THE UNIVERSITY OF CALIFORNIA

SIERRA FOOTHILL RESEARCH & EXTENSION CENTER

Presents:

Annual Beef & Range Field Day

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April 11, 1996

Beef & Range Field Day

SIERRA FOOTHILL RESEARCH & EXTENSION CENTER

8279 Scott Forbes Rd., Browns Valley

April 11, 1996

AGENDA

09:15 Introduction - Mike Connor, Superintendent, Sierra Foothill Res. & Ext. Center

09:20 Welcome - Harry Carlson, Director, DANR Research & Extension Centers

09:30 Byproduct Feed Values - Jim Fadel, Assoc. Professor, UC Davis

09:50 A Panel Discussion on Cattle Marketing:
Moderator: Jim Oltjen, Animal Systems Specialist, UC Davis

Alternatives for Marketing Calves - Steve Blank, Ext. Economist, UC Davis

What's this Calf Worth? - Bob Sainz, Asst. Professor, UC Davis

Experiences with Calf Marketing Through Alliances - Hank Stone, President of Calif. Beef Cattle Improvement Association

Question and Answer Period

11:15 Visual Cues to Range Forage Value - Bill Frost, Natural Resources Advisor, UCCE-El Dorado County

11:35 Immunization Techniques for Sterilization of Heifers - Cindy Daley, Post Graduate Researcher, UC Davis

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NOON LUNCH BREAK
BBQ BEEF TRI-TIPS

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Afternoon Tour and Discussions

1:30 Estimate of Forage Nutritive Value Based on Manure Analysis - Sheila Barry, Livestock & Natural Resources Advisor, UCCE-Tehama County

1:50 Animal Health Update - John Maas, Extension Veterinarian, UC Davis

2:10 Strategic Supplementation: Which Cow to Supplement and When - Jim Oltjen, Animal Systems Specialist, UC Davis

Co-Sponsored by: UC Cooperative Extension & UC Davis - Animal Science Dept.

TABLE OF CONTENTS

By-Product Feed Values

James G. Fadel
Animal Science Department, UC Davis

INTRODUCTION

Ruminants are an integral part of the food and fiber system because they can utilize food and fiber not digestible by humans. One important role ruminants play is providing high human edible returns. For example, beef fed only forage would have a higher human edible return than beef raised on a high corn diet. The goals of animal production are numerous but one goal is to optimize total resource utilization over the long term while making a reasonable profit from the enterprise.

By-products in California are here to stay as long as California's status as the leading agricultural state in the nation remains intact. Considering only nine by-products, researchers at UC Davis found their market value to be about .25 billion dollars in 1992 (Grasser, et al., 1995). A by-product feed is a secondary product obtained during harvest or processing of a principle commodity and has value as an animal feed. Bath et al., 1993, identified 355 by-product commodities that are used in livestock feed in the United States. The by-products range from common feedstuffs such as whole cottonseed, dried beet pulp, and wheat mill run to lesser known products such as citrus pulp, bakery waste, and tomato pomace. Feeding by-products of crop and food processing industries to livestock turns material that would otherwise be wasted into human food.

Crops processed for human consumption produce by-products that can account for a large percentage of the total crop. For example, citrus pulp is about 50% of the whole fruit when orange juice is processed (Kimball, 1991). Cottonseed represents approximately 62% of the total crop yield (lint plus seed) in the harvest of cotton (Barr, 1991). Numerous by-products are suited to ruminant diets because of the ability of the ruminant to process high fiber diets. Replacing all or part of the grain portion of a ration with by-products did not significantly alter carcass characteristics (Adams and Lofgreen, 1976). Recent research at UC Davis has demonstrated that by-products compete favorably with traditional feedstuffs and are an important part of the dairy industry (Grasser et al., 1995). Researchers at UC Davis measured the composition and the variability of nine by-products used in California (Arosemena et al., 1995).

The purpose of this paper is to demonstrate the potential use of by-product feeds in the beef cattle industry to decrease feed costs without decreasing performance.

BY-PRODUCT COMPOSITION

Arosemena et al., 1995, reported the composition and variability within nine selected by-products used in California. The nine by-products were beet pulp, rice bran, almond hulls, citrus pulp, bakery waste, wheat mill run, brewers grain, distillery grains, and soy hulls. For the purpose of this paper, five of these by-products are presented in more detail. Several samples were collected for each by-product and three of those samples are presented in Table 1 for beet pulp, rice bran, almond hulls, wheat mill run, and brewers grains. All by-products selected show some differences among the three sources selected. Most notable variations are: NDF and CP in beet pulp; ether extract and TDN in rice bran; ADF and lignin in almond hulls, NDF in wheat mill run; and NDF and ADF in brewers grains. Differences between means of the three sources and the NRC table values were found in all by-products but the differences found with rice bran were the most dramatic because of the ether extract composition.

BY-PRODUCT USE AS SUPPLEMENT

The use of by-products in a feeding program was evaluated with a cow-calf operation and a feeder operation using an optimization program that minimized ration costs given specific requirements and feed constraints. The details of the input and the results follow.

Cow-calf operation:

Alfalfa early bloom or oat hay was considered as a potential forage source as well as range forage. The cost of range forage was considered zero for the purposes of these analyses. By-products (almond hulls, beet pulp, brewers grains, rice bran, wheat mill run) were considered potential supplements to these base forages using an optimization program (Dunbar et al.,1993). Each by-product was considered independently and current feed prices were used. The cow was assumed to weigh 1050 lbs, to produce 10 lbs of 4% fat milk daily, and to be able to consume up to 20% more than recommended by NRC (1984). The time period was from September through December and good quality range forage could be used up to 50 percent of the total dry matter consumed. Each by-product was restricted to no more than 25% of the total DM intake. The optimization program was run using the composition means of the by-products in Table 1.

The results in Table 2 indicate that the supplementation of forage with by-products is feasible with the more expensive and higher quality alfalfa hay. In particular, almond hulls, beet pulp, rice bran, and wheat mill run are by-products that would be profitable to use with the prices used in these formulations. Range forage was used up to the maximum allowed in all rations. Corn was included as a comparative feed and was not used with oat hay or alfalfa.

The opportunity price is shown on Table 2 that is the price the by-product would need to be before it would be used in the ration. The opportunity price is considerably lower than the current market price for all feeds except for brewers grain when used with alfalfa.

A lower quality range forage, a drop in the cost of any by-product with an opportunity price, or less food intake would probably result in an increase in by-product utilization.

Feeder operation:

Alfalfa early bloom or oat hay was considered as potential forage source. Range forage was not considered as a forage source. By-products (almond hulls, beet pulp, brewers grains, rice bran, wheat mill run) were considered as potential supplements to either alfalfa or oat hay using an optimization program (Dunbar et al., 1993). Each by-product was considered independently and current feed prices were used. The growth was assumed to be from 600 to 800 lbs for a medium frame steer. The animal was assumed to be able to consume up to 10% more than recommended by NRC (1984). The time period was considered from June through August. Each by-product was either restricted to no more than 25% of the total DM intake or unrestricted. The optimization program was run using the composition means of the by-products in Table 1. The highest daily gain feasible was used for each possible feed combination. This was accomplished by increasing daily gain incrementally over several formulations until the highest daily gain was achieved with each diet.

The daily gain, cost per gain, daily feed price and other results are in Table 3. The cost per lb of gain varied from .58 to 1.05 for restricted by-product supplementation when fed with oat hay and from .61 to .87 for restricted by-product supplementation when fed with alfalfa hay. Supplementing alfalfa hay with by-products was the more expensive combination when considering only daily feed price. However, when considering cost per gain, supplementing alfalfa with by-products resulted in the lowest cost per gain except with rice bran.

Unrestricted use of by-products produced some results that are not practical but the results are included to illustrate the relative optimal gains for a given by-product. Corn was included for comparative purposes and was a competitive supplement.

REFERENCES

Adams, N. J., and G. P. Lofgreen. 1976. The effects of replacing grain with byproducts in a finishing ration. Page 11 *in* California Feeders Day Program. Dep. Anim. Sci. Coop. Ext. Serv., Univ. California, Davis.

Arosemena, A., E. J. DePeters, and J. G. Fadel. 1995. Extent of variability in nutrient composition within selected by-product feedstuffs. Anim. Feed Sci. Technol. 54:103.

Barr, J. S. 1991. Cottonseed: the industry. Page 34 *in* Proc. Alternative Feeds for Dairy and Beef Cattle,. Natl. Invitational Symp. USDA- Ext. Serv. Allied Ind., and Univ. of Missouri, Columbia.

Bath, D., J. Dunbar, J. King, S. C. Berry, and S. Olbrich. 1993. Byproducts and unusual feedstuffs. Feedstuffs Ref. Issue 65(30):32.

Dunbar, J. R., A. Ahmadi, W. N. Garrett, J. W. Oltjen, D. J. Drake. 1993. TAURUS: Least cost and ration analysis programs for beef cattle. Version 2.00. Regents Univ. California, Dep. Anim. Sci., Univ. California, Davis

Grasser, L. A., J. G. Fadel, I. Garnett, and E. J. DePeters. 1995. Quantity and economic importance of nine selected by-products used in California dairy rations. J. Dairy Sci. 78:962.

Kimball, D. A. 1991. Citrus processing: quality control and technology. 1st ed. Van Nostrand Reinhold, New York, NY.

National Research Council, 1984. Nutrient requirements of beef cattle, 6th edn. National Academy of Sciences, National Academy Press, Washington, DC.

TABLE 1. Chemical composition as percentage of DM and calculated TDN (%), NE_m (Mcal/lb), and NE_g (Mcal/lb) for different by-product feeds and forages.

BPF[1]	S[2]	ASH	NDF	ADF	LIG[3]	EE	CP	NDICP[3]	ADICP[3]	TDN[4]	NE_m[5]	NE_g[5]
BP	1	6.86	42.18	21.97	1.92	.31	8.57	4.30	.88	68.63	.72	.45
BP	2	5.34	37.58	20.08	1.53	.74	6.03	3.95	.51	72.58	.78	.50
BP	3	9.55	33.22	17.21	1.12	.75	9.61	2.92	.40	70.26	.74	.47
average		**7.25**	**37.66**	**19.75**	**1.52**	**.60**	**8.07**	**3.72**	**.60**	**70.49**	**.75**	**.47**
	NRC	6.10	44.00	25.00	3.00	.60	10.10	N.D.	N.D.	67.20	.70	.43
RB	1	6.46	20.12	9.38	3.10	18.40	12.94	1.99	.40	96.02	1.09	.77
RB	2	6.47	21.54	10.39	4.31	20.79	13.19	2.10	.40	97.16	1.11	.78
RB	3	6.97	21.49	9.12	3.41	24.25	14.39	2.20	.45	102.20	1.17	.83
average		**6.63**	**21.05**	**9.63**	**3.61**	**21.15**	**13.51**	**2.10**	**.42**	**98.46**	**1.12**	**.79**
	NRC	12.80	33.00	18.00	N.D.	15.10	14.10	N.D.	N.D.	80.91	.89	.60
AH	1	4.76	34.98	25.96	9.20	2.41	6.36	1.82	1.53	64.85	.66	.40
AH	2	5.25	31.88	23.71	8.47	2.42	5.06	1.55	1.53	66.18	.68	.41
AH	3	5.06	35.39	29.14	12.75	2.61	6.50	2.09	2.32	61.45	.61	.35
average		**5.02**	**34.08**	**26.27**	**10.14**	**2.48**	**5.97**	**1.82**	**1.79**	**64.16**	**.65**	**.39**
	NRC	6.50	32.00	28.00	9.00	3.00	2.10	N.D.	N.D.	65.15	.67	.40
WMR	1	4.24	38.54	10.75	3.78	7.71	20.27	3.54	.41	78.55	.86	.57
WMR	2	4.86	44.05	13.12	3.98	4.39	18.37	3.92	.43	71.86	.77	.49
WMR	3	3.32	29.91	8.06	2.69	5.31	18.64	2.95	.33	80.44	.88	.59
average		**4.14**	**37.50**	**10.64**	**3.48**	**5.80**	**19.09**	**3.47**	**.39**	**76.95**	**.84**	**.55**
	NRC	1.61	N.D.	N.D.	N.D.	4.60	17.20	N.D.	N.D.	77.87	.85	.56
BG	1	4.19	54.95	20.10	4.66	7.49	26.92	9.23	3.72	73.52	.79	.51
BG	2	2.92	38.72	15.50	4.02	4.96	23.82	4.71	1.73	76.19	.83	.54
BG	3	3.76	51.36	20.06	6.17	5.52	26.23	5.23	2.82	69.16	.73	.45
average		**3.62**	**48.34**	**18.55**	**4.95**	**5.99**	**25.66**	**6.39**	**2.76**	**72.96**	**.78**	**.50**
	NRC	4.80	42.00	23.00	5.00	6.50	25.40	N.D.	N.D.	74.30	.80	.52
alfalfa, early blm		9.60	42.00	31.00	8.00	3.00	18.00	N.D.	N.D.	60.00	.59	.33
alfalfa, full blm		8.90	50.00	37.00	10.00	2.00	15.00	N.D.	N.D.	55.00	.52	.26
oat hay, dough		6.90	56.00	34.00	9.00	4.20	11.50	N.D.	N.D.	53.00	.48	.23
range forage		11.00	58.4	40.10	6.20	1.10	10.10	N.D.	N.D.	48.00	.58[6]	.32[6]

[1]BPF= By-product feedstuffs; BP = beet pulp; RB = rice bran; AH = almond hulls; WMR = wheat mill run; BG = brewers grains.
[2]S= Sources are denoted 1, 2, and 3; Arosemena et al., 1995.
[3]LIG = lignin; NDICP = CP in NDF; ADICP = CP in ADF.
[4]TDN, according to Weiss, et al., 1992; except for forages, NRC, 1984.
[5]$NE_m = 1.37ME - 0.138ME^2 + 0.0105ME^3 - 1.12$; $NE_g = 1.42ME - 0.174ME^2 + 0.0122ME^3 - 1.65$; 1 kg TDN = 3.62 Mcal of ME; NRC, 1984
[6]Determined experimentally (Personal communication, J. Dunbar, 1996)

Table 2. Daily feed price, percentage of feeds used in ration, food intake, current prices, and by-product (BPF) opportunity prices for oat or alfalfa hay fed with range forage or fed with range forage and a by-product.[1]

Feeds	Feed Price ($/day)	Range forage	Hay	BPF	Food Intake (lbs)	Current price ($/ton)	Opportunity price[2] ($/ton)
		---------	%	---------			
Oat hay	.64	50	50		20.2	100	
Oat hay+							
Almond hulls	.64	50	46	4	19.9	106	
Beet pulp	.64	50	50		19.3	155	128.21
Brewers grains	.64	50	50		20.2	45	29.95
Rice bran	.63	50	47	3	17.6	135	
Wheat mill run	.64	50	50		18.3	155	134.17
Corn	.64	50	50		20.2	194	98.93
Alfalfa hay	.89	50	50		20.2	155	
Alfalfa hay+							
Almond hulls	.77	50	31	19	19.9	106	
Beet pulp	.87	50	31	19	19.3	155	
Brewers grains	.89	50	50		20.2	45	41.96
Rice bran	.74	50	37	17	17.6	135	
Wheat mill run	.81	50	25	25	18.3	155	
Corn	.89	50	50		20.2	194	137.56

[1]Cow-calf operation. Assumptions: 1050 lb cow, medium frame producing 10 lbs 4% Fat milk daily. Season is September to December. Feed intake may be up to 20% greater than NRC (1984).

[2]Opportunity price is the price a feed not in the ration would need to be before used in the current ration.

Table 3. Daily gain, cost per gain, feed price, percentage of forage and by-product (BPF) used in ration, and feed intake for oat or alfalfa fed alone or with a by-product restricted to 25% of dry matter intake (R) or unrestricted (U).[1]

	Gain (lb/day)	Gain ($/lb)	Feed Price ($/day)	Hay %	BPF %	Feed Intake (lbs)
Oat hay	.55	1.59	.88	100		15.8
Oat hay+						
Almond hulls, R	.90	1.05	.94	75	25	16.7
Almond hulls, U	1.30	.78	1.02	50	50	17.8
Beet pulp, R	1.15	.95	1.09	75	25	17.4
Beet pulp, U	2.00	.69	1.38	39	61	18.8
Brewers grains, R	1.25	.97	1.22	75	25	17.9
Brewers grains, U	2.90	.70	2.02		100	18.8
Rice bran, R	1.95	.58	1.21	75	25	18.6
Rice bran, U	3.10	.37	1.14	35	65	17.0
Wheat mill run, R	1.35	.84	1.13	75	25	17.8
Wheat mill run, U	2.95	.52	1.53	8	92	18.3
Corn, R	1.25	.73	1.27	75	25	18.4
Corn, U	2.90	.55	1.59	45	55	18.8
Alfalfa hay	1.60	1.00	1.60	100		18.5
Alfalfa hay +						
Almond hulls, R	1.70	.87	1.48	75	25	18.6
Almond hulls, U	1.90	.66	1.90	27	73	18.8
Beet pulp, R	1.90	.85	1.61	75	25	18.8
Beet pulp, U	2.50	.64	1.60	20	80	18.9
Brewers grains, R	2.00	.87	1.74	75	25	19.0
Brewers grains, U	2.90	.70	2.02		100	18.8
Rice bran, R	2.65	.61	1.61	75	25	19.2
Rice bran, U	3.20	.43	1.37	44	56	17.3
Wheat mill run, R	2.10	.78	1.64	75	25	19.0
Wheat mill run, U	3.00	.53	1.58	11	89	18.4
Corn, R	2.45	.72	1.76	75	25	19.2
Corn, U	3.24	.55	1.78	28	72	17.5

[1]Assume growth from 600 to 800 lbs of a steer, medium frame from June through August. Feed intake may be up to 10% greater than NRC (1984).

What is this calf worth?
An approach to value-based marketing.

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Background

Value-based marketing, the notion that animals and their products may be traded based upon their ultimate value in the marketplace, has been vigorously promoted in recent years. At the end of the beef production chain, this has led to increased contract and formula trading, in which the value assigned to finished cattle depends upon specific carcass yield and grade parameters. Since the amount and quality of meat produced from a given carcass may be assessed fairly accurately, assignment of value on the rail is relatively straightforward. As we consider transactions that are further from the production endpoint, assigning value becomes progressively more difficult. As an extreme example, the opposite end of the production chain would be the purchase of breeding stock, which are notoriously difficult to value accurately. An intermediate stage is the sale (and purchase) of weaned calves or feeder cattle. Just as the packer assigns value to finished cattle based upon their expected yield of salable product, feeder cattle must be valued based upon their expected performance in the feedlot and the packing plant. Essentially, this is the same as calculating a break-even price for buying cattle based on expected sale price and costs of production. Predicting subsequent performance and value, however, is substantially more difficult in the live animal than in the carcass. This study aimed to evaluate several factors affecting feeder cattle performance, both biological and economic. Rather than conduct exhaustive new experiments for this purpose, a mathematical model that integrates a wide range of existing information was used to simulate the conditions of interest. Specifically, weight, height (or frame score), and back fat (by ultrasound) were the objective measures; feed intake capacity was also included, although we currently have no adequate means to evaluate this characteristic.

Procedure

Data from several studies at the UC Davis feedlot were collected and applied in these analyses (Sainz et al., 1994, 1995a,b). This enabled validation of the ultrasound methodology, as well as the computer model of growth used in subsequent analyses. Modeling simulations were conducted using a mathematical model of beef cattle growth and composition (Oltjen et al., 1986), which used initial weight, frame score and fatness as input. User-specified feed intakes (as % of body weight) allowed the model to predict days on feed to reach average Choice grade, final body weight and fat content as outputs. Simulations were conducted within the following ranges of inputs: initial weight, 600 to 800 lbs; hip height, 42 to 50 inches (equivalent to frame scores of 4 to 8); and backfat, 0.1 to 0.3 inches (equivalent to 12 to 21% fat in the empty body).

Predicted performance was then used to calculate buying break-evens, taking account of expected sale price (assuming 60% dressing percentage and $0.90/lb carcass price) and costs of production (assuming $120/ton for feed and $0.30/head/day overhead charge). Model outputs (feed costs, overhead costs, final value) and break-evens were related to inputs using correlation analysis and stepwise multiple regression, which identifies only those inputs that significantly influence the outputs.

Results and discussion

Table 1 shows the simple correlations among inputs to and outputs from this exercise. A correlation of zero indicates that there is no relationship between two variables, whereas a correlation of one indicates a perfect one-to-one relationship. Correlations of zero among body weight, height and backfat do not occur in real life, but did occur in this exercise because all possible combinations of inputs were used. In other words, real calves get taller (and fatter) as they gain weight, but this study considered short, heavy steers as well as tall, light ones. Final body weight (FBW) was positively associated with initial weight and height, and negatively related to backfat. Therefore, larger animals finished at heavier weights, and fatter steers finished at lighter weights. These results should surprise nobody, but are mentioned here to illustrate that the model is capable of producing reasonable response patterns. Final animal value (Sale $) was calculated from FBW, therefore the correlation between Sale$ and FBW is one, and correlations with other variables are the same for both.

The number of predicted days on feed to reach average Choice (PDOF) was slightly related to body weight (BW, -0.28) and height (HT, 0.21), moderately to backfat (BF, -0.46) and highly related to feed intake (FI, -0.80). Feed costs (Feed$) were highly related to PDOF and overhead costs (OH $; 0.83 for both); the perfect correlation between PDOF and OH$ is not surprising since OH$ was calculated from PDOF. Feed$ was also highly related to BF (-0.77), because fatter animals require less feed to reach slaughter finish. The negative correlation between Feed$ and FI reflects the fact that animals that consume more feed gain more rapidly and require less time in the feedlot. The bottom line for cow-calf and stocker producers is the value of calves, estimated here as a break-even to buy. Break-evens (Buy BE) were highly (and positively) related to HT (0.60) and FI (0.63), and moderately (and negatively) to BW (-0.35).

The simple correlations shown in Table 1 tell us something about the relationship between any two variables, but cannot capture the complexity of multiple interacting factors. Therefore, stepwise multiple regression was used to determine which factors affected the outputs in a significant fashion. In most cases, all inputs (BW, HT, BF, FI) were included in the final equation (Table 2). The exception was the equation for Feed$, which was not improved by inclusion of BW. Of the inputs used, FI is the only one that cannot be measured objectively prior to shipping cattle. Therefore, the stepwise procedure was repeated using only BW, HT and BF. For FBW and Sale$, the equation using all variables had a coefficient of determination (R^2) of 99.1, indicating that these variables accounted for 99.1% of the variation in final weight and value. Removal of FI had a minor effect on the R^2, decreasing it to 96.5, suggesting that FI only accounted for 2.6% of the variation in final weight. For all other variables, however, FI had a major effect on the accuracy and precision of the equations. For example, the full equation accounted for 89.9% of the variation in Buy BE, with a residual standard deviation (RSD) of $0.0114. Removal of FI resulted in a drop of 40% in R^2, with a more than doubling in RSD.

The relationship between steer value and body weight is shown in Figures 1 and 2. As shown in Figure 1, backfat had a negligible effect on the relationship, but frame score had a major influence on it (Figure 2). Also apparent in these figures is the price slide: as calves become heavier, the break-even value decreases by $0.01 to $0.02/lb for each 100 lbs body weight.

Therefore, body weight, frame score and backfat together account for 1/3 of the variation in days on feed and overhead costs, 3/4 of the variation in feed costs, and almost all of the variation in final value, but only account for 1/2 of the variation in the value of the feeder steer. The capacity for feed intake is a major factor influencing time in the feedlot and the buying break-even.

Implications

Cow-calf and stocker producers are being urged to maintain accurate records of all production costs, adequate for calculation of break-even selling prices. This is undoubtedly sound business advice. At marketing, however, the price received will depend upon subsequent value, not the cost of production. In other words, cattle producers are price takers, not price makers. This study identified some simple objective measures that can help determine subsequent value of calves. One major factor influencing animal value, feed intake, is impossible to quantify at present. This is an area that certainly warrants further study.

Literature Cited

Oltjen, J. W., A. C. Bywater, R. L. Baldwin, and W. N. Garrett. 1986. Development of a dynamic model of beef cattle growth and composition. J. Anim. Sci. 62:86-97.

Sainz, R.D. and Oltjen, J.W. 1994. Improving uniformity of feeder steers using ultrasound and computer modelling. *Proceedings of the American Society of Animal Science, Western Section* **45,** 179-181.

Sainz, R. D. , Smith, J. G., Garnett, I. and Lee Y. B. 1995a. Use of ultrasound and computer modeling to predict days on feed and improve beef carcass uniformity. *Proceedings of the American Society of Animal Science, Western Section* **46,** 148-150.

Sainz, R. D., F. De la Torre, and J. W. Oltjen. 1995b. Compensatory growth and carcass quality in growth-restricted and refed beef steers. J. Anim. Sci. 73:2971-2979.

Table 1. Correlations among inputs and outputs for break-even analysis on feeder steers.

	BW	HT	BF	FI	PDOF	FBW	Sale$	Feed$	OH$	Buy BE
BW	1.000									
HT	0.000	1.000								
BF	0.000	0.000	1.000							
FI	0.000	0.000	0.000	1.000						
PDOF	-0.276	0.205	-0.455	-0.796	1.000					
FBW	0.599	0.581	-0.518	-0.162	0.323	1.000				
Sale $	0.599	0.581	-0.518	-0.162	0.323	1.000	1.000			
Feed $	-0.016	0.415	-0.774	-0.459	0.830	0.714	0.714	1.000		
OH $	-0.276	0.205	-0.455	-0.796	1.000	0.323	0.323	0.830	1.000	
Buy BE	-0.350	0.603	0.105	0.634	-0.381	-0.007	-0.007	-0.138	-0.381	1.000

Table 2. Regression equations relating inputs and outputs based on modeling results

	Constant	BW	HT	BF	FI	R^2	RSD
PDOF	320.5	-.127	2.36	-8.20	-73.1	95.8	7.96
PDOF (-FI)	137.7	-.127	2.36	-8.20		32.5	31.6
FBW	-50.1	.693	16.8	-23.5	-37.4	99.1	9.40
FBW (-FI)	-143.6	.693	16.8	-23.5		96.5	18.2
Sale$	-27.1	.374	9.07	-12.7	-20.2	99.1	5.08
Sale$ (-FI)	-77.6	.374	9.07	-12.7		96.5	9.85
Feed$	100.6		4.00	-11.7	-35.4	98.2	4.39
Feed$ (-FI)	12.2		4.00	-11.7		77.1	15.4
OH$	96.2	-.038	.707	-2.46	-21.9	95.8	2.39
OH$ (-FI)	41.3	-.038	.707	-2.46		32.5	9.49
Buy BE	.191	-.00015	.00639	.00175	.0537	89.9	.0114
Buy BE (-FI)	.325	-.00015	.00639	.00175		49.7	.0252

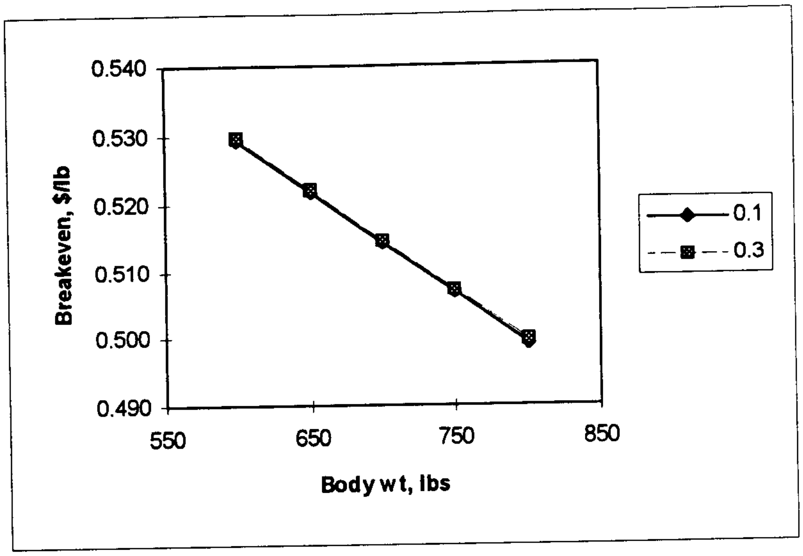

Figure 1. Effect of body weight on steer value, at two backfat depths (0.1 and 0.3 in) and at constant frame score (5) and feed intake (2.5% of body wt).

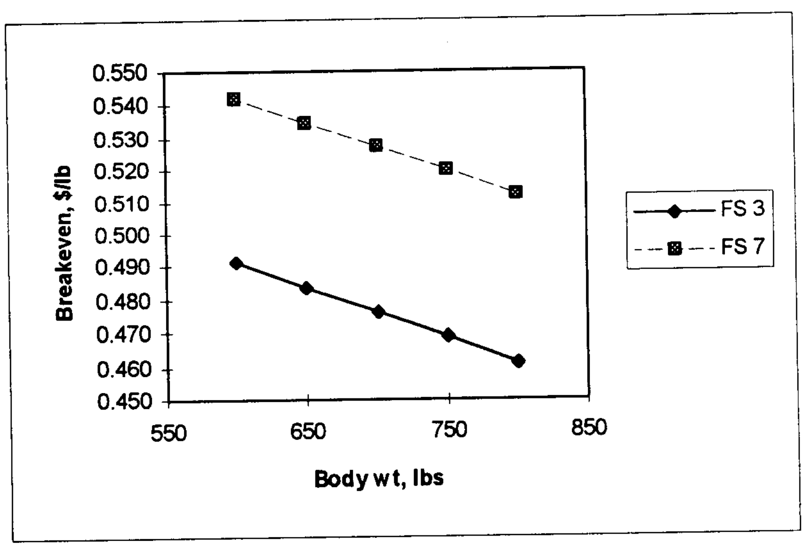

Figure 2. Effect of body weight on steer value, at two frame scores (3 and 7) and at constant backfat (0.2 in) and feed intake (2.5% of body wt).

Experiences with Calf Marketing through Alliances

Henry H. Stone
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Selecting for Carcass Traits

If satisfactory performance levels of reproductive and growth traits can be achieved, selection for carcass traits can be a logical step towards improving a breeding program. The benefit of supplying calves that have the genetic potential to produce desirable carcasses can give producers a competitive edge as value-based marketing systems are increasingly emerging.

Selection for carcass traits requires developing goals, making effective selection decisions and managing cattle accordingly by providing cattle with an environment that allows for superior carcass genetics to be expressed. Selection for carcass traits should not sacrifice the performance of reproductive, growth, environmental adaptability and other economic traits of importance. For the cow-calf producer achieving a balance of several traits is essential.

Steps to Take to Identify and Improve Carcass Quality

Producers can develop carcass goas with consideration for the market supplied, the environment and resources available, the uniformity of calves, and the factors affecting rate of genetic improvement. To select for carcass traits one must consider the breed/biological type of animal and the breeding system employed, and collect and analyze carcass performance data. Of course, providing good management is always important, including health (e.g. free from disease), nutrition (e.g. feed quality & quantity), handling (e.g. minimal stress), and other management practices. It is also important to identify calves (progeny) with inferior genetics using carcass data and eliminating sires and dams that consistently produce undesirable carcasses due to genetics. One must also consider environmental effects that could have affected carcass performance.

What Does the Consumer Want?

Live cattle and beef carcass targets can be divided into three consumer groups.

1. White Table Cloth Consumer

   This target expects the ultimate in tenderness, flavor and juiciness. Consumers are not much concerned about price, cholesterol or nutritional value of their eating experience. However, they do not desire trimmable or separable fat.

2. Retail Consumer

   This type of consumer desires beef products that have a sufficient amount of marbling to assure satisfactory taste and tenderness. This type of consumer wants optimum levels of price, palatability, nutritional value and leanness. They do not desire trimmable or separable fat.

3. Lite or Lean Consumer

   This consumer is especially diet-health conscious. They are most concerned about leanness and are willing to give up some taste or palatability to obtain lean beef. They are not necessarily price conscious, but nutritional value and low fat are primary concerns. They too, do not desire trimmable or separable fat.

Live animal and carcass beef targets (Table 1) can help determine what kind of cattle are needed to supply different types of beef to these three consumer types.

Table 1. Suggested Live Cattle and Carcass Specifications*

Trait	Lean	Retail	"White Table Cloth"
Live Weight	1000 to 1350 lb.	1000 - 1350 lb.	1000 - 1200 lb.
Age at Slaughter	Max. 24 months	Max. 30 months	Max. 40 months
Frame Size	Large (typical)	Medium (typical)	Medium (typical)
Frame Score	6 - 8	5 - 7	4 - 6
Muscling	Medium to Thick (thick typical)	Medium to Thick (thick typical)	Medium to Thick (medium typical)
Days on Feed	90 days minimum	90 days minimum	120 days minimum
Breed Type	Predominantly Continental crosses	Continental and British crosses	Predominantly Continental Crosses
Yield Grade	1 or 2	1 or 2	1 or 2 (some 3's)
Carcass Weight	600 - 850 lb.	600 - 850 lb.	600 - 850 lb.
Fat Thickness	less than .35 inches	.20 to .40 inches	.30 - .50 inches
Ribeye Area	13.0 - 16.0 sq. in.	12.0 - 16.0 sq. in.	12.0 - 16.0 sq. in.
Quality Grade	Select/Lower Choice	Select or Choice	Prime/UpperChoice
Maturity	A	A	A
Marbling	Slight to Small	Slight to Moderate	Minimum to Modest
Growth	Superior growth	High growth	Average/high growth
Maturing Rate	Slow	Average/slow	Average/rapid

*Colorado State University & Kansas State University

Heritability of Carcass Traits

Because most heritability estimates for carcass traits are moderate to high (Table 2), genetic improvements can be accomplished by accurately selecting breeding animals that have shown to be highly productive for desired carcass traits. Actual heritability estimates of particular traits may vary slightly from herd to herd.

Table 2. Heritability Estimates for Feedlot and Alliance Performance Traits*

Trait	Heritability
Post-weaning Feedlot Gain	.45
Efficiency of Feedlot Gain	.45
Carcass Weight	.50
Carcass Quality Grade	.40
Marbling Score	.55
Fat Thickness	.45
Ribeye Area	.65

*Colorado State University

Performance Records and Marketing Calves

Calf crop performance records are a true test of a producer's selection practices and the goals that he/she wants to accomplish. Records may be recorded "On the Ranch" or "Off the Ranch" depending on records needed to select for desired traits (Table 3).

Producers who want to obtain "off ranch" performance data can consider:

1. Working with feedlots and packers that will provide the data.
2. Participating in a "ranch to rail" steer performance program.
3. Participating in a strategic alliance.
4. Working with a branded beef program.
5. Participating in Carcass Data Service

Table 3. Records Market Calves

On Ranch	Off Ranch (Feedlot)	Off Ranch (Packing House)
Calving Date	Average Daily Gain	Live Slaughter Weight
Birth Weight	Feed Efficiency	Dressing Percentage
Pre-Weaning Gain	Days on Feed	USDA Yield Grade
Weaning Weight	Ultrasound Ribeye Area	Carcass Weight
Age at Weaning	Ultrasound Fat Thickness	USDA Quality Grade
Conformation		
Calf Crop Weaned		

Experience with Steer Futurities and Alliances

Since 1994 I have marketed ranch-raised steers through California State College Futurities (Table 4) and the Angus Alliance in Syracuse, Kansas. Results of those experiences are summarized in table 5.

Table 4. California Futurities

Institution	Gender	Starting Date	Contact
Cal Poly San Luis Obispo	Steer/Heifer	June or Nov.	Mike Hall (805) 756-2685
C.S.U. Chico	Steer/Heifer	Mid Oct.	Dave Daley (916) 898-4539
C.S.U. Fresno	Steer/Heifer	June	Randy Perry (209) 278-4793
Intermountain Fair, McArthur	Steer	Labor Day	Dennis Hoffman (916) 336-5695

Table 5. Experience with Alliances and Futurities

	Angus Alliance		Cal Poly 1994		Chico State 1995	
	$/cwt	%	$/cwt	%	$/cwt	%
Hot Carcass Price	117	$116*	108	$107*	116	$116*
Select Discount	3	14	5	20	?	0
CAB Premium	2	30	0	40	0	14
Prime Premium	2	10	0	0	0	0
Carcass Weight or Dark Cutter Discount	0	0	0	0	0	0
Yield Grade Premium/Discount						
YG1:	0	0	0	0	0	29
YG2A:	2	5	0	20	0	29
YG2B:	1	10	0	20	0	43
YG3B:	-2	38	0	40	0	0
YG4:	-10	5	0	0	0	0
Performance						
Dressing %:	63		63		62	
Back Fat, in	0.56		0.54		0.37	
Rib Eye Area, square in.	12.1		11.69		12.7	
In Weight, lb	702		659		777	
Average Daily Gain, lb	3.27		4.7		2.95	
Days on Feed	133		105		139	
Feed/Gain	6.74		6.03		9.04	

* Actual average price received

Value-Based Marketing Opportunities

Traditionally, most methods of marketing cattle have been based on averages. In contrast, value-based marketing is a marketing system based on paying for individual animal value rather than using average prices. Several different types of value-based marketing exist for cow-calf producers to consider:

1. Retain ownership of calves in the feedlot.
2. Work with a local feedlot to set up an alliance.
3. Supply cattle for a branded beef program.
4. Build a reputation for quality calves with acceptable carcass merit.

VISUAL CUES TO RANGE FORAGE VALUE

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Matching the nutrient needs of livestock and the nutrients supplied by range forage is a balancing act practiced by ranchers for a considerable portion of each year. Forage quality measures, such as protein, energy, vitamins and minerals follow a declining trend as the growing season progresses. Conversely, measures of low quality such as fiber and lignin increase as forage plants mature.

While cattle tend to select diets that are higher in protein and lower in fiber than that contained on the average in the available forage, protein in the diet can become a limiting factor for growth and maintenance. Protein levels often become limiting before energy, especially for young stock and lactating cows, one of the main reasons performance of these classes of cattle declines sharply when forage matures.

This project is attempting to develop photographic guides which can be combined with a general description of the vegetation to provide an approximate estimate of the protein content. In the past, ranchers have depended upon visual cues from livestock (declining condition) or historic supplemental feeding timing. We feel that utilization of declining livestock condition has already subjected the animals to stress, while use of historic timing may not account for yearly variations in forage quality.

To develop the information necessary for photo guide development, forage samples have been collected to represent the adequate green forage period (approximately late March/April) through the inadequate green forage period (ending in December). Samples have been analyzed for protein content and acid detergent fiber. Prior to clipping, the locations have been photographed and a rough categorization of species composition (by groups of grasses, legumes, forbs) has been completed. The project has incorporated sampling locations in Madera, Calaveras, El Dorado and Yuba County (Sierra Foothill Research and Extension Center).

These photographic guidelines will be dependent upon a categorization of forage species by group (grasses, legumes, forbs) and the color of the forage (green to brown). First years results are promising. As expected we found the highest protein contents (13-16%) in green forage where there was a significant proportion of legumes (primarily rose clover). The protein content dropped as the plants matured and dried (corresponding to color changes from green to green-yellow to brown), to a low of about 5% protein by late summer.

We will continue to collect forage samples during the April - December period in 1997 to combine with our 1996 data and historical information. This information, along with current photographs, will be integrated into the photographic guides

Development of a Vaccine to Prevent Pregnancy/Cyclicity in Heifer Calves.

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University of California, Davis
Department of Animal Science
Sierra Foothill Research and Extension Center

Inadvertent pregnancy in heifer calves destined for the feedlot represents justification for the current $6 -$10.00/cwt price spread between heifers and steers off the ranch[1]. Studies on over 300,000 hd of feeder cattle on the High Plains indicated that the average daily gain for feedlot heifers was 13.5% less than steers[2]. This reduction in gain is due not only to sex differences but is further confounded by reduced performance as a result of abortion, calving, metritis and other pregnancy related problems. The increased death loss in feedlot heifers of 0.5% from this study is related almost entirely to problems associated with abortion and calving. In addition to the reduced performance as realized by reductions in gain, feed efficiency, and relative increases in days on feed, producers need to consider the additional losses that occur in dressing percentage due to the number of heifers that are pregnant at slaughter.

In a survey designed to evaluate the magnitude of weight loss at slaughter attributable to pregnancy in fed heifers, Monfort Packing Plant in Greeley, CO monitored 11,000 heifers and heiferettes (over a 3 month period) for incidence of pregnancy at slaughter[3]. Of the 11,000 hd included in this study, 23% were at some stage of pregnancy resulting in a 5.6% reduction in dressing percent for pregnant heifers. Further proof that the feedlot and packing industries are aware of these problems was demonstrated in a "feeder/packer survey" conducted by Colorado State University which posed the following questions[4]:

	Low	Mean	High
A. What percent of incoming feedlot heifers are pregnant?	0%	16.5%	25%
B. What is the cost of pregnancy testing and abortion?	$4.75	$5.29	$6.00
C. What is the increased value of open vs. preg hfrs/ hd?	$10.50	$30.32	$50.00
D. What percent of slaughter heifers are pregnant?	2%	17%	33%
E. What is the average loss in dressing % of slaughter heifers due to pregnancy?	1.%	3.38%	6%

[1] Western Livestock Journal, March 18, 1996. Vol. 75:No.21. Crow Publications
[2] Hoelscher, M. August Feedlot Analysis. Feedstuffs, Vol. 58: No. 39. Sept 22, 1986.
[3] Bennett, B. The Pregnant Feedlot Heifer. Animal Nutrition & Health, May 1985. pp. 5-8.
[4] Bennett, B.W., and Rupp, G.P. 1983. Feeder/Packer Survey: Department of Clinical Sciences, Colorado State University.

From the feedlot/packer perspective, Monfort evaluated 3 different management scenarios to estimates the losses associated with each regime:

	Loss/hd on lots of 1000 hd	Loss/preg. hfr
1. Do nothing: No pregnancy check or abortion:	$ 19.04	$115.42
2. Preg ck and attempt to abort (80% effective)	$ 8.71	$ 52.76
3. Preg ck at purchase and sell back pregnant hfrs	$ 8.29	$ 50.24

Pregnancy in market heifers results in substantial economic losses throughout the entire production cycle. Because abortion and pregnancy detection has limited effectiveness, some producers have opted to spay heifers through a surgical procedure which removes the ovaries. Studies to compare the feedlot performance of spayed vs. non-spayed indicates that the spayed heifers do not gain as well as intact control heifers. However, when spayed heifers are implanted with commercially available growth promotants, the implanted spayed heifers outgained the non-spayed, non-implanted heifers[5].

The disadvantages of this procedure include an increased death loss, sickness and reduced performance following surgery. Spaying also requires the expertise of a licensed veterinarian to perform the procedure in a sterile environment. Additionally, from an animal welfare perspective, this procedure may appear invasive and stressful to the heifer.

Because heifers are already pregnant when they reach the feedlot, it is presumed that the bulk of these inadvertent pregnancies are coming off the ranch. Due to selection pressure on early maturity, heifer calves can become cyclic as early as 6 months of age and would be considered "at risk" from this point on. The extensive range conditions in the western United States is conducive to inadvertent pregnancies because it is often impossible to control the movement (and segregation) of cattle, particularly bulls.

The Department of Animal Science at the University of California at Davis is evaluating a new vaccination procedure that eliminates the need for abortifacients or surgical spaying methods. The principle is the same as other vaccines commonly used by producers to prevent disease (e.g. Clostridial's, IBR-PI3-BRSV). However, this vaccine stimulates the heifer's immune system to produce antibodies against the primary reproductive hormone coming from the brain, i.e. gonadotropin-releasing hormone (GnRH), rather than a specific disease. Because the vaccine stimulates antibodies against GnRH, it is called "Anti-GnRH".

[5] Rupp, G.P. 1987. Why Spay Heifers? The Bovine Proceedings, Beef Session II: Spaying Heifers: The Why's, Techniques & Economics. No. 19, pp. 156-160.

Rationale: The objective of the following studies is to develop an alternative heifer management program for extensive range conditions that will inhibit early inadvertent pregnancies in heifer calves. The first study evaluated the effectiveness of the vaccine in a commercial cowherd where 45 heifer calf pairs were identified and randomly allotted (by age of dam and calf birthdate) to 1 of 3 treatment groups to evaluate the following objectives:

1. determine the optimal age for immunization (prepubertal vs. postpubertal)
2. determine how long the vaccine suppresses reproduction (cyclicity and pregnancy)
3. determine if the suppression of reproduction is reversible

Treatment group 1 was immunized between 4 to 6 months of age (prepubertal), treatment 2 was immunized between 10 to 12 months of age (postpubertal), and treatment 3 was an untreated control group. To assess the effectiveness of the vaccine, heifers were monitored for:

1. serum progesterone (hormonal indicator of reproductive cyclicity)
2. antibody concentrations against GnRH (indicator of vaccine effectiveness)
3. reproductive tract development by rectal palpation (scored according to the CSUC system: 1 = immature - 5 = mature)
4. pregnancy by rectal palpation as a true measure of fertility

Heifer calves were continuously exposed to a bull. In this manner, pregnancy was used as the indicator of fertility and was also used as an endpoint for "recovery" in the immunized heifer groups.

Results: Heifers experienced a reduction in reproductive tract development following immunization as shown in Table 1, while control heifers (untreated) exhibited linear growth of the reproductive tracts that is typical of yearling heifers of this age. Average progesterone values reported in Table 1 reflects ovarian activity.

Table 1. Average Reproductive Tract Scores and Serum Progesterones for Heifers by Treatment Group.

	June 93		Nov. 93		April 94	
	RTS	Prog.	RTS	Prog.	RTS	Prog.
Trt. 1: Imm. 4-6 m of age (April 93) (prepubertal)	1.00	0.54 ng/ml	1.60	0.44 ng/ml	3.20	2.94 ng/ml
Trt. 2: Imm. 10- 12 m of age (Nov 93) (postpubertal)	1.33	0.56 ng/ml	3.00	0.66 ng/ml	3.27	0.73 ng/ml
Trt. 3: Control	1.27	1.53 ng/ml	3.13	0.73 ng/ml	4.73	3.56 ng/ml

Table 2 shows that at 12 months of age, heifers in treatment group 3 (control) experienced a 27% percent pregnancy rate indicating that this population of heifers can indeed become pregnant at this early age. Treatment group 2 was immunized at an average age of 10 months (postpubertally) and experienced a 20% pregnancy rate verifying the need to immunize heifers prior to puberty to prevent pregnancy. These heifers were unable to develop sufficient antibody titers (antibody protection) before pregnancy occurred.

At 2 years of age, the control heifers resulted in an 87% pregnancy rate. Heifers immunized at an average age of 5 months experienced a 47% pregnancy rate when these heifers reached 2 years of age, indicating that these heifers do indeed recover from the sterilization procedure although the duration of infertility is highly variable. Immunized heifers that recovered from the period of sterilization and became pregnant, calved normally without assistance.

Table 2. Average Pregnancy Rate and Average Age at Calving by Treatment Group

	Pregnancy Rate 12 months of age:	Pregnancy Rate 24 months of age:	Avg. age at Calving:	Duration of anestrus
Trt. 1: Imm. 5m of age (April 93) (prepubertal)	0%	47%	30.5 mos	432 days
Trt. 2: Imm. 10m of age (Nov 93) (postpubertal)	20%	33%	33.5 mos	328 days
Trt. 3: Control	27%	87%	24 mos	NA

The Anti-GnRH vaccine generated antibody titers to GnRH in 98% of the heifers indicating that the vaccine is highly effective in stimulating the immune system. This data indicates that the Anti-GnRH vaccine is successful in creating a temporary suppression of reproductive function and would prove useful in preventing inadvertent pregnancies in heifers destined for the feedlot. In this manner, heifer calves would remain open through the growing and finishing phase, resulting in more efficient and profitable production of beef.

Several studies have been designed to synchronize the recovery of immunized heifers in an attempt to develop management strategies for large groups of heifers where it is difficult to make culling decisions early. In this manner, all heifers could be managed identically until culling decisions are made. Under this management strategy, the immunization procedure would be temporary and recovery of replacement heifers could be synchronized so that this population of females would still calve at two years of age. New vaccine adjuvants are currently being evaluated to determine their usefulness under this type of management scheme.

Determining Forage Diet Quality by Analyzing Fecal Matter with Near Infrared Spectroscopy

Sheila Barry, Livestock/Natural Resource Advisor, UCCE - Glenn, Tehama & Colusa Counties

Maintaining the nutritional status of cattle with efficient use of forage and supplements is critical during tough economic times. In the past, many ranchers have supplemented livestock on a "catch-all" basis. Based on experience and knowledge, they put out whatever supplements they can afford.

A relatively new technique developed by the Department of Range Ecology at Texas A&M University can quickly determine the nutritional status of cattle grazing rangeland or pasture. Cattle manure is analyzed using near infrared reflectance spectroscopy (NIRS). Correlation equations determine the cattle's actual protein and energy consumption. Ranchers have been excited about this new technique because it is quick and easy.

Fresh manure can be collected right off the ground. Results from the analysis are faxed to the rancher approximately 72 hours after the manure is collected. Researchers and ranchers in the mid-west have been impressed by the accuracy and utility of this technique. Many ranchers have saved thousands of dollars in supplement costs. Other ranchers have been able to quickly "turn around" herds in poor condition.

What is NIRS?

The NIRS process involves exposing a dried, ground fecal sample to light energy. The intensity of light reflectance is measured across several hundred wavelengths in the near infrared band (Lyons and Stuth 1991, 1992). A series of near infrared wavelengths from feces were found to be highly correlated with known diets derived from esphogeal fistulated animals sharing the same pasture. The reflectance is influenced by the number and type of chemical bonds in the manure. Because the chemical bonds are associated with fiber and protein in the diet, a predicition equation based on the wavelength of the reflectance from the manure can determine forage diet quality.

Since 1990, the Grazing Animal Nutrition Lab in Texas has been testing the geographical robustness of the forage diet quality prediction equation. Analysis of over 5000 samples has shown that spectral outliers occurred in less than 10% of the population samples. In an extreme test of geographical stability, the GAN Lab analyzed 160 samples from an Acacia savanna in Kenya and found only 4 crude protein outlies and 5 digestible organic matter outliers. An independent study conducted by South Dakota State University found very close agreement with dietary crude protein of esophageal fistulated cattle grazing range (R=0.92) (Stuth et. al., 1995).

This fall, UC Cooperative Extension began a project to validate and demonstrate the use of near infrared manure analysis to determine forage diet quality of cattle grazing in the Sacramento Valley.

Manure samples have been collected from ranchers throughout the Sacramento Valley. The results are summarized below.

Ranch Location	Cattle Description	Pasture Description	Date Collected	% Crude Protein	% TDN Total Digestible Nutrients
5 mi. west of Willows, Glenn Co.	Crossbred cows, fall calving	Dry annual range - lots of starthistle	10/16 11/20	<3% 3.3%	53.96% 50.87%
		Dry/green annual range	1/9 2/7	8.61% 8.75%	59.01% 60.87%
5 mi. west of Orland, Glenn Co.	Crossbred cows, fall calving	Irrigated ryegrass/clover pasture -wheat hay (10 lbs/head/day)	10/16 11/20	8.51% 10.78%	61.22% 61.32%
		Dry/green annual range	1/10 2/6	7.29% 8.38%	58.89% 62.97%
10 mi. east of Stonyford, Glenn Co.	Crossbred cows, fall calving	Dry annual range-oak woodland: wild oats, soft chess, starthistle, medusahead	10/17 11/20	3.46% <3%	52.14% 45.96%
		Dry/green annual range	1/8 2/6	8.04% 8.42%	59.61% 62.11%
20 mi. west of Red Bluff, Tehama Co.	Crossbred cows, spring calving	Dry annual range - oak woodland wild oats, soft chess, starthistle, medusahead, stipa, annual clovers	10/17	<3%	51.50%
		Dry/green annual range - oak woodland	1/10 2/7	6.53% 9.07%	60.19% 60.36%
25 mi. east of Stockton San Joaquin Co.	Crossbred cows	Dry/green annual range; low ground with riparian	2/8	9.6%	63.64%
		Dry/green annual range with lots of clover	2/8	10.22%	64.00%
		Dry/green annual range, rolling hills Dry/green annual range, rolling hills	2/8 2/8	8.53% 9.46%	60.97% 62.59%
12 mi. north of Chico, Vina Plains	Crossbred cows, fall calving	Dry/green annual range	2/12 2/12	10.40% 9.89%	62.70% 62.37%
	Yearling steers and heifers	Dry/green annual range with rice bran and almond hull supplement	2/12	16.27%	64.05%
Santa Clara County Area					
Top of foothills overlooking San Jose	Crossbred cows	Oak woodland range	3/1	15.30%	75.44%
Eastside of Mt. Hamilton	Crossbred cows	Oak woodland range	2/28	9.85%	55.71%
Northern Monterey County	Yearlings	Annual/perennial range	2/27	14.76%	59.98%

NIRS results for forage diet quality from cattle grazing at the Sierra Foothill Research and Extension Center were collected in October and January. Diet quality and animal performance was evaluated from these results using computer software, NUTBAL. NUTBAL was designed by the GAN lab to link NIRS technology with specific site and animal conditions to determine animal performance.

NUTRITIONAL BALANCE REPORT

Sierra Foothill Research Center (October) - Data Input:

Cattle Description: Crossbred cows (last 1/3 of gestation)

Manures samples collected from 33 cows grazing dry annual range without additional supplement were analyzed.

Average results:

Forage Crude Protein: 3.34%
Forage Digestibility: 57.47% (TDN)

Balance Report

	Est. Intake	Requirement
Crude Protein	0.42 lbs.	1.51 lbs.
Net Energy for maintenance	6.93 Mcal/day	11.33 Mcal/day

Estimated cow weight change: Cannot accurately predict amount of loss. Protein level is insufficient to maintain rumen function.

Sierra Foothill Research Center (January) - Data Input:

Cattle Description: Crossbred cows with fall born calves
60-day lactation milk production: 10.81 lbs/day

Manures samples collected from 26 cows grazing green /dry annual range without additional supplement were analyzed.

Average results:

Forage Crude Protein: 9.69%
Forage Digestibility: 62.33% (TDN)

Balance Report

	Est. Intake	Requirement
Crude Protein	2.26 lbs.	2.04 lbs.
Net Energy for maintenance	14.64 Mcal/day	14.34Mcal/day
Net Energy for gain	0.15 Mcal/day	0.00Mcal/day

Estimated cow weight change: 0.08 lbs/day

Low End Results:

Forage Crude Protein: 7. 82%
Forage Digestibility : 60.17% (TDN)

Balance Report

	Est. Intake	Requirement
Crude Protein	1.72 lbs.	2.04 lbs.
Net Energy for maintenance	13.13 Mcal/day	14.39 Mcal/day

Estimated cow weight change: - 1.4 lbs/day

High End Results:

Forage Crude Protein: 11. 60%
Forage Digestibility : 61.73% (TDN)

Balance Report

	Est. Intake	Requirement
Crude Protein	2.89 lbs.	2.04 lbs.
Net Energy for maintenance	16.59 Mcal/day	14.39 Mcal/day
Net Energy for gain	1.32 Mcal/day	0.00 Mcal/day

Estimated cow weight change: 0.69 lbs/day

Literature Cited

Lyons, R.K. and J.W. Stuth. 1991. Prodecdures for processing cattle fecal samples for NIRS analysis. Anim. Feed Sci. Technol. 35:21-36.

Lyons, R.K. and J.W. Stuth. 1992. Fecal NIRS equations predict diet quality of free-ranging cattle. J. Range Manage. 45:614-618.

Ranching Systems Group. 1993. Nutritional Balance Analyzer User s Guide. Dept. of Rangeland Ecology and Management, Texas A&M University, College Station, TX 77843-2126, 148pp.

Stuth, J.W, J.N. Kelleher, and R.K. Lyons. 1995. NIRS-NUTBAL Nutritional Management System for Cattle. In: Proceedings of Mid-South Ruminant Nutrition Conference. May 4-5, 1995.

BOVINE COCCIDIOSIS

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Coccidiosis causes significant economic losses in cattle. Although most cattle are exposed to coccidia and infected, most of the infections are self-limiting and mild or asymptomatic. The parasites that cause this condition are members of the species ***Eimeria***, and the most important of this species for causing disease in cattle are ***Eimeria bovis*** and ***Eimeria zuernii***.

The life cycle of these parasites is complex. Single cell **oocysts** are passed in the feces of cattle, are resistant to disinfectants, and can remain in the environment (particularly moist, shady areas) for long periods of time and maintain their infectivity. The oocysts sporulate and these sporulated oocysts are ingested by the host and the **sporozoites** are released in the intestine. Sporozoites enter the intestinal cells, form **trophozoites**, which in turn divide into many **merozoites**. These merozoites penetrate additional intestinal epithelial cells and form more **meronts**. Eventually, **macrogametes** and **microgametes** are formed which combine to produce the next generation of oocysts. When the oocysts are mature, they rupture the host cell and are released into the lumen of the intestine and pass out in the feces. The reproduction of these organisms is phenomenal as illustrated by the following:

1 oocyst
X 8 sporozoites
X 120,000 first generation merozoites
X 30 second generation merozoites
X 80% macrogametocytes
= 23,040,000 oocysts

The potential damage to the intestinal cells is obvious. It is estimated that as few as 50,000 infective oocysts ingested by a young susceptible calf can cause severe disease. The replication of the coccidia within the host's intestinal cells and the subsequent rupture of the cells is responsible for the disease and the clinical signs that develop. The severity of the disease is directly related to the dose of infective oocysts that are ingested. The more oocysts ingested, the more severe the subsequent disease. With light infections, the damage to the gut cells is minimal and because the cells in the gastrointestinal tract are replaced rapidly the damage is quickly repaired. In the case of heavy infections, about two weeks after the oocysts are ingested, most of the epithelial cells at the base of the intestinal glands are occupied by meronts or gametocytes. As these cells rupture, damage is severe and there is loss of blood into the feces. Also, fluid, electrolytes, and blood proteins (albumin) are lost.

Most animals infected with coccidia do not show signs of illness. This is due to the normally low dose and after a course of infection the animal is immune to that particular ***Eimeria*** species. However, this does not mean they are immune to all ***Eimeria*** species. Therefore, coccidiosis is primarily a disease of the young where there is crowding, stress, and/or nonimmune animals. Older cows certainly act as a reservoir and shed oocysts into the environment. Stress such as shipping, weaning, dietary changes, steroid therapy, and other problems can precipitate an outbreak of coccidiosis. Older cattle immune to their own endemic species of coccidia can become infected and/or ill when moved to a new herd and exposed to a different species.

The clinical signs of coccidiosis can include the following:

Diarrhea (bloody at times)
Straining (tenesmus)
Loss of appetite
Fever (slight)
Debility
Death (in severe cases)

Many cattle are affected and experience weight loss or decreased weight gains without showing obvious illness and these cattle account for the majority of the economic losses.

Your veterinarian can diagnose coccidiosis on the basis of clinical signs, fecal oocysts examinations, and post mortem examination of dead animals (if that occurs). Once an accurate diagnosis is made there are a number of drugs useful in treatment or prevention. Some of the drugs that can be used for treatment include:

Amprolium	Corid®	10 mg/kg daily for 5 days
Sulfaquinoxaline		2.72 mg/kg daily for 3-5 days
Sulfamethazine		110 mg/kg daily for 5 days

Some of these drugs and dosages may require a veterinarian's prescription and extended withdrawal time, be sure to check with your veterinarian before treating animals. Drugs can be very useful in helping to prevent coccidiosis and some of these are listed below:

Lasalocid	Bovatec®	1 mg/kg per day, maximum 360 mg/day
Decoquinate	Deccox®	22.7 mg/100 lb. daily for 28 days
Monensin	Rumensin®	100 to 360 mg/head per day

Both lasalocid and monensin are polyether ionophores which are used to increase feed efficiency and weight gains; however, they also have effectiveness to prevent (not treat) coccidiosis. Monensin has a lower threshold for toxicity and cattle must be gradually introduced to it in their diet to prevent diarrhea, feed refusal, or toxicity. Drugs useful for treatment are not necessarily useful for prevention and vice versa. Drugs administered in feed or water may not be consumed by sick animals, so the owner must be aware of this in treating ill cattle.

In a clinical research trial conducted at the Sierra Foothill Research and Extension Center in 1995 looked at the effect of prevention of coccidiosis on weanling cattle. Calves were preconditioned to a feed supplement prior to weaning. The supplement did not contain any drugs prior to weaning. At weaning, the calves were split into 3 groups randomly. The groups continued to receive their supplement base which then contained (1) no drugs, control group, (2) decoquinate (Deccox®), or (3) lasalocid (Bovatec®). The animals were closely monitored for signs of clinical disease, fecal oocyst counts, weight gains. The cattle were maintained on the treatments for only 28 days. At the end of the treatment period, the cattle with access to the two anti-coccidial compounds gained 0.5 pounds per day more than the control group. These cattle were not heavily parasitized and can best be characterized as mildly to moderately infected with coccidia. Our conclusion was that coccidiosis prevention, in weaned calves that are minimally exposed to coccidia may have important production benefits.

Strategic Supplementation of Range Beef Cows: Split Feeding by Body Condition and Stocking Rate

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Introduction

This paper describes research aimed at identification of optimal strategies for supplementary feeding of beef cows begun at the Sierra Foothill Research and Extension Center in 1994. Such strategies must maximize use of forage, promote high reproductive and lactation performance, and maintain range condition. The objectives of supplementary feeding on range are to supply nutrients which are deficient in the forage and are limiting animal production, and to maximize enterprise profits. The level of supplementary feeding should never exceed the point where the cost of the last unit of supplement equals the economic value of the production response it produces. While we know a great deal about the need for protein, energy, mineral and vitamin supplementation, we have inadequate information regarding the minimum amount and timing of supplementation required to insure economical cow herd performance.

Past Research

Current supplementation practices on foothill rangeland are based on results of studies conducted at the San Joaquin Experimental Range north of Fresno in the 1930s and 40s and more recent work at the UC Sierra Foothill Research and Extension Center. These studies may be briefly summarized as follows:

* Response to supplementation is influenced by stocking rate.
* Stocking rate should be stated on an available forage basis to remove differences in stocking rate due to forage productivity.
* While high producing rangelands such as those at Sierra Foothill Research and Extension Center may need less supplementation, rangelands of lower productivity and shorter green seasons such as those at San Joaquin Experimental Range may have greater supplementation requirements in terms of amount and duration of feeding.
* The length of the green season or adequate green season will influence supplement decisions so that years with long green seasons may require less supplementation than years with shorter green seasons.
* Producers require visual cues that signal critical thresholds of forage nutrient decline. Likewise, critical thresholds or targets for the cow such as condition score at calving should be defined. This would enable estimation of the need for supplementation based upon nutrient requirements and supply over time.

While providing useful information, these studies have not provided sufficient information about critical management variables and their interactions. The complexity of animal responses, superimposed on variation in forage supply and time lags of months between nutritional stress and reproduction preclude simple analyses and predictions. This study attempts to quantify these responses; later computer-based tools will be developed to assist producers.

Body Condition and Supplemental Feeding

For years, cattle producers have recognized the important relationship between the body condition of their cowherd and reproductive efficiency. Body condition scoring quantifies this relationship by placing a numeric score on the relative degree of fatness or energy reserves that is observed or palpated. Body condition scoring can be used by cow-calf producers to monitor nutrition programs as forage conditions and nutrient needs change. We have used a body scoring system of 1-9 (Table 1). Previous research has found that cows should have good body condition at calving to ensure good reproductive performance. Those in lower condition with a score of 5 or less at weaning may require a higher plane of nutrition relative to their better-conditioned peers.

Separating the cowherd by body condition and feeding each group according to specific requirements is one "strategic" supplementation method that may significantly increase the efficiency of a supplementation program. With this supplementation strategy nutritional needs can be better targeted, thereby allowing the producer the option of using a variety of energy-containing feedstuffs and/or better quality pasture to realize weight gains necessary to improve body condition, while feeding the cows with abundant flesh (body condition greater than 5) with lower quality forages to maintain condition through calving. In order to ensure cows have a body condition score of greater than 5 at calving, this strategy must be implemented several months prior to calving. Waiting too long to take action to improve body condition is cost prohibitive and, in some cases, impossible. Producers must recognize that calving through rebreeding is the most critical period in the beef cow's production cycle, with energy requirements at their peak. For example, the average cow needs approximately 40 percent more energy and over 60 percent more protein during this period than when dry. Typically, the cow loses approximately 120 to 140 pounds at calving which should be partially regained 60 to 80 days after calving. Furthermore, she has to produce adequate milk, undergo uterine involution and meet her maintenance requirements. On the downside, there are factors cow-calf producers must ponder if considering split-feeding as an alternative supplementation strategy. Split-feeding the cowherd into multiple groups requires additional pasture, fencing, and water that must be conveniently located.

Experimental Procedure

Initially, the research has been directed toward three hypotheses:

1. Optimal use of range forage over a number of years requires that rates of utilization be moderate most years, with heavy use in dry seasons and light use in favorable years.
2. Feeding programs aimed at achieving specific targets of body condition at various times during the year enable more efficient use of feed resources and maintain cow performance.

3. As maternal characteristics improve due to cross-breeding and genetic selection, reproductive and productive performance of cows become more sensitive to nutrition; therefore, supplementary feeding programs assume greater importance.

This experiment is aimed at examination of interactions between cow condition, time of year, grazing intensity (stocking rate) and feed supplementation. To this end, three supplementation strategies (none, standard and strategic) are used in conjunction with two stocking rates (moderate and heavy, Table 2). Stocking rates are maintained during the critical green forage availability time of year, late Fall and Winter. Type of supplement fed and specific time of supplementation are shown in Table 3. Cows enter the trial when they have weaned their first calf on June 1 each year. Standard management practices are observed, with open cows culled.

Measurements are aimed at definition of changes occurring in the cattle and on productivity and economic efficiency. As cows are moved from a paddock, residue levels are recorded. Cattle measurements include body weight, condition score, and ultrasound backfat at various times throughout the year (Table 3). Reproduction (post-partum anestrous interval, conception and calving rates, dystocia) and production (weaning weights) are also monitored. All inputs and outputs are recorded to enable valid economic analyses.

Preliminary Results

Complete data are available for the first year of the study, and number of cows on some of the treatment combinations are low. Thus several more years of data collection are necessary before one may place confidence in the results. On August 15, 1994, 36% (54 of 152) of the cows in the strategic supplementation group were in adequate condition and received no late summer supplementation (Aug. 16 - Sep. 30). In October all cows were placed on Heavy or Moderate stocking rate treatments. In the strategic group, low body condition resulted in 3 of the 54 cows not supplemented in the late summer and 68 of the 98 summer supplemented cows to be assigned to autumn supplementation (Oct. 1 - Dec. 31). Clearly cows in good condition in late summer tend to remain in good condition, but only 31% (30 of 98) of those in poor condition gained condition with protein supplementation during the dry summer feed season. Stocking rate slightly affected Jan. 1 body condition with those stocked moderately having average scores of 4.84 compared to 4.52 for the heavy stocking rate. However, nearly all cows needed winter supplementation, only 3 of the 152 cows in the strategic group were in adequate condition to not be placed in the supplemented group.

There were trends but no significant effects on calf weaning weight at weaning in May 1995, probably due to the relatively low number of cows the first year of this study. Cows that were allocated to heavy stocking rates had decreased pregnancy rates (73.2 vs. 89.5%, $P<.05$). Also, there was a significant interaction between supplementation treatment and condition score at calving (Table 4). Cows in the strategic group had pregnancy rates which differed by 11 percentage units between high (>5.25) and low (<5.25) condition scores, compared to 30-40 percentage units for the other supplement treatments (no or standard supplementation). It appears that body condition score at calving for cows on the strategic supplementation treatment was not as influential a variable on subsequent pregnancy rate. This suggests that strategic supplementation may be beneficial and has promise. The slightly lower pregnancy rates for the cows in greater condition is difficult to explain, and further research in this long term experiment should be helpful.

Table 1. Condition scoring system for beef cows.

Score	Appearance	Description
1	Severely emaciated	All ribs and bone structure easily visible, no visible or palpable fat detectable over spinous processes, transverse processes, hip bones or ribs. Tail-head and ribs project quite prominently. Animal has difficulty standing or walking.
2	Emaciated	Tail-head and ribs are less prominent. Individual spinous processes are rather sharp to the touch but some tissue cover exists along the spine. Animal not weak, but no fat detectable.
3	Very thin	Ribs are individually identifiable but not so sharp. No fat on ribs, brisket, spine and over tail-head, with some tissue cover over dorsal portion of ribs. Individual hind quarter muscles easily visible, spinous processes apparent.
4	Thin	Spinous processes can be identified individually. Ribs and pin bones are easily visible and fat is not apparent by palpation on ribs or pin bones. Individual muscles in the hind quarter are apparent.
5	Moderate	Ribs less apparent, less than .5 cm fat. At least 1 cm fat on pin bones. Last two or three ribs felt easily. No brisket fat. Hind quarter individual muscles not apparent. Area on either side of tailhead now has palpable fat cover.
6	Good	Smooth appearance throughout. Some fat deposition in brisket. Individual ribs are not visible. About 1 cm of fat on the pin bones and on the last two to three ribs. Fat evident around tailhead.
7	Very good	Brisket full, tailhead and pin bones have protruding fat deposits. Back square. Indentation over spinal cord. Between 1 and 2 cm fat on last two to three ribs. Some fat around vulva and in crotch.
8	Obese	Very fleshy and over-conditioned. Back very square. Protruding deposits on tailhead and pin bones. Brisket distended. Neck thick. Large spinal cord indentation. 3 to 4 cm fat on last two to three ribs.
9	Very obese	Extremely wasty, patchy and blocky. Tail-head and hips buried in fatty tissue. Bone structure no longer visible and barely palpable. Motility may be impaired.

Table 2. Experimental groups.

Treatment	Description
Supplementation	
None	No supplement given
Standard	Supplement fed during entire dry feed season
Strategic	Supplement given only to meet condition targets
Stocking rate (Nov. 16 - Feb. 28)	
Moderate	ca. .75 cows/acre; >800 lb/acre residue (Oct. 1)
Heavy	ca. 1.0 cows/acre, 625-800 lb/acre residue

Table 3. Supplement Application Design.

Item	Supplement Applied					
	Jun1-Aug15	Aug16-Sep30	Oct1-Nov15	Nov16-Dec31[1]	Jan1-Feb28[1]	Mar1-May31
Supplementation						
NONE	None	None	None[2]	None[2]	None[2]	None
STANDARD	None[3]	Protein[3]	Protein[2]	Alfalfa	Alfalfa	None
STRATEGIC[4]	None Protein[3]	None Protein[3]	None[2] Alfalfa	None[2] Alfalfa	None[2] Alfalfa	None None
Body condition score & weight	Aug 15	Sep 30		Dec 31		May 31
Minimum # cow groups	3	3	3	2x2	2x2	1

[1]Allocate cows at two forage availabilities, moderate and high.

[2]If forage availability is less than 625 lb/acre, supplement to achieve minimal forage intake.

[3]Cows which have weaned their first calf are grazed on irrigated pasture in the supplemented groups.

[4]Cows allocated to strategic supplementation are assigned their supplement based on a model at each body condition scoring date.

Table 4. Effect of Supplement Treatment and Condition Score at Calving on Subsequent Pregnancy Rate (%).

	Calving Condition Score	
Supplement Treatment	<5.25	>5.25
None	43.1	91.7
Standard	71.8	100.0
Strategic	73.4	84.6