplemental protein sources on a CP equivalent rather than a unit weight basis.

NPN Supplementation

Ruminants have a unique ability to assimilate nonprotein nitrogen (NPN) into microbial cell protein. The microbial cell protein is than ultimately available for digestion and absorption by the host animal. Based on these observations, the use of NPN such as urea or biuret would seem to offer tremendous potential as an alternative to nature protein supplementation of low-quality roughages.

However, NPN has not been as effective as natural protein sources when supplemented to cattle consuming low-quality roughages. Summarizing six experiments evaluating the value of urea and feed-grade biuret in supplements fed to cattle on winter range, Clanton (1978) reported decreased performance with supplements containing greater than 3% urea or 6% biuret as compared to cattle receiving all natural protein supplements. Likewise, Rush and Totusek (1976) found that cows maintained on winter range forage lost less weight when a natural protein supplement was fed as compared to isonitrogenous supplements containing urea and biuret. Numerous other researchers have also observed depressions in expected beef cow performance when NPN is substituted for a portion of a natural protein in a supplement (Raleigh and Turner, 1968; Williams et al., 1969; Oltjen et al., 1974).

Summary

Natural protein appears to be the most beneficial supplement for high-fiber, low-quality roughages in ruminant diets. In contrasts to energy supplements, supplemental protein encourages the intake and digestibility of the low-quality roughages. Likewise, NPN does not appear to be as beneficial as natural protein supplementation of low-quality roughages.

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SHOULD YOU SWITCH TO COMMODITY FEEDING?

Michael J. Gamroth

Faced with declining milk prices, dairy farmers in the Northwestern U.S. have trimmed feed costs by feeding bulk commodities and byproducts. How effective is this cost-cutting tool and what problems does the dairy operator face in feeding bulk feeds? Oregon dairy farmers shared their costs and tips for making commodity feeding successful in a recent survey. These dairies ranged in size from 185 to 700 cows.

Does it pay?

If you price the value of commodities in a commercial grain mix, there is a $40 to $50 per ton difference between raw grain prices and the finished product. Saving this difference could mean about $50,000 to the owner of a 300 cow herd. Certainly, some of the savings would dissolve in the same costs a feed mill faces, such as labor, interest, maintenance, and shrink.

A detailed Washington State University study looked at the feed cost savings in a commodity feeding program. This 300 cow herd would save $100 to $150 per cow after all costs were considered. Most people agree commodity feeding is profitable for the large herd, but this study showed commodity feeding could save money for the 100 to 130 cow herd if planned carefully.

Studies have to make some assumptions and use general costs to develop the theoretical "bottom line." The decision to feed commodities must be tailored to the farm and individual. It is important to develop a budget with costs estimated to the farm situation. While it appears that commodity feeding may pay, let's look at what it costs.

What facilities and equipment are needed?

In the Northwest, it is most common to store bulk feeds in pole or frame-type buildings with floor bins. The entire floor is concrete including a wide apron at the open side of the building for unloading feeds. Some operations have a few metal grain tanks or bins for storage, too.

Operators suggest bins be sized to hold one and a half truckloads of a commodity. While a few operators have bins 12 feet wide, a minimum 14 foot width allows easier loading and unloading of floor bins. Most operators found they need more bins than the number of ingredients in their grain mix. This allows room for storing their pre-mixed grain, an extra load of a feed at a good price, or a fresh load of feed while they use the remainder of an older load.

If a farmer chooses to pre-mix commodities for a week's feeding and has 5 or 6 feeds in storage, he or she would probably need 7 or 8 bins. If feeds are mixed daily in the wagon prior to feeding, one less bin would be required. The farmer feeding a commercially-prepared grain with one or two extra feeds mixed in the forage would get by with only 3 or 4 bins.

A pole-type building with 6" concrete in the floor and 4 foot high concrete foundation walls costs about $6 per square foot to build. Assuming a 14'X 30' bin with a 14' front apron, a $3,600 building investment is required for each feed stored. Total investment in the commodity shed ranged from $8,000 to about $30,000.

A shed roof with gravel base can serve to store sacked items on pallets separately. Adding the shed roof to one end of the barn has worked well for some operators. This 30 foot long storage unit can be used to store salt, minerals, and sacked feed for calves and dry cows. It is important to keep these dry and covered, but storage in a commodity bin is expensive and unhandy.

Most feeding is done during daylight hours or with loader lights on so only moderate lighting in the commodity shed is necessary. If feed mixing, receiving, or loading is done at night, consider yard lighting positioned to shine in each bin and to illuminate the slab area where the feed wagon is parked for loading.

Many commodities are delivered ready to feed. In fact, a good grain mix can be formulated with feeds not needing any processing. This can help hold down the initial investment, but Oregon dairies reported a need for limited processing to make best use of commodity feeding. Most use a dry roller to crack grains for feeding. A dry roller costing $10,000 to $15,000 installed can pay for itself in a little more than one year compared to buying rolled grains delivered from a grain company.

Some operations also use a molasses-based liquid feed in the finished ration. Of course, this requires tank storage and a loading pipe. Liquid feed can be drained into the loader bucket and dumped into the mixer wagon, but most who have tried this report it unsatisfactory. Pumping it through a pipe into the running mixer is far better.

A bucket loader, about $30,000 (used), is required, as well as a mixer wagon with scales ($8,000 to $30,000) and a tractor to run the wagon. These may already be part of the outside feeding program or used elsewhere on the dairy. Defining the total investment in commodity feeding is difficult due to variation in size of equipment, price paid and other uses. Building and equipment investments in the 1986 Washington study ranged from $70,000 to $170,000. All the above were changed to the commodity feeding program and the high end included a large stationary mill, not common in the Northwest.

Don't miss the obvious. If commodities are mixed on the farm, do existing housing and feeding systems allow them to be fed? The bill gets bigger if other remodeling is necessary.

What about all the work?

Labor costs in feeding commodities decrease per ton as volume of feed used increases because mixing feed for 300 cows doesn't take much longer than for 200 cows. It is only slightly faster to dump part of a loader bucket than to dump one and a part.

Many of the operators reported pre-mixing a full batch of commodities for later feeding to get a better mix of small measure ingredients and to make filling the mixer wagon for daily feeding easier and more fool-proof. This takes about 2 hours weekly. Since most Oregon feeders were already feeding forage and an outside mix prior to switching to commodities, they reported the additional labor of a scoop or two of the prepared feed mix took no more than 30 minutes weekly. Grain preparation and loading took about 2.5 hours weekly regardless of herd size and grain preparation in this survey. This can be converted to a budgeted cost per ton by multiplying by the charge per hour and dividing by the tons of feed used weekly.

Labor costs of receiving commodities can be priced on a per ton basis. While unloading a truck can take from 20 minutes to 4 hours, a good driver with the proper type of truck will take about an hour of your time. If the truck contains 25 tons, at $8 per hour, the cost will average about $.35 per ton.

Per ton costs for total labor for receiving, preparing and loading feed in Oregon herds range from $.95 to $1.50.

Smart buying is important.

Oregon operators agreed attention to markets and smart buying was necessary, but none felt the phone bill had gotten out of hand nor that it took a lot of time. They agreed good buys are obvious, when they are available, and when they have to buy on the current market the price is about what would be charged by any commercial source. In other words, they bought carefully on quality, but the money to be saved in commodity feeding isn't from buying feeds more cheaply than a commercial mill. About half bought most of their commodities through a commercial feed company and about half through a feed broker. A reputable dealer is important.

Taking delivery of feeds requires some management. Most times you receive each load of an ingredient from a new truck driver. They won't know your operation and may be unaccustomed to hauling feeds. Provide a good drive-through to your commodity barn. Truck drivers spend most of their time driving forward on pavement. Backing between buildings on loose gravel, soft soil, or mud will disappoint you and the driver. Deliveries can happen anytime. Always have the driver call ahead with the expected arrival time and to receive directions. When ordering feeds, clearly explain days or hours unacceptable for deliveries. You will still get a load or two when you don't want it. Locate truck scales near your farm that can be used if needed. Several farmers reported loads arriving with no weigh slip available. Two Oregon feeders require every truck to weigh before unloading to reconcile their inventory and feed bills.

Some commodities are available seasonally. Forward contracting is required for year round feeding. Two examples of seasonal feeds used in the Northwest are sugar beet pulp and whole cottonseed. Loads may be available throughout the year, but the price increases sharply as supplies diminish.
Commodities are hard to get during year-end holidays. Schedule up deliveries before Thanksgiving, if possible. This is where extra storage space in the shed can be used.

Don't forget to find a source for a reliable mineral-vitamin pre-mix. Feed companies may sell this in sacks or in bulk pellets. Trace mineralized salt does not substitute for a quality mineral-vitamin pre-mix. Oregon producers use either dry mix from sacks or suspended in their molasses blend liquid feed.

A few words about management...

Most Oregon feeders admit they are very interested in their feeding program. Those that quit feeding commodities lost interest or weren't "into" nutrition before starting.

While the time to manage a commodity feeding program is not overwhelming, some attention to detail is required. Nutritional advice may come from a feed company if you buy your feed through them or you may hire a nutritional consultant. The money and time spent is essential to successful feeding. You gain the responsibility for watching the quality of your feeds at purchase and on delivery. You may have to send some loads back and negotiate with your supplier. You also must use feed analyses to determine the quality of individual ingredients and your final mix.

Total mixed rations are best suited to commodity feeding. Usually additional labor and investment is much less when forages and grain are already mixed before feeding. There is no problem of loading conventional grain tanks with farm-mixed grain when all grain is fed with forages. The TMR advantages of less worry about palatability of feeds and easier ration changes are also beneficial. And finally, using more of a feed in a TMR than is possible in a parlor-fed grain can even out the amounts of commodities fed.

Other costs.

The charge for interest on feed inventory should be considered and is included in most economic models. It is calculated assuming the average annual inventory volume is half the yearly feed use. This volume times its average value multiplied by the current interest rate for short term capital gives the inventory interest. But Oregon producers reported terms that allow 6 weeks to two months between delivery and payment due so the load is fed before payment is made so most producers in the Northwest reported costs of less than half the calculated inventory interest. A load of protein supplement may last several months and would result in some interest expense. Interest reported ranged from nothing to about $3 per ton.

Maintenance and repairs on buildings and equipment costs Oregon feeders about 5 percent of the investment. This cost is typical of charges for other buildings and equipment used on the dairy.

Producers agreed records are essential in a commodity program. From load sheets to purchase records, it was clear the survey herds kept good records and used them frequently. A final cost of mixing grain products on the farm is the "shrink," or loss in volume from delivery to the cow. Some articles critical of commodity feeding report losses as high as 15% (300 pounds per ton). Three producers kept good records of this loss at 2 or 3%. Estimates made by the other herds were usually slightly higher. One Northwest mill with good production control has averaged 1% for three years.

It's up to you.

Commodity and byproduct feeding is a viable cost-saver, even for smaller herds. However, it requires more work, money, and management. Consider the change to farm mixing carefully. Ask Extension personnel or other advisors to help you with a budget like the one at the end of this article.

The decision to mix your own grain doesn't have to be at the expense of your grain company. Northwest feed dealers are working with producers and both seem satisfied with the results.

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O.S.U. EXTENSION Analysis of a Commodity Feeding Program

For: Enter name
Date: 10/23/89

Cost of farm mixed grain:				
800 pounds of	Barley	@	$112.00	
400 pounds of	Bakery Waste		$98.00	
300 pounds of	Brewer's grains		$175.00	
170 pounds of	Protein Supp.		$220.00	
250 pounds of	Beet Pulp		$150.00	
80 pounds of	Mineral pre-mix		$375.00	
2000 pounds total mix			$143.10	
			$145.96	with shrink & waste
ASSUME:	140 milking cows		$190.00	purchased grain
	50% High producers		$145.96	mixed grain
	50% Low producers			
Hired labor for mixing or feeding:			$0.30	feed delivery
(per ton)			$1.20	mixing & loading
26	pounds grain daily (high cows).			
18	pounds grain daily (low cows).			
22	average pounds fed daily	=	$2.09	daily cost @ $190.00
		-	$1.62	daily cost @ $147.46
			$0.47	less w/mixed grain
INVESTMENT			$65.51	less for 140 cows / day
$30,000	mixer wagon w/ scales		$23,911	gross change in income/year
$20,000	commodity shed			
$12,000	mill-grinder w/elect.		$7,440	interest @ 12%
$62,000	Total investment		$16,471	net annual change

It would take 45 months to pay for this investment through the assumed grain savings only.

Interest on purchased commodities is not included. Interest is charged on the total capital investment. This analysis assumes 100% borrowed for investment capital and none for operating capital.

Labor for buying, mixing, and feeding grains are based on averages of other commodity feeders. Make the best estimate for your facilities.

SELENIUM - AN UPDATE

J.E. Oldfield
Director, Nutrition Research Institute

Selenium supplementation of livestock diets in areas of selenium-deficient soils in Oregon has a history of successful applications, over some 30 years. Recent disclosure of selenium toxicity among wildlife in central California have raised concern about the safety of such supplementation practices. This report summarizes information currently available on selenium deficiency or toxicity in domestic animals.

In 1958, selenium deficiency was shown to be cause of white muscle disease (WMD) in central Oregon, and careful supplementation of deficient diets with sodium selenite at 0.1 ppm in the dry matter was shown to be completely preventive (Muth, et al, 1958). This finding was hailed at the time as a means of countering the effects of WMD, which had caused losses in production efficiency of cattle and sheep, including deaths, costing Oregonians in excess of $1 million annually.

Selenium - an essential nutrient

Our knowledge of selenium has increased a great deal since that time. New Zealanders showed that selenium deficiency interfered with reproduction in sheep, causing fetal deaths which increased the numbers of "empty ewes" and reduced lambing percentages (Hartley and Grant, 1961). Dr. S.H. Wu, at Oregon State, showed that selenium deficiency reduced the mobility of sperm, which also reduced reproductive performance (Wu, et al, 1973). Workers at Lederle Laboratories demonstrated that selenium supplementation would prevent liver disease in pigs (Eggert, et al, 1957), and myopathy of the gizzard in poultry (Dean and Combs, 1981). It was also shown to be helpful in lessening problems of retained placentas after calving, in dairy cattle (Trinder, et al, 1973).

Evidence was thus assembled that selenium was, in fact, an essential nutrient and that an adequate supply of it was necessary for normal growth and reproductive performance in domestic animals. Extensive soil and plant analyses (Kubota, et al, 1967) made it possible to chart, at least in general terms, areas where selenium was adequate or deficient in the United States. With all this information available, it is not surprising that selenium supplementation was enthusiastically adopted by livestock producers in areas of selenium deficiency, both in this country and worldwide.

The federal Food and Drug Administration, charged with ensuring the safety of meat, milk and other food products in this country, examined the selenium situation very closely and after a widespread and intensive testing program, allowed the supplementation of livestock diets, where needed, with 0.1 ppm of selenium, usually supplied as its sodium salt, Na2SeO3. It has since raised the allowable level of supplementation to 0.3 ppm in the diet. Various alternative methods have proven satisfactory. Veterinarians have long given selenium, in sterile water solution, by intramuscular injection, or by oral drench. Australian scientists perfected a heavy pellet containing selenium which could remain in the fore-stomachs of cattle and sheep, slowly discharging selenium over periods of a year, or more (Kuchel and Buckley, 1969). Selenium could also be added to fertilizer and spread on selenium-deficient soils, to improve the selenium content of feed or forage plants (Watkinson, 1983).

The other side of the picture

Long before selenium was recognized as a dietary essential, it had been implicated as a poisoner of livestock. Cavalry horses stationed at Fort Randall, in what was then the Nebraska territory, about mid-19th century, suffered from an unexplained condition that caused lameness, cracking of the hoof tissue, and loss of hair. Then, in 1934, proof was presented that the cause of the difficulty was selenium, which was accumulated to toxic levels in some peculiar range plants, and subsequently consumed by the animals (Franke, 1934). Selenium is thus extremely active metabolically, and may cause problems at both ends of the supply spectrum. Most nutrients behave similarly, but for selenium the range of safety is narrower than most others. Animals eating grains or forages that contain five to forty mg. of Se per Kg over a period of a month or more, exhibit chronic selenosis, which is popularly called "alkali disease" (NRC, 1983). Such problems are generally confined to areas of seleniferous soils and are prevented by eliminating the causative feed, or diluting it with low-Se material.

The problem of selenium toxicity regained public attention in an unusual set of circumstances that occurred in the San Joaquin valley of north-central California in 1983. Wildlife scientists noted cases of deformed young in nests of waterfowl in the Kesterson Wildlife Refuge, at the north end of the valley (Ohlendorf, et al, 1986). Analyses of water, insects and small fish to which the wild birds were exposed, showed unexpectedly high levels of selenium, and the problem was diagnosed as selenium toxicity. The initial source of the selenium was in the Panoche hills, a seleniferous outcrop on the southwest side of the valley. Over time, the selenium leached to the valley floor, where it was picked up in irrigation water, some of which was conveyed by the San Luis drain, to the Kesterson refuge, where it was discharged into shallow ponds. Here, evaporation concentrated the soluble salts, including selenium, and inherent insects and fish concentrated them still more, so that when the wild birds ate them, they were frankly toxic.

A local newspaper generalized upon this situation, suggesting that both animals and human diets might be compromised by excessive levels of selenium (Sacramento Bee, 1985). Investigation by the FDA revealed that calculations on which the newpaper's predictions were based, were flawed (Jacobs, 1988) and extensive analyses of agricultural products in the San Joaquin valley by University of California scientists showed that they were well within safety limits for selenium (California Extension, 1989). Interestingly, field trials conducted by the California Extension Service, near the Fresno-Tulare county line, and not far removed from the source of the high-selenium problem, showed that cattle responded positively, in terms of weight gains, when given supplementary selenium (Nelson and Miller, 1987).

Summary

Selenium is accepted, scientifically, to be an essential micronutrient for animals and humans. Extensive land areas have been recorded as selenium-deficient, both in this country and worldwide. When forages or other crops from such areas make up the major part of diets for farm animals, the animals show signs of selenium deficiency which may result in lowered growth and reproductive performance, or death. In such situations, provision of supplementary selenium to the extent of about 0.3 ppm in the total diet dry matter allows the animals to maintain a normal selenium status, with accompanying benefits in performance.

In other areas, selenium levels in soils may be excessive and animals eating crops grown on them may show signs of selenium toxicity. Concentration of selenium by evaporation of surplus irrigation water has caused toxicity problems in nesting waterfowl in the Kesterson Wildlife Refuge, in California. Evidence shows that this is a situation that is unique to the combination of seleniferous soil leaching, irrigation runoff and concentration of selenium by evaporation and acquatic life. The presently approved levels of selenium supplementation are safe and pose no threat of toxicity.

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THE RELATIONSHIP OF NUTRITION AND FERTILITY IN DAIRY CATTLE

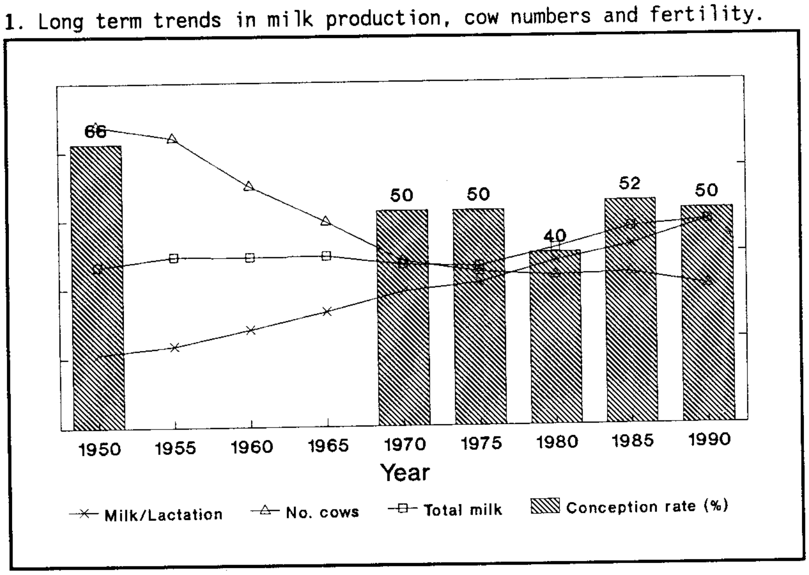
Lloyd V. Swanson

Introduction

While the milk producing ability of US dairy cows has steadily improved, we have not accomplished similar objectives in the important area of reproduction (Figure 1). First service conception rate seems to have settled in the 50% range with no sign of change. Yet we know of many herds having milk production considerably above the average and having less infertility as well (infertility will be used in this paper to mean cows which require additional services and time postpartum to achieve pregnancy). So it is possible to have both. Since the conception rate in heifers is believed to be about the same today (65%) as in the 1950's, it is unlikely that we have bred cows to be more infertile. Furthermore, just about every experiment looking at the heritability of fertility has concluded that it is at or near 0%. Not only is fertility not heritable (at least the way we presently measure it), it is not very repeatable either (about 10%). Therefore, a cow which had a difficult time conceiving this lactation may not necessarily have a difficult time conceiving her next lactation. Nonetheless as managers, the best way to select for fertility is to eliminate the poor breeders by culling.

Following parturition, several physiological systems in the cow need to return to normal before the cow is fertile again. That is why the normal recommendation is to wait 60 days before rebreeding. Rebreeding can begin as early as 45 days after calving, providing the cow had a normal delivery and no postpartum disease or metabolic disorders. However, rebreeding at 45 days will require about 0.1 additional services on the average.

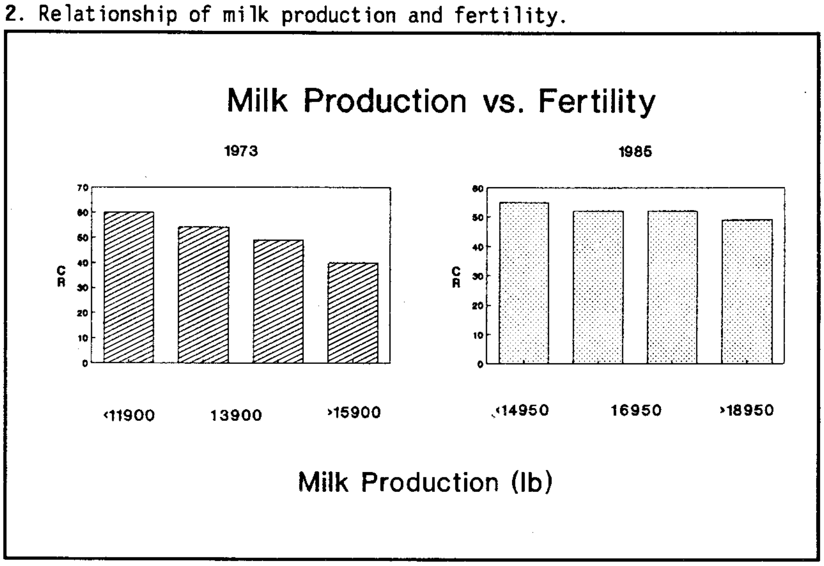
1. Long term trends in milk production, cow numbers and fertility.



So what has happened in our cow population that has contributed to this problem of infertility? As in so many other aspects of dairy production, it is likely that several factors have contributed to a higher level of infertility than we desire. And most of these factors involve management. Take, for example, our confinement housing situation where cows spend all their time on concrete. Experiments in the US have clearly shown that access to a dirt corral can result in significant improvements in fertility, at least if management is efficient in heat detection. Some managers, of course, are not. That is why about 20% of our cows are bred when they are not in heat and about 90% of the cows which managers say are anestrus are actually cycling. Having recently returned from New Zealand, I observed the difference pasture (ie. no concrete) can make in improved heat detection efficiency and heat detection accuracy. It is much less of a problem for their dairymen.

Some would claim that the level of milk production in our modern cows also contributes to infertility. Unfortunately, there are probably as many experiments showing no effect of milk production as there are which show a negative effect on fertility. As illustrated in Figure 2, it may have been true in the past that a negative correlation existed between these two factors, whereas such a relationship may or may not exist today. The problem in trying to measure fertility is that huge numbers are needed to detect true differences. Survey data are about the only way to get this quantity of data. And survey data for fertility are unfortunately confounded with management. Although we may know when postpartum rebreeding begins, thus removing that variable, we don't know the efficiency or accuracy of estrous detection in each herd.

2. Relationship of milk production and fertility.



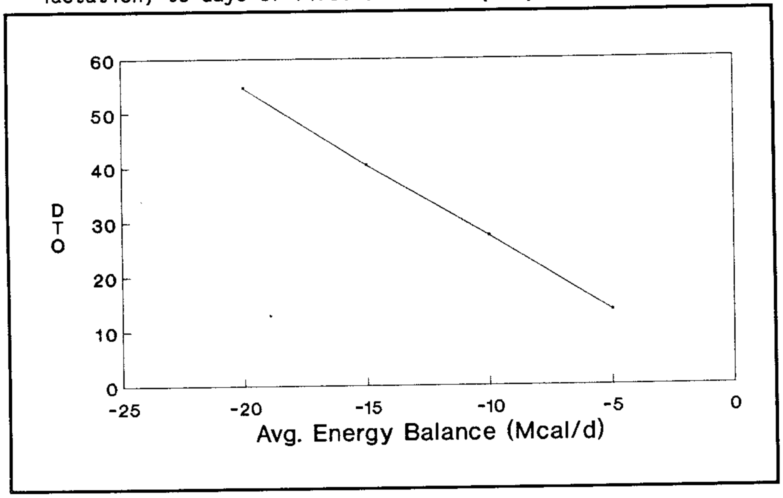
Another factor is nutrition. Improved nutrition has contributed a large portion toward the improved milk production in our cows. Fortunately or unfortunately, genetic improvement has kept pace with improved nutrition. Therefore our cows are under a severe nutritional stress during that part of their lactation when we are trying to rebreed them. Because US dairymen have intentionally selected AI sires for increased milk production, I think it is safe to conclude that they are willing to accept the consequences of increased milk production in terms of increased infertility and metabolic disorders.

Nevertheless, as managers with confinement dairies, we normally have total control over the nutrition of our cows, at least when we can purchase the feeds we desire. What are some specific ways in which the various aspects of nutrition affect fertility? This paper will examine some of those.

Effect of energy

We realize that the cow is in a negative energy balance for the first few weeks after calving. At least she should be, for that is the mark of a good producer. Excellent managers have their cows in good body condition (but not fat) at calving so that they can mobilize nutrients from their body until their appetite can match their requirements for milk production. Thereafter, we advise feeding cows above their requirements so that they can rebuild body condition during their lactation, which is more efficient than doing so during the dry period. As illustrated in Figure 3, the magnitude of the negative

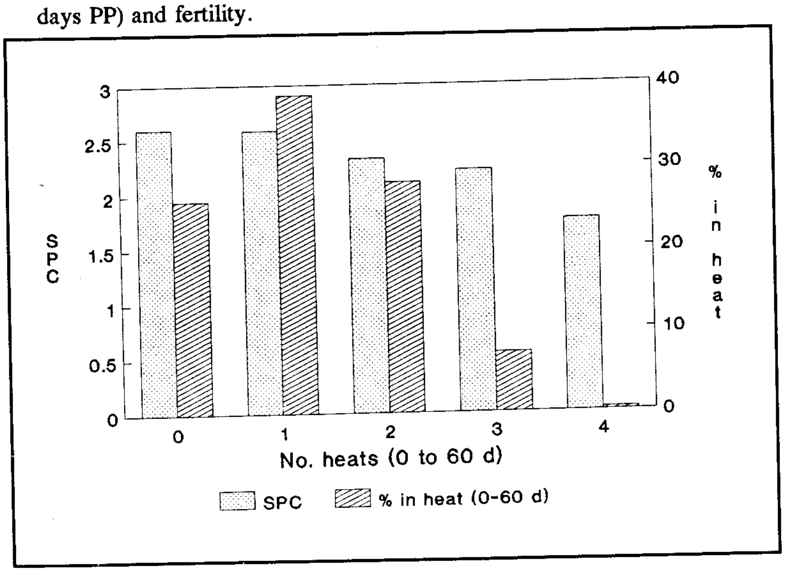
3. Relationship of energy balance (during the first 20 days of lactation) to days of first ovulation (DTO).



energy balance during is directly correlated with the interval to first ovulation. First ovulation occurs approximately 10 days after the cow reaches maximum negative energy balance and near peak lactation. It is important to realize that ovulation can and does occur during the period of negative energy balance but the chances of doing so are much improved if energy is returning toward a positive balance. And that is where dairy managers can have an important role. That is, to stimulate the cow's appetite so that the energy balance bottoms out early during the postpartum interval and begins returning toward a positive balance. The problem is that individual cows respond to a negative energy balance by different combinations of increased feed intake and mobilization of body reserves, making it difficult to predict her current status on the basis of feed intake, milk production, or weight loss. While the average cow ovulates 17 to 42 days after calving, some cows may take 75 to 100 days or longer. This may have a direct affect on fertility as it has been shown that the more times a cow cycles before breeding, the higher her fertility will be (Figure 4).

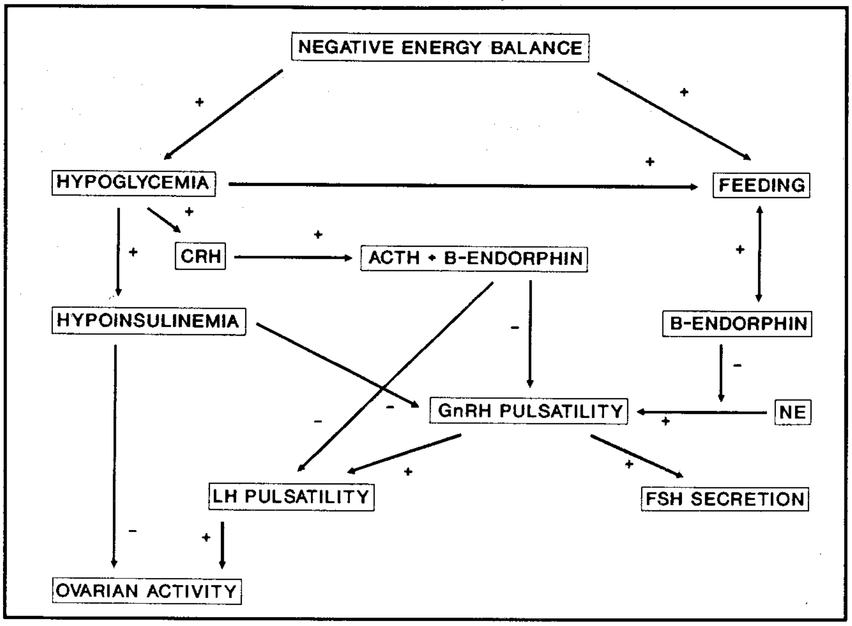
A negative energy balance may have a direct affect on the reproductive hormones, especially luteinizing hormone (LH). Recent experiments have shown that a lack of glucose (ie. energy), resulting in hypoinsulinemia, may directly inhibit LH. Another possibility involves a group of hormones synthesized in the brain, the opioid peptides. Release of these peptides is stimulated by an increased appetite which occurs in early lactation. Since these peptides inhibit LH pulses, one of the reasons cows in early lactation don't cycle is that their appetite is increasing at this time, thereby indirectly inhibiting LH pulses.

4. Relationship of postpartum estrous cycles (number of cycles prior to 60 days PP) and fertility.



A working model of these interactions is shown in Figure 5. Note the factors impinging on LH pulsatility (actually they first impinge on GnRH pulsatility-GnRH is synthesized in the brain; it is a precursor of LH.

5. Effects of negative energy balance on reproductive hormones.



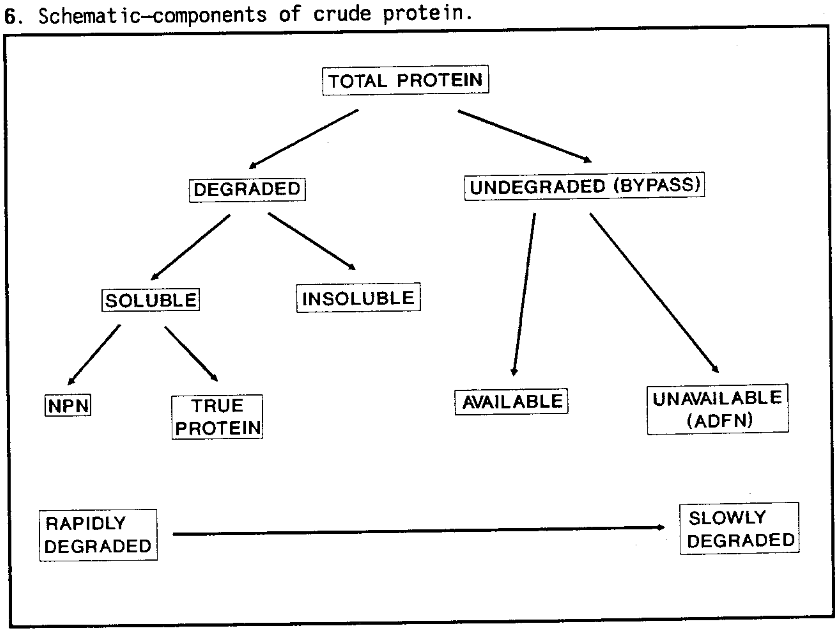
You're familiar with GnRH through the use of Cystorelin, a synthetic GnRH, namely β-endorphin (an opioid peptide) and possibly the presence of ketones (ketosis) or lack of insulin (negative energy balance). Increased uptake of glucose by the udder for milk synthesis lowers insulin, which directly stimulates appetite. Low insulin levels also stimulate fat mobilization (lipolysis) which stimulates appetite, while high levels of ketone bodies may inhibit GnRH pulsatility. Increased feed consumption would be associated with increased release of β-endorphin, inhibiting the GnRH pulse system. An additional factor recently developed is the direct effect of insulin on the ovary.

Should this turn out to be true, it may be able to be circumvented by administering substances to prevent the release of opioid peptides. It remains to be seen how important each of these factors are in the overall problem of postpartum infertility. But, as stated at the beginning, it is likely a combination of these factors which renders the cow less fertile. Let me conclude this section by saying that the proper feeding of the dry cow and fresh cow will only become more critical as milk production continues to climb.

Protein

As milk production continued its upward climb, nutritionists began to realize that simply feeding the cow more protein wasn't the answer. The rumen microbes can only metabolize (capture) so much nitrogen; any additional nitrogen is excreted as urea. This is not only wasteful and expensive but also contributes toward infertility. High producing cows require more protein than can be provided by the rumen microbes. Protein feeding has become a complex art in the new NRC requirements for dairy cattle. I say "art" because some of this is still theory and few feedstuffs have been analyzed for the various protein components. The protein component everyone is familiar with is undegraded or bypass protein (Figure 6). Feeding bypass protein gets around the microbe limitation by delivering some of the protein to the small intestine where it is broken down to amino acids and utilized directly by the cow. Bypass protein is especially important during the first 12 weeks of lactation. During this period, rations should contain 17 to 18% crude protein with 40% of the protein in the bypass form. By-product proteins that have undergone heat treatment during processing are good sources of bypass protein (ie., distiller's dried grains, corn gluten meal, blood meal, meat and bone meal, fish meal).

6. Schematic—components of crude protein.



Rations high in crude protein but low in bypass protein may contribute towards infertility by causing high levels of toxic by-products of protein metabolism in the blood and tissues. Examples of these toxic by-products include ammonia and urea, both of which are known to be harmful to sperm and ova. Case studies have been published where a significant improvement in fertility occurred after dietary total protein was decreased while bypass protein was increased, resulting in lower blood levels of urea.

Protein feeding is also tied in with the energy content of the ration. Feeding excess bypass protein in a ration low in energy will likely result in decreased fertility because in that situation the excess amino acids (from bypass protein) may be converted to urea. Age of the cow is another important factor. Excess bypass protein may not depress fertility in an older cow whereas it may in younger cows which are partitioning nutrients for growth. Furthermore, younger cows usually do not respond with increased milk production when fed additional dietary protein as do mature cows.

Dietary protein may also affect fertility through the reproductive hormones. Midcycle levels of progesterone during the cycle prior to breeding have been related to fertility. Rations low in energy may contribute to lower progesterone levels and specific protein sources, such as soybean meal and urea, may influence progesterone levels. Insulin, discussed earlier, may stimulate progesterone synthesis; a ration deficient in energy would lower blood insulin levels.

In summary, mature high producing cows fed a ration containing 20% crude protein, of which only 30% is bypass, would be predicted to have lower fertility, whereas a ration lower in crude protein (18%) but with 40% as bypass protein would be predicted to have normal fertility. It has been estimated that the first scenario might cost $60 per cow in terms of lowered fertility and extra protein which is wasted.

Vitamins and minerals

It is unlikely that gross deficiencies of vitamins or minerals will occur in dairy herds, at least in the well managed/high producing herds. But borderline deficiencies are a distinct possibility, either because of improperly balanced rations or because the fresh cow has not as yet developed a full appetite during the postpartum period. Such deficiencies may express themselves in terms of infertility.

Because these deficiencies are borderline, research findings have been difficult to interpret. For example, under some circumstances, supplementation of rations with ß-carotene, niacin, selenium, zinc or vitamin E has increased reproductive efficiency. Reproductive tissues and hormone systems may be limited by nutritional deficiencies during critical time periods, such as during peak milk production when we are trying to breed cows which are just beginning to achieve a full appetite. This would be especially important in the first lactation heifer which requires nutrients for growth as well for as milk synthesis.

ß-carotene is a precursor of vitamin A and the standard conversion is assumed to be 1 mg ß-carotene=400 IU vitamin A. This assumption may be oversimplified in that the conversion ratio is dependant on forage quality and the combination of feedstuffs in the ration. Recent research has sought to determine if ß-carotene has a role in reproductive function aside from being a precursor of vitamin A. When supplemental ß-carotene has been effective in improving reproductive function, it has expressed itself in terms of increased estrous intensity, increased conception rate, decreased services per conception, decreased days open and a decreased incidence of cystic ovaries. Concentrations of ß-carotene are high in the blood, follicular fluid and corpus luteal tissue. Therefore, scientists have assumed that ß-carotene may have a role in corpus luteum function, specifically in the synthesis of progesterone. But ß-carotene supplementation is usually ineffective unless a deficiency of ß-carotene or vitamin A exists in the ration.

Vitamin E and selenium are generally included in rations for their antioxidant effect (especially if the ration contains added fat) as well as for their role in reproduction. In addition, they each have a sparing effect on each other and they both may have a role in the immune defense system of the cow. The most typical reproductive response for which they are used is retained placenta. A positive response has been achieved in herds having a high incidence of retained placentas or when selenium or vitamin E were limiting in the ration. The mechanism is not clear but it may involve their antioxidant roles or their effect on prostaglandin synthesis.

Vitamin D, phosphorus and calcium are involved in reproductive function but normally are not limiting. Vitamin D may have a role in regulation of calcium and calcium binding proteins in reproductive tissue, including the ovary, uterus, placenta and pituitary. And we're all familiar with the role of calcium in dystocia, retained placenta and milk fever. Clinical manifestations of phosphorus deficiencies relative to reproductive function are not normally evident until after other signs of phosphorus deficiencies are evident.

Currently there is interest in supplementing dairy rations with niacin, choline and thiamine, even though they are normally supplied through rumen bacterial synthesis. However, a clear role for these B vitamins in the reproductive process is not known at this time. Zinc is sometimes supplemented in dairy rations. Zinc has an essential role in many enzyme systems in the cow, several of which may involve synthesis of the ovarian hormones, estrogen and progesterone. There is very limited evidence that zinc supplementation may enhance conception rates. Optimal amounts of zinc in the ration for reproductive functions are not known. Copper deficiencies have long been known to exist in the northwest. In addition to clinical deficiency symptoms of anemia and impaired growth, copper may have a role in expression of behavioral estrous. Availability of copper is reduced by an excess of other minerals such as sulphur, iron, calcium, zinc, and molybdenum. The mechanism by which copper may interact with the reproductive system is unknown. Iodine is involved through its function in the thyroid gland and body metabolism.

In conclusion, vitamins and minerals do affect the reproductive system in dairy cattle. Previous research has shown a role for several vitamins and minerals in reproductive function when they were deficient in the diet. However, borderline deficiencies are new territory. It remains to be shown if specific reproductive roles for these various vitamins and hormones exist under conditions of borderline deficiencies. Another complication is that the rations we are feeding our modern high producing cows are quite different from those previously fed when the classical deficiency experiments were done. Furthermore, many of the previous studies were not done with lactating dairy cattle. Despite having what we believe to be adequate levels of vitamins and minerals in the ration, their availability may be open to question as rations with higher densities and higher proportions of concentrates are fed and as the rate of passage speeds up as greater amounts of dry matter are fed. The nutritional relationship to reproduction is a new field of research in dairy cattle with ample room for new discoveries.

CONSIDERATIONS IN BREEDING EWE LAMBS

James M. Thompson

The breeding of ewes to lamb at one year of age is a management practice that can increase production efficiency for many sheep producers. Many producers are successfully following this practice in their sheep operations. Likewise, there are those who have tried the practice but have discontinued it due to unsatisfactory results. In order for the practice to be successful it requires high level management and must fit the sheep production system of a given farm or ranch.

In order to achieve maximum performance when breeding ewe lambs producers need to consider such factors as ewe breed, nutrition, and mating management.

Breed

In order to be successful in breeding ewe lambs, breed is an important consideration. Among the various breeds, differences exist with regards to age when first estrus is exhibited. A review by Dyrmundsson (1973) showed that the incidence of estrus the first year of life ranged from 0-100% for various breeds with the mean value for the first estrus being 6-18 months in age. For many breeds there appears to be great variability among individuals of the same breed. In addition, genetic effects on puberty are obscured due to environmental factors such as nutrition and season of birth (Dyrmundsson 1987).

Early maturing breeds and crossbred ewe lambs tend to have better reproductive performance when bred as ewe lambs. Producers may want to consider this when evaluating this practice in their flocks.

Nutrition

Nutritional programs for growing and developing ewe lambs are important to the success of a ewe lamb breeding program. It has been well documented that ewe lambs placed on higher nutritional levels reach puberty and exhibit estrus sooner than those on a lower plane of nutrition. (Burfening et al., 1971; Jordan et al., 1970). Placing ewe lambs born late in the lambing season on a high plane of nutrition will aid in bringing them into estrus their first year (Moore and Smeaton, 1980).

The desirable weight for ewe lambs to be when exposed to rams at 7 to 8 months will vary by breed depending upon mature size. Some sheep producers indicate they should be least 100 pounds while 80 pounds was found to be a minimum weight (Thompson et al., 1976). Perhaps a better criterion for determining breeding weight would be percentage of mature weight attained at breeding. Suggested weights for ewe lambs should be 60-65% of expected mature size before breeding and 75% of mature size at lambing. In order to attain these weights ewe lambs will have to gain from 1/3 to 1/5 pound per head daily from weaning to breeding. Flushing does not appear to have a clear cut effect on ewe lambs (Allen and Lamming, 1961).

Although increased levels of nutrition result in advancing puberty in most ewe lambs, the feeding of very high energy diets prior to breeding may result in increased barrenness in ewe lambs (Stoerger et al., 1976). Umberger et al. (1985) found that a high plane of prepubertal feeding impaired mammary gland development and first lactation milk yield. All this suggests that the nutrient requirements of ewe lambs need to be more clearly determined to avoid overfeeding as well as underfeeding if they are to be exposed at 7-8 months of age.

Nutrition and management of the young ewe following lambing until the next breeding season is especially important to avoid a high number of open ewes for the second breeding period. This is an area where many producers have become dissatisfied with breeding ewe lambs and thus have discontinued the practice.

Nothing special is required during this period except that early weaning following the first lamb crop is recommended. This will allow the now-yearling ewe to recuperate and continue growing toward her mature weight. It is recommended that ewes reach at least 80% of expected mature weight by the next breeding season.

Mating management

Other than nutrition, proper management of the ewe flock at mating can also have a positive impact on the results of mating ewe lambs. Ewe lambs should be mated to lamb after the mature flock to allow special attention to the younger ewes at lambing time.

Ewe lambs exhibit weaker signs of behavioral estrus and exhibit estrus of shorter duration than mature ewes (Edey et al., 1978). Therefore ewe lambs in heat will make little effort to approach the ram or accept services of the ram when he makes his sexual advances. Based on this behavior, it is recommended that ewe lambs be bred separately from mature ewes. Maturing in a confined area with a high ram to ewe ratio may also enhance the results obtained from mating ewe lambs.

The so-called "ram effect" has produced mixed results in synchronization of estrus and advancing puberty in ewe lambs (Dyrmundsson 1987).

If the breeding of ewe lambs does not fit a particular management system, producers may want to still reap the benefits associated with higher subsequent reproduction from ewes that exhibit estrus as ewe lambs. Vasectomized rams equipped with marking devices could be placed with ewe lambs and colors changed every 16 days. Lambs exhibiting the greatest number of estrous cycles their first year could be saved for replacements (Levine et al., 1978).

If the breeding of ewe lambs is to be part of a sheep operation, every effort should be taken to insure that production efficiency is achieved. It will require additional inputs in the form of feed and labor if it is to be successful. Likewise, the increased output must pay for the added inputs. This will only occur if a high level of lambs are produced and marketed from ewe lambs that are bred. In addition, performance of the ewe lambs in subsequent lambings must not be decreased nor should the practice of breeding ewe lambs detract from the production efforts of the mature ewe flock.

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NATIONAL SIRE SUMMARY DATA AS A SELECTION TOOL

W. A. Zollinger

Genetic improvement of breeding stock has been the goal of cattle producers for centuries. The desire to select superior animals as seedstock has lead to several traditions in the beef industry. Much of the heritage of old west cattle history in the U.S. revolves around the change from the native cattle to the "meatier" domestic cattle resulting from importation of cattle from Britain. The showring was established as the selection place for superior breeding animals. As the value of different production traits was recognized, producers attempted to quantify those traits, i.e. measurement by a weigh scale.

The worth of individual animals were compared using within herd ratios. Thus, an animal's relative worth was measured as a percentage difference from the herd average. With the advent of the computer (in the 60's and 70's), breed associations began to report and use estimated breeding values (EBV's) as a numeric representation of an animal's genetic worth. EBV is a systematic way to combine the information of heritability with the performance of relatives and progeny to define an animal's breeding value. This procedure increased the accuracy of selection over that achieved through phenotypic (visual appearance) selection. While individual performance records increased the accuracy of selection within a herd, they did little to assist the breeder trying to select bulls from the total population. Within herd comparisons are useful for selection of replacement females, but breeders wanting to make maximum genetic progress need to be able to compare and select superior bulls from the entire population.

Expected Progeny Difference (EPD)

Advances in computer technology led to the ranking of non-parent bulls and heifers in the total population. The "Reduced Animal Model" procedure which produces expected progeny difference (EPD) and estimates accuracies (ACC) requires a large computing base. Estimates use all available progeny and performance records of close relatives. EPD's can be calculated for bulls and cows with progeny and all non-parent bulls and females with legitimate records. Non-parent bull and female EPD calculations combines the individual performance and all collateral relative performance. Primary ancestral information going into young non-parent EPD calculations comes from the animal's sire and dam. Procedures for these calculations are very complex and difficult to understand. Producers should not be concerned about the formulas or calculations but should begin to use the information in making replacement selections. The dairy industry has used this approach successfully for years in their breeding programs.

Most beef breed associations are now using National Sire Evaluation Data to provide EPD's based on comparison of the progeny performance of bulls by using reference sires. This breeding plan allows for comparative results in different herds and environments. One of the limitations of this approach is the measurable traits involved in the reports. Most sire summary reports will include birth weight, weaning weight, yearling weight and maternal ability (milking ability) estimates for the bulls. Some group reports will add calving ease scores, carcass traits or combinations of these traits.

Not all producers will select for one or more of these traits directly. Growth traits are positively genetically correlated to each other, thus, selecting for an increase any one trait will increase the other weights also. For example, an increase in weaning weight is usually associated with an increase in birth weight. Calving ease decreases as birth weight increases (negative genetic correlation). Thus, by selecting for weaning weight alone, a producer selects indirectly for increased calving problems. It is not the intent of this paper to define selection criteria but to show the usefulness of EPD's when selecting sires (and daughters) for herd replacements. By studying EPD's of different sires we might avoid some of the pitfalls inherent in situations as described above.

EPD's reflect the expected results from using different sires and are based on the average of the population. The calculations must be made with a reference population as a base and a designated year each time they are estimated. The reference population year may change from time to time. Thus, year to year the EPD values may change and the average may not be zero. A review of the printed sire summary describes these changes and averages. Thus, the major use of EPD's may be to compare two or more individuals for relative merit and not to be used as absolute values of genetic worth. For example, two bulls each appear to be functionally sound. The EPD's are +35 and +15, respectively. The first bull is expected to produce calves 20 lbs. heavier than is the second bull. The progeny would be 35 lbs. or 15 lbs., respectively, heavier at weaning than the average in the reference breed. If on the other hand they are mated to cows above average in performance, then the magnitude of the increased weight would be smaller. However, the 20 lbs. difference in progeny performance between the two bulls should be constant.

Bulls can be evaluated and their utility defined relative to EPD groupings. The top 5% of bulls in a breed are the elite group and should be used in purebred herds for maximizing growth in the foundation stock of the industry. This group of bulls has the highest chance of being the superior sires of the future. The next group of bulls (50-60% of total bulls) include those that will increase growth in the commercial cattle population. Those grouped below these levels of EPD would not be useful as sires to increase weights.

An antagonism exists between many of the economically important traits in beef cattle. Different segments of the industry has different priorities of important traits which is confusing to a cow-calf producer at the beginning of the production chain. Each producer needs to identify those traits most important to his management and marketing program. The total production ideal probably does not exist. Once the production goals are clearly stated, a producer can develop an effective selection strategy involving EPD's.

A breeder needs to balance traits when using EPD's. The production goals of a producer might be to improve weaning weights without large changes in either yearling weight (for replacement female mature size) or birth weight (to reduce calving difficulty). Because the genetic correlation between the three traits is positive, the expected increase in weaning weight is lower than if selection is only for this one trait. There are bulls that fit this criteria.

Thus, different breeders will select different sires to meet their breeding objectives.

Maternal EPD's

Maternal EPD predicts the weaning weight performance of a sire's grand progeny which is an indication of the value of his daughters as replacements in the cow herd. Weaning weight is the result of the genetics for growth and the ability of the dam to produce milk. An individual receives one-half of the genetics to grow from each of its parents. Thus, the estimate for a grand-progeny to grow is one-half of the grandsire's EPD for weaning weight. The estimate of Maternal EPD is the sum of one-half the EPD weaning weight plus the EPD for milk. If an estimate can be made for two values, the third is easily calculated.

Maternal Milk EPD describes how daughters of a bull are expected to produce milk compared to other cows in the reference population. An estimated value can be calculated for an unproven bull using production data on daughters of his sire and paternal and maternal grandsires plus his dam's progeny. Once a bull's own daughters come into production the value is calculated using the records of his own daughters in addition to those of his sire and paternal and maternal grandsires.

An example* of sire selection

The selection procedure used depends on whether a producer's goal is to obtain maximum gain in a single trait or improve two or more traits simultaneously. The more traits a producer selects for, the less improvement expected in any one trait. However, when net profit is considered, maximization of a single trait without concern for other traits may be costly. The following mini-summary (Table 1) and selection examples (Table 2) illustrate how the Sire Summary can be used for production different goals.

Table 1. MINI SIRE SUMMARY

Sire	Birth		Weaning		Yearling		Carcass Cutability		Marbling Score		Lean Yield		Maternal	
	EPD	ACC*	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC	EPD	ACC
A	+1.5	.80	+33.5	.86	+52.1	.80	+.214	.63	+.061	.63	+3.2	.70	+23.2	.88
B	+5.6	.75	+39.1	.85	+65.2	.78							+12.8	.85
C	+8.5	.71	+45.2	.82	+80.6	.75	+.352	.65	-.631	.65	+8.5	.72	-5.0	.91
D	-0.5	.73	+24.3	.78	+42.0	.75							+28.0	.90

*ACC = Accuracy of the estimated EPD. Indicates the reliability of the EPD

Breeder No. 1 (table 2) has decided to maximize growth regardless of birth weight or maternal performance and thus has chosen Sire C. Breeder No. 2 wishes to improve growth while maintaining an adequate level of maternal performance. His choice is Sire B. Breeder No. 3 wants to improve growth and maternal performance while minimizing increases in birth weight. Sire A is his choice. Breeder No. 4, who wants to improve maternal performance, maintain acceptable growth and reduce birth weights, selected Sire D. Many combinations of selection criteria are possible, including carcass data which were left out in the above example for the sake of simplicity. Unless selection criteria are very strict, several bulls in the Sire Summary will meet your standards.

Table 2. SOME SELECTION EXAMPLES

Breeder No.	Selection Goals	Birth EPD	Weaning	Yearling	Maternal EPD	Bull Selected
1.	Maximize growth	none	maximize	maximize	none	**C**
2.	Improve growth and maintain adequate maternal performance.	none	+35.0	+60.0	+10.0	**B**
3.	Improve growth, improve maternal performance, minimize increase in birth weight.	+3.0	+30.0	+50.0	+20.0	**A**
4.	Improve maternal performance, reduce birth weight, maintain acceptable growth.	0.0	+20.0	+35.0	+25.0	**D**

* 1985 Polled Hereford Sire Summary, pg. 3

Accuracy of EPD Estimates

Whenever an estimate such as EPD is calculated, there is some degree of probability that the estimate is correct and an offsetting chance it is not accurate. Each association reports an accuracy figure (ACC) for each individual estimate which is an expression of reliability of the EPD. Values for ACC can range from 0.0 to +1.0 where higher values indicate greater reliability.

The ACC values for EPD's can be categorized as estimates with low, medium or high reliability.

Reliability	ACC of EPD
Low	Less than .64
Medium	.65 to .75
High	.76 or more

Accuracy values for EPD's on bulls without progeny will not be as high as values for bulls with progeny. As the number of progeny records increase, so will reliability of the estimate of accuracy increase. A young bull's EPD accuracy is about .35 and can change as progeny records are added. When adequate progeny records are available, the accuracy will quickly exceed .76 and, as such, indicates that the EPD's are reliable and little change should be expected in the estimate.

Standard Error

A brief description of the statistical term "standard error" might help us understand what is happening. Standard error indicates the magnitude of the expected changes in particular estimates. Remember the estimates are specific to a breed. This is illustrated, by using data from the American Hereford Association Sire Summary for 1986.

Table 3. American Hereford Standard Error of Genetic Traits at Two Accuracy Levels (lbs)

	Standard Error	
Trait	.35 Acc	.90 Acc
Birth Weight	± 3.0	±0.4
Weaning Weight	±15.0	±2.5
Yearling Weight	±23.0	±3.5
Milk	±15.0	±2.2

If a group of young bulls all +30 lbs. for weaning weight are selected for use, 68% of the actual breeding values of these bulls will be within a range of +15 to +45 pounds EPD (within one standard error of the predicted value). Almost all (98%) would be within a ± two standard error units (0-60 lbs) when progeny proven. Predicted EPD's on young bulls can change over time as progeny records are added.

However, on older bulls the standard error ranges are much narrower. The true progeny difference for a proven bull with an ACC of .90 and a weaning weight EPD of +30 is within the range of +25 to +35 pounds. A breeder understanding that estimates can change over time can group the bulls and select on price if genetics are similar.

While the estimated EPD accuracy values for non-parent bulls appears to be low, their estimates are still more usable than within herd ratios or breeding values.

Summary

Producers now have the information to make a more accurate selection of breeding cattle than has ever before been available. The opportunity for breed improvement is directly on the breeders. Breeders who mate the right bulls with the right cows will be the breeders with successful programs and will be those who move the breed forward. The only way a breed can move ahead is by getting a high percent of the cows within that breed bred to superior bulls. The top bulls in the breed should be used on a wide scale to insure genetic improvement.

EPD's are also an important tool for commercial cattle producers. The criteria for selection of the herds an individual uses as sources of bulls indicate the genetics one is buying. If a commercial breeder is concerned about birth weight, and the seed stock producer is concerned with maximum weaning weight response, that herd may not be a good source of genetics for this commercial breeder. Thus, a commercial breeder can select herds as well as individual bulls for genetic material. The use of these tools (EPD's) in selection can help the purebred breeder reach production goals more rapidly. Also, the commercial producer can make selection of seedstock based on fact and not just guesswork as the "eye" sees it. Each producer can gain insight into the genetics of selected breeding stock by using these selection aids.

Table 4. NATIONAL BEEF CATTLE ASSOCIATIONS WITH SIRE SUMMARIES

ANGUS - American Angus Assn. Richard Spader, Ex. V. Pres., 3201 Frederick Blvd., St. Joseph, MO. 64501

BRAHMAN - American Brahman Breeders Assn. Wendell Schronk, Ex. V. Pres., 1313 LcConcha Lane, Houston, TX 77054

BRANGUS - International Brangus Breeders Assn. Jerry Morrow, Ex. V. Pres., 5750 Epsilon Dr., Box 69620, San Antonio, TX 78249-6020

CHAROLAIS - American International Charolais Assn. Joe Garrett, Ex. V. Pres., 11700 N.W. Plaza Circle, Box 20247, Kansas City, MO 64195

CHIANINA - American Chianina Assn. Robert Vantreose, Exec. Off. P.O. Box 890, Platte City, MO 64079

GELBVIEH - American Gelbvieh Assn. Exec. Dir., 5001 National Western Drive, Denver, CO 80216

HEREFORD - American Hereford Assn. H.H. Dickenson, Ex. V. Pres., 715 Hereford Dr., Kansas City, MO 64105

LIMOUSIN - North American Limousin Foundation, Greg. Martin, Exec. V. Pres., 100 Livestock Exchange Building, Denver, CO 80216

MAINE-ANJOU - American Maine-Anjou Assn. Steve Bernhard, Exec. Sec., 567 Livestock Exchange Bldg., Kansas City, MO 64102

POLLED HEREFORD - American Polled Hereford Assn. T.D. Rich, Pres., 4700 E. 63rd St., Kansas City, MO 64130

RED ANGUS - Red Angus Assn. of America. Betty Grimshaw, Exec. Dir 4201 I-35 North, Denton, TX 76201

SALERS - American Salers Assoc. Steve Strohm, Dir. Breed Services 5600 S Quebec St., Suite 220A

SHORTHORN - American Shorthorn Assn. Roger Hunsley, Ex. Sec., 8288 Hascall St., Omaha, NE 68124

SIMMENTAL - American Simmental Assn. Earl Peterson, Ex. V. Pres., 1 Simmental Way, Bozeman, MT 59715

TABLE 5. PERFORMANCE TERMS

ACCURACY (of selection) - Correlation between an animal's unknown actual breeding value and a calculated estimated breeding value.

BEEF IMPROVEMENT FEDERATION (BIF) - A federation of organizations, businesses, and individuals interested or involved in performance evaluation of beef cattle. The purposes of BIF are to bring about uniformity of procedures, development of programs, cooperation among interested entities, education of its members and the ultimate consumers of performance evaluation methods, and to build confidence of the beef industry in the principles and potentials of performance testing.

BREEDING VALUE - Value of an animal as a parent. The working definition is twice the difference between a very large number of progeny and the population average when individuals are mated at random within the population and all progeny are managed alike. The difference is doubled because only a sample half (one gene of each pair) is transmitted from a parent to each progeny. Breeding value exists for each trait and is dependent on the population in which the animal is evaluated. For a given trait, an individual can be an above-average producer in one herd and a below-average producer in another herd.

COLLATERAL RELATIVES - Relatives of an individual that are not its ancestors or descendants. Brothers and sisters are an example of collateral relatives.

CONTEMPORARY GROUP - A group of cattle that are of the same breed and sex and have been raised in the same management group (same location on the same feed and pasture). Contemporary groups should include as many cattle as can be accurately compared.

CORRELATION - A measure of how two traits vary together. A correlation of +1.00 means that as one trait increases the other also increases -- a perfect **positive** relationship. A correlation of -1.00 means that as one trait increases the other decreases -- a perfect **negative**, or **inverse**, relationship. Correlation coefficients may vary between +1.00 and -1.00.

CULLING - The process of eliminating less productive or less desirable cattle from a herd.

DYSTOCIA (calving difficulty) - Abnormal or difficult labor causing difficulty in delivering the fetus and/or placenta.

EFFECTIVE PROGENY NUMBER (EPN) - An indication of the amount of information available for estimation of expected progeny differences in sire evaluation. It is a function of number of progeny but is adjusted for their distribution among herds and contemporary groups and for the number of contemporaries by other sires. EPN is less than the actual number because the distribution of progeny is never ideal.

ESTIMATED BREEDING VALUE (EBV) - An estimate of an individual's true breeding value for a trait based on the performance of the individual and close relatives for the trait. EBV is a systematic way of combining available performance information on the individual, brothers and sisters of the individual, and the progeny of the individual.

EXPECTED PROGENY DIFFERENCE (EPD) - The difference in performance to be expected from future progeny of a sire, compared with that expected from future progeny of the average bull in the same test. EPD is an estimate based on progeny testing and is equal to one-half the estimate of breeding value obtainable from the progeny test records.

FRAME SCORE - A score based on subjective evaluation of height or actual measurement of hip height. This score is related to slaughter weights at which cattle will grade choice or have comparable amounts of fat cover over the loin eye at the 12th to 13th rib.

GENERATION INTERVAL - Average age of parents when the offspring destined to replace them are born. A generation represents the average rate of turnover of a herd.

GENETIC CORRELATIONS - Correlations between two traits that arise because some of the same genes affect both traits. When two traits, (i.e., weaning and yearling weight) are highly correlated to one another, successful selection for one trait will result in an increase in the other trait. When two traits are negatively and highly correlated (i.e., birth weight and calving ease) to one another, successful selection for one trait will result in a decrease in the other trait.

MATERNAL VALUE FOR BULLS - Maternal data (EPD's) is an estimate of a sire's ability to transmit maternal traits as expressed in weaning weight of his daughters calves. The milk EPD is lbs. of weaning weight expected from a bull's daughters ability to produce milk. However, these daughters pass along some additional growth genes to their offspring other than milking ability. The maternal EPD is the total amount of weaning weight expected from a bull's daughters from both milk production and growth potential.

NATIONAL SIRE EVALUATION - Programs of sire evaluation conducted by breed associations to compare sires on a progeny test basis. Carefully conducted national reference sire evaluation programs give unbiased estimates of expected progeny differences. Sire evaluation based on field data rely on large numbers of progeny per sire to compensate for possible favoritism or bias for sires within herds.

NUMBER OF CONTEMPORARIES - The number of animals of similar breed, sex, and age, against which an animal was compared in performance tests. The greater the number of contemporaries, the greater the accuracy of comparisons.

PARTURITION - The act of giving birth; calving.

PERFORMANCE DATA - The record of the individual animal for reproduction, production, and carcass merit. Traits included would be birth, weaning and yearling weights, calving ease, calving interval, milk production, etc.

POSSIBLE CHANGE - The variation (either plus or minus) that is possible for each expected progeny difference (EPD). This measurement of error in prediction or estimation of EPD decreases as the number of offspring per sire increases.

PUBERTY - The age at which the reproductive organs become functionally operative and secondary sex characteristics begin to develop.

RATE OF GENETIC IMPROVEMENT - Rate of improvement per unit of time (year). The rate of improvement is dependent on: (1) heritability of traits considered; (2) selection differentials; (3) genetic correlations among traits considered; (4) generation interval in the herd; and (5) the number of traits for which selections are made.

REFERENCE SIRE - A bull designated to be used as a benchmark in progeny testing other bulls (young sires). Progeny by reference sires in several herds enable comparisons to be made between bull not producing progeny in a common herd(s).

SEEDSTOCK BREEDERS - Producers of breeding stock for purebred and commercial breeders. Progressive seedstock breeders have comprehensive programs designed to produce an optimum or desirable combination of economical traits.

SELECTION - Causing or allowing certain individuals in a population to produce offspring in the next generation.

SIBS - Brothers and sisters of an individual.

SIRE SUMMARY - Published results of National Sire Evaluation programs.

SECTION IV.

ONGOING RESEARCH

ALFALFA SUPPLEMENTATION OF BEEF CATTLE GRAZING WINTER SAGEBRUSH-STEPPE RANGE FORAGE

Tim DelCurto, Ray Angell, Roxane Barton and Jeff Rose
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As part of an ongoing research direction, the experiment station is evaluating the efficacy of wintering beef cattle on the sagebrush-steppe range areas of the Great Basin. This research directive is designed to evaluate alternatives to traditional winter management systems and management of sagebrush-steppe rangelands. The overall objectives of this research is: 1) to determine if grazing cattle during the winter months is a economically viable alternative to traditional hay feeding management systems and 2) to define supplementation strategies to optimize cattle performance with the use of the dormant range forage.

The current years study is evaluating graded levels of supplemental alfalfa pellets on beef cattle performance and subsequent utilization of the dormant range forage. Forty-eight pregnant Hereford x Angus cows have been blocked by age and body condition and randomly allotted to four treatments: 1) control, no supplement; 2) 1.5 kg alfalfa pellets per day; 3) 3.0 kg alfalfa pellets per day and 4) 4.5 kg alfalfa pellets per day. Feeding of the treatment supplements were initiated October 30, 1989 on an individual animal basis and will continue until February 21.

Cow weights and body condition are being recorded on a 28 day basis. In addition, forage intake, diet digestibility and quality of diet selected is being determined for 8 day periods in early December, January and February. Likewise, cow grazing behavior and distance traveled are being monitored for these periods using vibracorders and digital pedometers, respectively. At calving, cow weights, cow body condition and calf birth weights will be recorded. Just prior to breeding (early June), percent cows cycling and cow milk production will be measured. Furthermore, summer cow weights and body condition as well as calf weights and average daily gain will be taken to evaluate the influence of the previous winter supplementation strategies.

Preliminary results (day 56 of supplementation) indicate a protein response in the maintenance of cow body weight and condition. The unsupplemented cows have lost an average of 32 lbs and .30 units of body condition (scale 1 to 9), whereas the supplemented cows have all gained weight and body condition.

ENZYMATIC AND MOLECULAR CONTROL OF MUSCLE PROTEIN DEGRADATION

Neil E. Forsberg

Skeletal muscle growth in domestic animals reflects a balance between synthesis and degradation of muscle proteins. Constraints to growth are associated with both of these processes. We have been investigating the enzymatic and molecular control of degradation of muscle proteins with long-term objectives of discovering specific constraints to growth that are associated with this process.

Muscle proteins are degraded by several proteinases; however, the calpains are responsible for initiation of this process. Hence, our studies have focused on these enzymes and on control of calpastatin, the endogenous inhibitor of the calpains. To date, four species of calpains have been identified. These include μ-calpain and m-calpain, which are activated by micromolar and millimolar concentrations of calcium, respectively, n-calpain, a skeletal muscle-specific proteinase, and Hi-m-calpain, which is activated by very high calcium concentrations.

We have used a variety of models to study control of these enzymes, including fasting, glucocorticoid treatment, aging and pregnancy. To date we have discovered that calpains are regulated in a manner appropriate to changes in rates of muscle protein degradation and that these changes result from alterations in steady-state messenger RNA concentrations encoding these proteins. Future work will examine transcriptional control and mRNA stability control as means by which differential mRNA levels are maintained in the above models.

An interesting observation was that calpastatin has three mRNA species encoding it (with variations in the 3′ non-coding regions), yet one species in particular appears to be regulated in fasting. It is possible this mRNA species is selectively translated and accounts for a "stress-response" whereas remaining mRNA species may have house-keeping functions.

The long-term application of this work entails genetic engineering and other basic approaches. For example, if we determine that the inhibition of the calpains is important to control of muscle growth, we could introduce synthetic DNA consisting of muscle specific promotors and calpastatin gene into embryos and cause over-expression of calpastatin. Such an effect may reduce calpain-dependent degradation of muscle proteins and increase muscle growth.

STUDIES ON THE PREGNANT MARE AND NEWBORN FOAL

D.W. Holtan

The first study in this report focuses on the necessity for and action of chorionic gonadotropin in the pregnant mare; a monoclonal antibody was used as a tool to block the action of the gonadotropin. The second study is preliminary data from a study of newborn foals with emphasis on steroid profiles in normal and distressed foals.

Pregnant pony mares (n=4) were passively immunized with a monoclonal antibody (MAb, 5I8B7 antibovine βLH, 35 mg, i.v.) on d 45 and d 49 plus $PGF_2\alpha$ (5 mg, i.m.) starting d 45 and every 12 h until abortion was confirmed by ultrasound. Plasma equine chorionic gonadotropin (eCG) was lower (P<.05) in treated mares compared to untreated controls (n=3) on d 46, 47, 48 and 51. In treated mares plasma progesterone decreased to <1 ng/ml within 24 h and abortion occurred in 5.8 ± 1.0 d (mean ± SE). There was a tendency (P = .13) for fewer ovarian luteal structures in treated than control mares (5.2 vs 8.0, respectively) but the proportion of ovulatory corpora lutea (66%) to luteinized follicles (33%) was similar. None of the treated mares conceived to breeding at ovulatory estrus subsequent to abortion. In another experiment treatment with MAb (n=3) on d 35 (25 mg), d 36 (35 mg), d 37 (45 mg) and d 38 (55 mg) delayed the increase in plasma eCG observed in untreated controls (n=3). On d 40 eCG was still less (P<.05) in MAB treated mares (12.5 IU/ml) compared to controls (30.6 IU/ml) but increased thereafter and was not different by d 49. Plasma progesterone decreased (P<.05) in treated mares within 4 h and remained lower through 24 h (3.8 vs 7.8 ng/ml in controls). Treated mares had a higher proportion (70%) of luteinized follicles which occurred later (P<.05) in gestation (71.1 ± 4.4 d); control mares had more ovulatory corpora lutea (78%) earlier (57.7 ± 4.5 d).

In another set of experiments newborn foals were studied to determine their steroid profiles during adjustment to extrauterine life. In premature or dysmature foals, unpredictable responsiveness to ACTH therapy and abnormal plasma profiles of pregnenolone, progesterone and cortisol have been reported. The current study was designed to simulate the distressed foal syndrome by treatment with trilostane, a competitive inhibitor of 3β-hydroxysteroid dehydrogenase which is a key enzyme in conversion of pregnenolone to cortisol. In normal newborns (n=8) plasma cortisol increased from birth (79.2 ± 12.9 ng/ml) to a maximum at 30 min (94.8 ± 18.5 ng/ml), then decreased rapidly and stabilized at 24 h (11.4 ± 2.2 ng/ml). Treated foals received ACTH (.22 IU/kg bwt, i.v., n=3) or ACTH plus trilostane (10 mg/kg bwt, per os, n=5) at 4 h after birth. Cortisol (42.8 ng/ml) increased after treatment, was maximum within 1 h (123.2 ng/ml) and gradually declined thereafter. There was apparently no suppression of the ACTH-induced rise in cortisol by trilostane at this (10 mg/kg) or higher dose levels (up to 30 mg/kg). A similar treatment regimen in rats and humans is reported to effectively block cortisol production. In three distressed foals cortisol was lower at birth than in normal foals (25.2 vs 79.2 ng/ml, respectively) and showed a gradual increase over the next 6 to 24 h while that in normal foals is decreasing. Work is underway to determine profiles of pregnenolone and other progestins in normal, treated and distressed foals.

INFLUENCE OF DIETARY ENERGY ON PRE- AND POST-NATAL RESPONSES BY THE SOW AND HER OFFSPRING

Wilhelmina Kwansa, David C. England and Ching Yuan Hu

Unborn pigs grow fastest during the last three weeks of gestation, therefore, nutrients needed for their maximum growth are greater in late gestation. One of the ways this nutrient need is traditionally met is by increasing feed intake of the sow in the last few weeks of gestation. Another way in which energy needs of developing piglets may be met is through the pregnant sow converting stored fat into fatty acids; this would be expected to increase blood level of fatty acids for utilization by unborn piglets.

Our research is designed to determine whether by changing the feeding pattern of the pregnant sow, increased amounts of energy substrated are indeed made available to unborn pigs in late gestation which is the time of fastest growth and greatest need for nutrients.

The operational hypothesis is that:

1. If energy in excess of metabolic needs is stored in the sow during mid-gestation; and

2. If this fat is changed into fatty acids in response to metabolic needs in the latter third of gestation during the more rapid growth rate of the fetuses, then it can be hypothesized that increased size and vigor of newborn pigs will occur and that there will be increased supply of fatty acids to the sow with potential for production of higher energy content milk during early stages of lactation.

Forty Landrace X Yorkshire crossbred sows will be used. Twenty will be randomly allocated as controls and the remaining twenty as experimental sows. The gestation period will be divided into: First trimester (day 0-36), 2nd trimester (day 37-72) and third trimester (day 73-110). Control animals will be fed 2.0 kg (4.4 lb) per sow per day during the first two trimesters and 3.0 kg (5.5 lb) per sow daily in the 3rd trimester. The experimental sows will receive 2.0 kg (4.4 lb) per animal daily in the first term, 3.0 kg (6.6 lb) per sow per day in mid-gestation, and 1.5 kg (3.3 lb) per sow daily in the last term of pregnancy.

Effect of pattern of feeding will be monitored by:

1. Collection and analysis of blood for free fatty acids, glucose, triglycerides and glycerol.

2. Weighing of sows at beginning, mid and end of each trimester and once weekly during the first three weeks of lactation.

3. Measurement of backfat thickness on the same days of weighing.

Growth rate of piglets will be monitored by weighing at birth and once weekly to three weeks of age.

In addition, measurement will be made of percent milkfat, protein and lactose in the sow's milk from samples taken on day of farrow, 3 days, 7 days, 14 days and 21 days of lactation. Milk intake of piglets will be measured by the weigh-suckle-weigh method.

A second objective is to determine whether reduction of energy intake without changing other nutrients will affect fatty acid content of newborn piglets.

This experiment is designed to determine whether restriction in energy intake from day 105 of gestation to farrowing affects blood fatty acid content of newborn piglets. This would be expected to occur only if sow fatty acid content influences fetal blood fatty acid content.

Crossbred females are randomly allocated to two groups—control and experimental. Blood samples are collected from dams on days 105 and 112 of gestation and day 7 of lactation for determination of the same four blood metabolites as in the first experiment. Weight and backfat thickness are recorded on day 5, 105 and 112 of lactation. Piglet growth rate is recorded to 7 days of age. Milk samples are collect on day of farrowing, days 3 and 7 of lactation for similar analysis as in experiment 1.

Sows are attended at farrowing so that blood samples can be obtained from piglets prior to suckling in order that the blood sample will reflect their status of the free fatty acids.

PLASMINOGEN ACTIVATOR PRODUCTION AS AN INDEX OF BOVINE EMBRYO SURVIVABILITY

Alfred R. Menino, Jr.

Accurate determination of bovine embryo viability prior to embryo transfer would improve the efficiency of the technique by affording only the transfer of embryos that have a high probability of survival. Although several investigators have attempted to develop assays that can measure embryo viability, rapid and dependable noninvasive procedures are limited. Because of embryonic size limitations, few individuals have evaluated viability from an enzymatic perspective. Our laboratory has been investigating the enzyme, plasminogen activator (PA) which is produced by bovine embryos during 7 to 14 d of development. This enzyme is liberated in a time-dependent manner by the bovine embryo and appears to be associated with hatching; the process where the embryo divests itself of the zona pellucida.

In a recent experiment we evaluated the relationship between PA production and cell stage, cell number and changes in overall diameter in bovine embryos developing in culture. Late morulae to blastocysts (n=80) were collected nonsurgically from naturally mated, estrous-synchronized and superovulated beef cows. Embryos were cultured, one embryo per 25-μl microdrop, for 6 d. At 24-h intervals, embryos were evaluated for cell stage and transferred to fresh microdrops, media were recovered for PA analysis, and embryo diameters were measured. At the end of the culture period, embryos were fixed and stained and the cell numbers determined. Total PA production was positively correlated to embryonic size (r=.40; P<.001), developmental stage (r=.35; P=.001) and cell number (r=35; P=.005). Hatched embryos produced more total PA than embryos that did not hatch (P<.01). In addition to producing more PA over the entire culture period, embryos which hatched produced three to four times more PA 12 to 36 h before completion of this process than embryos which did not hatch. Secretion of PA during this period may indicate how successful an embryo would be in establishing a pregnancy. Although the data from the culture study are encouraging, validation of embryonic PA production as a means of predicting whether or not an embryo will result in a pregnancy following a transfer remains to be determined.

DETERMINING ECONOMIC RETURNS TO ULTRASOUND IDENTIFICATION AND PREFERENTIAL MANAGEMENT OF MULTIPLE-BEARING EWES

Howard Meyer

Ultrasound diagnostic services are being offered to sheep producers, but there is little information available by which the economics of such procedures can be evaluated. A project was initiated with the support of the Oregon Sheep Commission to determine the effects of preferential feeding of multiple-bearing ewes on lamb birth weights, survival and weaning weights, and to determine the economic return to preferential feeding of multiple-bearing ewes and thereby determine the acceptable fee a producer can pay for ultrasound diagnosis.

A total of 185 mixed-age Polypay ewes were randomly allocated to either group mating with harnessed Hampshire rams or single-sire mating to harnessed Polypay rams. Ewes were scanned with real-time linear ray ultrasound at approximately 70 days gestation to identify multiple-bearing ewes. Sixty such ewes were selected at random within mating cycle for group nutritional supplementation during the last 30 days prior to initiation of lambing. The supplemented and control groups graze identical ryegrass pastures and will receive the same basal diet when shifted to intensive management two weeks pre-lambing.

All ewes will be weighed and condition scored at ultrasound scanning, at initiation of supplementation and when shifted to intensive management. Lambing will take place during February, 1990. The numbers and weights of lambs weaned will be related to supplemental feed costs to determine the likely returns made possible by ultrasound determination of multiple pregnancies.

EVALUATION OF COOPWORTH AND POLYPAY SHEEP IN CROSSBREEDING SYSTEMS

Mohammad Nawaz and Howard Meyer

Commercial Polypay and Coopworth ewes (produced by 2-3 generations of backcrossing commercial medium wool whiteface ewes to Coopworth rams) were mated to purebred Polypay, Suffolk and imported Coopworth rams over two mating seasons to produce a total of 250 female offspring. Daughters were repeatedly group-mated to Hampshire rams to evaluate their annual lamb production capabilities from two years of age onward.

Ewe reproductive performance for the first three lambings has been reported previously and is shown in Table 1. In 1989, ewes were examined by laparoscopy to estimate the importance of ovulation rate (also shown in Table 1) as the basis for litter size differences. Results indicate a higher ovulation rate for Polypay-sired ewes and suggest possible higher embryonic success as well. Resulting litter size in 1990 will be related to the observed ovulation rates to estimate any genetic difference in uterine efficiency/embryonic loss.

Table 1. Reproductive performance of crossbred ewes.

	(Mean Litter Size (1987-89)		1989 Ovulation Rate	
Ewe's dam:	Coopworth	Polypay	Coopworth	Polypay
Coopworth	1.43	1.54	1.64(22)	1.67(46)
Polypay	1.53	1.71	1.72(25)	1.78(36)
Suffolk	1.58	1.71	1.65(23)	1.78(36)

ESTROUS SYNCHRONIZATION

Lloyd V. Swanson

Estrous synchronization products have limitations in that cows cannot be synchronized precisely enough to be bred by appointment. Until heat detection can be eliminated, estrous synchronization programs will not be completely successful. Progesten-containing devices, for example, yield better synchrony the longer they are used but fertility also decreases with length of use. Prostaglandin products don't decrease fertility but double injections must be used to obtain good synchrony which is expensive. Fertility declines when cows are bred by appointment when synchronized by either product.

The Controlled Internal Drug Releasing device (CIDR) is a plastic device which slowly releases progesterone when inserted into the vagina. It was developed recently in New Zealand and is being used by dairy producers is Australia and New Zealand. As with other progesten synchronization programs, fertility declines when CIDR's are used for longer than 12 to 14 days. The majority of cows return to estrus in 48-72 hr after removal of the device.

We recently conducted an experiment where heifers were synchronized with CIDR's for 10 to 17 days in an attempt to determine why fertility decreases with extended use of these devices. Follicular waves were monitored by ultrasound every other day and blood levels of progesterone and estradiol were followed as well. The five treatments were: 1) control, 2) CIDR for 10 days, 3) CIDR for 17 days, 4) CIDR for 10 days + a new CIDR for an additional 7 days, and 5) CIDR for 10 days with the CL present. Prostaglandins were administered upon CIDR insertion for treatments 2-4 so that a functional CL was not present during synchronization whereas the CL was present with the CIDR in treatment 5 - prostaglandins were injected upon removal of the CIDR.

Follicle size was assigned to 3 categories: small (3-5 mm), medium (6-9 mm) and large (>9 mm). The number and size distribution of follicles present during and following synchronization was not affected by treatment. However, large follicles persisted for long time periods when CIDR's were used with no CL present (ie. prostaglandins administered at CIDR insertion). Large ovulatory size follicles normally do not persist for more than 3-5 days. We observed large follicles persisting for as long as 22 days, although this did not vary with length of CIDR use. Therefore, we were unable to relate the infertility associated with CIDR use for 17 days with the treatments we imposed. A major difference we did observe was that large follicles did not persist when the CL was present, ie., follicular waves continued.

Serum progesterone was significantly higher in treatment 5 when the CL was present during CIDR use. However, progesterone levels did not differ between treatments 2, 3, and 4. We have not completed the estradiol analysis as yet.

In summary, fertility declines as cows are synchronized for longer periods of time, necessary to achieve good synchrony. Follicular waves are disrupted when CIDR's are present without a CL but not in the presence of a CL. Aged follicles may be fertilized but most die soon thereafter.

GENETIC AND ENVIRONMENTAL EFFECTS ON OVULATION RATE AND EMBRYO MORTALITY

Kathy West and Howard Meyer

Sheep producers have long known the positive effects of pre-mating flushing and good ewe body condition on producing high lambing rates. However, little is known about the need to sustain good nutrition post-mating in order to get the full benefits of earlier good management.

A total of 60 Polypay x 60 Coopworth and Polypay F_1 3-year-old ewes were randomized to 16 weeks of Low or High pre-mating nutrition to achieve target body conditions of 2.0 and 4.0, respectively, on a 5-point scale (1 = emaciated, 5 = grossly fat). Three weeks prior to mating the Low ewes were placed on High nutrition for flushing. All ewes were synchronized with progestogen pessaries and mated to semen-tested Coopworth rams. Ewes were placed on pre-assigned Low or High post-mating nutrition for the next 6 weeks. Low post-mating nutrition consisted of maintenance for Low pre-mating ewes and .80 NRC maintenance for High pre-mating ewes. High post-mating nutrition consisted of 1.50 NRC maintenance for Low pre-mating ewes and maintenance for High pre-mating ewes. Ewes remained with harnessed rams for detection of returns to service. Returning ewes were excluded from the remainder of the trial. Ultrasound examination was initiated 20 days post-mating to count number of embryos and repeated at 28, 34 and 45 days post-mating.

Mean body condition scores achieved pre-flushing were 1.5 for Low ewes and 3.9 for High ewes. Mean ovulation rates (O.R.) and conception rates (C.R.) are shown below.

Low body condition reduced ovulation rate by .5 ova in both genotypes but had no adverse effect on conception to the synchronized estrus.

		C.R.		O.R.	
Breed	Pre-Mating	No.	Mean	No.	Mean
Polypay	High	24	92%	21	2.90
	Low	27	93%	25	2.40
Coopworth X Polypay	High	31	87%	26	2.81
	Low	28	96%	27	2.33

Litter size of individual ewes will be compared to their ovulation rate t determine the effects of pre-mating body condition and post-mating nutrition on lost reproductive potential.

SECTION V.

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