

NEW YORK FEEDLOT AND CARCASS VALUE DISCOVERY PROGRAM
2000/2001 Report
M. J. Baker, D. J. Ketchen
Cornell University

A. Materials and Methods.

Twelve farms consigned 78 steers and 45 heifers to the New York Feedlot and Carcass Value Discovery program in November 2000. The cattle were delivered on November 2 and 3 to the Beef Unit of the Cornell University Teaching and Research Center in Harford, NY. Prior to delivery the cattle had been vaccinated for IBR, BVD, PI₃, BRSV, Leptospirosis, 7-way Clostridial, Pasteurella spp. and Haemophilus somnus, treated for internal and external parasites, supplemented with injectable Selenium and weaned for at least 30 days. On arrival the cattle were weighed and tagged, hip heights were measured and they were separated by sex and placed in feeding pens of 30-35 head. An estimated final weight was assigned to each animal as the weight at which the steer or heifer would be expected to grade low Choice. The Cornell Beef Unit manager made these assignments based on age, conformation, frame score and breed type. On November 9 cattle were re-weighed. This weight (less a 4% pencil shrink) became the official start weight of the feedlot phase of the program. The calves were implanted depending on projected days on feed. Days on feed were determined by dividing the difference between the official start weight and the final weight by 3.5 for steers and 3.0 for heifers. To maintain carcass quality, no cattle were implanted within 100 days of the projected harvest date. Two products were used: Synovex™ and Revalor™. The cattle were fed a total mixed ration once a day. The corn based high-energy ration (Table 1) was 13% crude protein and provided 0.60 Mcal/lb. of net energy for gain. The diet was designed using the Cornell Net Carbohydrate and Protein System version 4.0 (CNCPS) (Fox et al., 1992, 1995, 1998, 1999, and 2000). Cattle were weighed every 28 days.

A. Table 1. Average Ration Fed to Steers and Heifers Consigned to 2000/2001 NY Value Discovery Program.

Ingredient	Ration % (as fed)	Ration % (dry matter)
Corn silage	36	18.
High moisture ear corn	20	16
Dry shelled corn	33	50
Chopped hay	2	4
Soybean meal	7	10
Minerals/ionophore	1	2
NE _m , Mcal/lb.	-	1.01
NE _g , Mcal/lb.	-	.60
CP, %	-	13
Ration costs, ton	\$74	-

Cattle were harvested at their optimal value determined by feedlot performance and existing market conditions. All animals were sold to MOPAC in Souderton, PA, on a grade and yield basis. An independent grader was hired to take carcass measurements: backfat, ribeye area, kidney, pelvic and heart fat, and quality grade. A USDA Yield grade was calculated using these measurements.

B. Results.

1. Feedlot Performance

The following numbers of calves were sired by the different breeds: Angus-87; Red Angus-19; Murray Grey-3; Simmental-4; Shorthorn-10. The Dams of the calves were mainly Angus, Polled Hereford, Simmental and Limousin. The majority (62%) of the calves was crossbred.

Average initial weight of the steers and heifers was 599 lbs. and 563 lbs. respectively (Table 2), with the majority (70%) weighing between 500 lbs.-700 lbs. Most of the cattle consigned were born between February and May. The finished cattle were marketed after 136 to 194 days on feed. Average daily gain of the steers was 3.66 lbs. \pm .44 lbs., indicating that 62% gained between 3.22 lbs. and 4.10 lbs. each day they were fed. Average daily gain closely tracks mature size, therefore one would expect the steers to gain better than the heifers. This was the case with heifers only gaining 3.17 lbs. \pm .40 lbs.

During the feeding period 13 (17%) steers were treated for Bovine Respiratory Disease (BRD) as were 8 (18%) heifers. One heifer died, and one heifer was sold early for poor performance.

The majority of the steers (62%) weighted between 1100-1300 lbs. at harvest (Finish weight). and 65% of the heifers weighed between 975 lbs. and 1175 lbs.

B. Table 2. Feedlot Performance of Steers and Heifers in 2000/2001 New York Feedlot and Carcass Value Discovery Program.

Item	Average	Min.	Max.	Average	Min.	Max.
	STEERS (78 hd.)			HEIFERS (45 hd.)		
Initial weight, lb.	599	363	780	563	384	726
Finish weight, lb.	1203	899	1430	1066	581	1254
Date of birth	3/15	12/13	6/14	3/22	2/15	6/13
Age at delivery, mo.	7.9	4.9	11.1	7.7	5.0	8.9
Age at harvest, mo.	13.5	10.7	15.7	13.1	9.5	15.1
Days on feed	166	136	194	164	136	194
Average daily gain, lb.	3.7	2.7	4.7	3.1	.8	4.1
Feed to gain, lb. DM	5.9	5.2	6.9	6.3	5.4	9.9

A key feature of this program is the allocation of feed to individuals fed in group pens. A method developed by Perry and Fox (1997), for allocating feed to cattle on an individual basis considering differences known to affect requirements, including breed type, body size, and stage and rate of growth was used to calculate individual feed

efficiency. Each pound of weight gain is composed primarily of two tissues: muscle and fat. This model predicts the quantity of muscle and fat in each pound of gain. The energy required to produce a pound of muscle and fat is different. Energy requirements for beef cattle are divided into two parts: 1) maintenance (vital organ function and body temperature maintenance, which is a function of body weight and environmental conditions) and 2) weight gain or growth. By predicting the quantity of muscle and fat in the gain (called composition of gain), and calculating the amount of energy required to maintain and grow these tissues, it is possible to determine the energy requirement of the total gain. Having determined the aggregate amount of energy to maintain and grow the animal, we then determine the amount of feed that had to be consumed to meet these requirements. Evaluation of this model with individually fed cattle (365 steers) indicated it accounted for 74% of the variation in actual feed consumed.

Adding together each animal's feed requirement gives the total DM required to produce the animal performance observed in the pen. The comparison of total feed DM delivered to DM required is presented in Table 3.

Table 3. Dry Matter Delivered to and Required by Steers and Heifers in 2000/2001 New York Feedlot and Carcass Value Discovery Program.

DM Delivered, lbs.	DM Required, lbs.	Difference, lbs.	Ratio
Steers (78 hd.)			
276,917	276,955	38	1.00
Heifers (45 hd.)			
141,758	139,517	2,187	1.02

Feed actually delivered to the steers was essentially equal to the model predictions, while the model under-predicted the heifers. This agrees with a data set of 12,105 feedlot steers and heifers reported by Guiroy et al., 2001. Micro Beef Technologies, Inc. (Amarillo, TX) provided the feedlot data, which was collected with their computerized electronic cattle-tracking system. Total feed DM delivered vs. the sum of each individual animal predicted DM required, was compared using this model. In this evaluation, DM required was under-predicted 9% in the steers and was over predicted in the heifers by 11%.

Once dry matter intake (DMI) is determined, feed efficiency is easily computed by dividing dry matter required by average daily gain (ADG). The steers converted feed more efficiently than the heifers during this feeding period as measured by Feed to gain (5.9 lbs. vs. 6.3 lbs.). The steers were heavier at harvest and as body weight is a key determinant in calculating a maintenance requirement, they required more feed to maintain this weight. However, the greater ADG of the steers compared to the heifers resulted in a lower overall feed intake relative to gain. Information on feed conversion of progeny can be used by beef herd owners in selecting for animals which use feed more efficiently, resulting in a lower cost of gain to reach a given market target. Selecting for feed efficiency in the growing cattle may also lead to improvement in feed efficiency by the cowherd.

2. Carcass Performance.

The data collected on the carcass component is provided in Table 4. The steers produced an average hot carcass weight (HCW) of 745 lbs. \pm 74 lbs. while the heifers weighed in at 673 lbs. \pm 54 lbs. Two steers and 4 heifers fell beneath the minimum HCW of 600 lbs. This resulted in a discount in price paid by the packer. HCW can be used as a gauge of cow size. The weight of a finished steer at low Choice is approximately equal to the mature weight of his dam. If the steer's HCW is less than 600 lbs., the cow/calf owner should look at productivity of that cow. Due to steep discounts for underweight carcasses, she may be a candidate for culling. No cattle exceeded the upper limit of 950 lbs.

C. Table 4. Carcass Performance of Steers and Heifers in 2000/2001 New York Feedlot and Carcass Value Discovery Program.

Item	Average	Min.	Max.	Average	Min.	Max.
	STEERS (78 hd.)			HEIFERS (45 hd.)		
Hot carcass weight, lb.	745	560	868	673	369	803
Dressing percent	62	53	67	63	59	69
Ribeye area, sq. in.	12.7	9.6	18.4	12.7	9.0	17.4
REA/cwt HCW	1.7	1.5	2.3	1.9	1.3	2.4
Backfat, in.	.50	.25	.85	.45	.10	.80
Yield grade	3.0	1.1	4.4	2.6	1.0	4.1
% Empty body fat	29.1	24.4	34.1	27.7	20.7	33.0
% Choice or higher	88.5			91.1		
% Select	7.7			4.4		
% Qualifier	51.3			46.7		
% Dark and/or Std	3.8			4.4		
%YG 4	9.0			2.2		
% <600 lb HCW	2.6			8.9		
% >950 lb. HCW	0.0			0.0		

Ribeye area (REA), is an indication of overall muscling and was acceptable. The steers and heifers exhibited equal muscling at 12.7 sq. in. Heavier carcasses generally have larger ribeye areas. Examination of REA when corrected for body weight gives a slight edge to the heifers. They had 0.2 sq. in. more REA per hundred pounds of body weight indicating that on average they carried more muscle for their body size compared to the steers. The heifers were also more consistent as indicated by a lower standard deviation (\pm .26 and \pm .20 for steers and heifers, respectively). To keep production related problems associated with heavy muscling (e.g. dysctocia) at an acceptable level, producers should aim to keep REA/cwt. of HCW between 1.8 and 2.2 sq. in.

Yield grade (YG) is an estimate of the percentage of boneless, closely trimmed, retail cuts (BCTRC). It is presented on a scale of 1-5, with a YG1 having more BCTRC than a YG5. It is calculated using hot carcass weight, backfat, ribeye area and internal fat. The steers had heavier carcasses and slightly more backfat but the same REA as the heifers. For YG to improve, REA must increase with HCW, therefore the heifer carcasses contained a higher percentage of lean compared to the steers YG 3.0 vs 2.6 for steers and

heifers, respectively). Generally, lighter muscled animals tend to produce more Yield Grade 4 (fatter) carcasses, which are discounted by the packer. The steers had 9% YG 4's while the heifers had just over 2%.

When harvested, Empty Body Fat (EBF) in finished cattle typically varies from 16 to 21% in the French and Brazilian markets to over 30% EBF in segments of the Japanese and Korean Markets (INRA, 1989; D. Lanna and C. Boin, University of Sao Paulo, personal communication). At 28% EBF, most cattle will grade low Choice. When selling to meat packers in the northeastern US, low Choice is the marketing target that generally results in the highest consumer satisfaction and optimal feedlot profit. While numerically different, the EBF and the percent Choice or higher is essentially the same between steers and heifers. This is a great improvement over last year when 70% of the cattle consigned to the Value Discovery Program graded low Choice at similar EBF.

Another factor that affects carcass value is the color of the lean. Lean color is used by consumers as an indicator of perceived freshness. Consumers will not buy cuts of meat that are dark unless discounted. Therefore packers severely discount cattle with carcasses classified as dark cutters. This defect was equally expressed by steers and heifers in this set of cattle. Grouped in with dark cutters are those cattle that have minimal intramuscular fat (IMF), a key determinant in Quality grade. Carcasses with traces of IMF are classified as Standard and are also deeply discounted.

3. Economic Performance

The economic performance of the Value Discovery cattle is described in Table 5. Feed cost of gain is the dollars of feed it took to produce one pound of gain. The steers were cheaper to feed than the heifers which is expected given their better feed efficiency. Total cost of gain (TCOG) includes feed cost, but also a yardage fee of \$.40/hd/day which covers labor, facilities, and other overhead costs. Added to that are charges for vet, medicine, trucking, marketing and data collection. The TCOG averaged \$.53/lb. and \$.57/lb. for steers and heifers, respectively. Calves that had higher rates of gain, and those that did not incur vet and medicine charges were more competitive than slow gaining sick cattle. This is especially evident when looking at the range in TCOG, with some animals costing as much as \$.75 for every pound of gain. The average price received was much improved from last year at \$1.28/lb and \$1.26/lb, compared to cattle marketed in Spring of 2000 at \$1.16/lb and \$1.13/lb for steers and heifers, respectively. This reflects a higher base price, more cattle receiving premiums and lower discounts. Cattle that reach middle Choice quality grade or above qualify for the Asian export market and receive a premium. This year 52% of the steers and 47% of the heifer qualified for this premium.

Table 5. Economic Performance of Steers and Heifers in 2000/2001 New York Feedlot and Carcass Value Discovery Program.

Item	Average	Min.	Max.	Average	Min.	Max.
	STEERS (78 hd.)			HEIFERS (45 hd.)		
Feed cost of gain, \$/lb.	.34	.30	.40	.36	.32	.46
Total cost of gain, \$/lb.	.53	.46	.75	.57	.49	.67
Price received, \$/lb.	1.28	.92	1.32	1.26	.54	1.31
Feeder value, \$/lb.	1.07	.49	1.43	1.03	.71	1.2
Profit/loss, \$/hd.	106	-217	200	99 ¹	-74 ¹	220 ¹

¹Removed from this calculation is the one heifer sold early for poor performance and one that died.

Cattle that are outside the targets specified by the packer are discounted. Table 6 lists the average discounts applied to this set of cattle.

Table 6. Discounts applied to carcasses not meeting given criteria in the 2000/2001 NY Value Discovery Program, March-June, 1999.

Grade/Description	Discount, \$/lb.
Heifer	0.01
Select	0.02
Standard	0.12
Yield Grade 4-5	0.10
Carcass < 600 lb.	0.10
Dark cutter	0.20

The value of the feeder calf consigned to the Value Discovery program is determined by the following equation:

$$\frac{\text{Total Receipts} - \text{Total Costs}}{\text{Initial weight of calf}}$$

This is the amount per pound that could be spent on this calf and still cover all costs. It is truly the value of that calf. On average, the steer with an initial weight of 599 lbs. was worth \$1.07/lb. Likewise, the average heifer was worth \$1.03/lb, at 563 lbs. In other words, retaining ownership of these cattle netted \$1.07/lb and \$1.03/lb for the steers and heifers respectively. Or, looking at it from the cattle buyers' perspective, \$1.07/lb is all that could be paid for the steers, and still cover the total cost of feeding. This was much higher than the price being paid for feeder cattle at the time of entry into the feedlot.

Finally, to determine the net profit/loss, a value was placed on the feeder calf based on prices received at various NY feeder calf sales during Fall of 2000. Due to very minimal market price fluctuation during the period the cattle were sold, the price used is actual and not adjusted. At this sale 620 lb. steers averaged \$.86/lb. and the 625 lb. heifers averaged \$.80/lb. To correct for calves not weighing exactly 550 lbs., for every 100 lbs. over 620 lbs. the price was decreased \$.05/lb. If the cattle were lighter, the price was increased \$.05 for every 100 lbs. below 620 lbs. After paying all feedlot and marketing costs, the net return on the average steer was \$106/head and \$99/hd on the heifers, compared to selling as a feeder

calf. The steer that lost the most money was classified by the grader as an aged animal, carrying a steep discount. While rare, this does happen, even though the physiological age was 13 months at the time of harvest. The heifer that lost money was under the 600 lbs. minimum carcass weight receiving a \$.10/lb discount. Even with the discounts on these outliers it was a good year, economically to feed cattle; only three steers and 4 heifers did not make a profit.

C. Discussion.

1. Cattle Health

To examine the impact of vaccination protocol on performance, every other animal was administered TSV-2™, on arrival (Table 7.). This intranasal vaccine provides a quick immune response to the primary organisms responsible for Bovine Respiratory Disease.

Table 7. Treatment Rate for Bovine Respiratory Disease in Cattle Differing in Vaccination Protocol.

Protocol	No. animals	No. animals treated
TSV-2™	67	7
Control	56	10

There was no improvement in health of animals that were vaccinated on arrival compared to those not vaccinated on arrival. Immunological studies where the incidence of disease is relatively low typically require large sample sizes. In this instance, the sample size (n=123) does not show a significant difference, where a larger sample might.

While vaccination at arrival did not increase ADG, the performance of the cattle was impacted within the first 28 days of feeding by sickness (Table 8). Cattle that required treatment for BRD gained 67% less than those not treated. Average daily gain, however was not significantly different when measured over the entire feeding period.

Table 8. Performance of Cattle Treated for Bovine Respiratory Disease

Status	No. animals	28 day ADG ¹ , lbs.	Cumulative ADG ² , lbs.
Not treated	106	3.6	3.7
Treated	17	2.4	3.4

¹Average Daily Gain, difference (P<.001)

²non-significant

Finally, the cattle that were treated for BRD were less profitable than those not treated (Table 9). The difference was not statistically significant, but numerically healthy cattle (non-treated) were nearly 30% more profitable than sick cattle. Healthy cattle having fewer days on feed, grading Choice more often and receiving a higher sale price could explain this improved profitability.

Table 9. Impact of Sickness on Feedlot and Carcass Performance of Steers consigned to 2000/2001 Value Discovery Program

Item	Treated	Not treated
TCOG	.54	.52
P/L (adj)	\$94	\$117
%choice	67	86
Sale Price	\$1.25	\$1.29

2. Sorting by profit.

To better understand the data generated by the program, pertinent information from the steers was summarized. Using profit as a key variable, the data set was sorted into thirds, the top third being the most profitable and the bottom third the least profitable. The data from this sort is presented in Table 10.

Table 10. Performance of Steers Sorted into Thirds by Profit In 2000/2001 New York Feedlot and Carcass Value Discovery Program.

Item	Top	Middle	Bottom
No. head	26	26	26
In weight, lb.	601	611	585
Out weight, lb.	1267	1213	1129
ADG	3.9	3.7	3.4
F/G, lb.	5.8	5.9	6.0
Hot carcass weight, lb.	802	748	686
Dressing percent, %	63	62	61
Ribeye area, in. ²	13.4	12.8	12.0
REA/cwt. Liveweight, in. ²	1.7	1.7	1.7
Backfat, in.	.53	.49	.49
Yield grade	3.1	3.0	3.0
%Empty body fat	29.5	28.9	28.9
% Choice	92%	92%	65%
Vet & Med., \$/hd	14.60	8.58	25.14
Feed cost of gain, \$/lb.	.34	.34	.35
Total cost of gain, \$/lb.	.50	.52	.55
Price received, \$/lb.	1.28	1.29	1.26
Total feedlot costs, \$/hd.	335	314	300
Feeder value, \$/lb	1.17	1.08	.97
Profit/loss, \$/hd	162	116	41

The steers in the most profitable third earned \$162/head. That's \$46/head more than the middle third and more than \$121/head above the bottom third. Reviewing the data showed that the most profitable steers had:

- 1) heavier finish weights
- 2) greater ADG

- 3) heavier carcass weights
- 4) higher dressing percentages
- 5) larger ribeye areas
- 6) Higher percentage reaching Choice quality grade
- 7) lower Total cost of gain.

The main differences affecting profits include heavier carcasses, higher daily gain, and a higher average % Choice. Since returns were above the break even sale price, selling as much weight as possible without discount increased profit. The higher % Choice further increased their advantage (selling more weight and at a higher price). Since all three groups averaged a similar degree of fatness when sold (as evidenced by similar empty body fat) this higher quality grade appears to be related to genetic differences which favor marbling. Feed efficiency was slightly higher at similar empty body fat. Being at similar body fat indicates that they were at a similar stage of growth. Therefore the more profitable group may be exhibiting a genetic propensity to convert feed more efficiently.

As feed cost of gain was similar across groups, differences in total cost of gain were due to lower vet and medicine charges and a fixed cost of gain (yardage, freight, data collection) that was lowered due to fewer days on the feedlot.

Producers should determine where their animals rank compared to the averages of this data sorted into profit groups. Tracking these animals back to their respective sire and dam can provide some direction in targeting selection pressure.

3. Benchmark comparison.

How does the feedlot and carcass performance of cattle consigned to NY Value Discovery compare to performance of other cattle in similar programs? How do they compare to the ideal steer? The Texas A&M Ranch to Rail program is a long running program evaluating the feedlot and carcass performance of steers in Texas. The National Cattlemen's Beef Association conducts periodic audits of the beef industry. From this audit, characteristics of the ideal steer can be drawn. Table 7 lists characteristics from each program and contrasts them to the performance of cattle in the NY Value Discovery program.

Table 11. Performance of Steers in Texas Ranch To Rail, NY Value Discovery Program and Ideal Values (1999/2000).

Item	Texas Ranch to Rail	NY Value Discovery	Ideal
IWt, lbs.	609	599	
FWt, lbs.	1190	1203	1050-1200
DOF	211	166	>120
ADG, lbs.	2.76	3.66	>3.0
V&M, \$/hd.	\$8.82	\$17.61	\$0
FCOG, \$/cwt.	\$54.06	\$34.39	
TCOG, \$/cwt.	\$61.39	\$52.62	
HCW, lbs.	787	745	650-750
%Ch	53	89	70
%YG 1,2	75	44	70
BF, in.	.40	.50	.25-.45
REA, in. ²	14.1	12.7	11-13
REA/cwt.	1.80	1.68	1.8-2.2
P/L, \$/hd.	\$142.09	\$106.03	

Cattle delivered to the NY Value Discovery program were similar to those in the Texas Ranch to Rail program in delivery (IWt) and harvest (FWt) weight. Average daily gain was 3.7 lbs. compared to 2.76 for Texas, and both feed and total cost of gain was lower than the Texas average. Health of local cattle needs to be addressed, as the average cost for vet and medicine for NY fed cattle was nearly twice that of Texas fed cattle. NY steers were in the upper range of desired carcass weights, while those of Texas were above this range. Local cattle excelled in marbling, having 89% reach the low Choice or higher, and did so with just over the ideal backfat level. Smaller ribeye areas and lighter carcasses however, led to Yield Grades that need to be improved. The national demand calls for 70% Choice cattle with 70% Yield grade 2 or lower. Until very recently, local packers were not providing pricing incentives for Yield grade 1 or 2. As such, there was little economic justification to select genetics that could lower fat, without impacting marbling. Recent changes in pricing grids that are being offered should push cow/calf producers to increase selection in this area, as well as encourage cattle feeders to shorten days on feed. Muscling as measured by ribeye area was adequate in reaching the overall target. Evaluation of muscling relative to carcass weight provides a needed area of focus. Only 21% of the carcasses had greater than 1.8 sq. in. of REA per hundredweight of carcass.

Net return from feeding favored the Texas program (Table 12). New York cattle commanded a higher price at \$1.28 compared to \$1.21, but as more pounds were sold per carcass and Texas valued their feeder calves lower than NY, profits were higher in the Texas Ranch to Rail program.

Table 12. Economic Results of Texas Ranch to Rail Program and NY Value Discovery Program, 2000/2001.

	Texas	NY
INCOME	\$952.96	\$953.60
EXPENSES		
Feeder calf value	\$462.28	\$530.84
Feed	\$306.96	\$207.72
Yardage	\$ 0	\$66.40
Vet and medicine	\$8.82	\$17.61
Data collection	\$2.90	\$25.00
Death loss, other	\$22.93	\$ 0
Interest	\$6.98	\$ 0
NET	\$142.09	\$106.03

D. Summary

Feedlot performance, cost of gain and carcass quality are areas where cattle consigned to the Value Discovery Program have done well. Areas for improvement lie in increase health status and in increasing muscularity.

Producers in this program are to be commended for taking the initiative and the risk to participate in this program. The information that they gather will allow them to determine whether they are on target or if they need to make changes in their breeding program. As they do, these producers will be well positioned to take advantage of value based markets as they become available.

Literature cited

- Fox, D.G., C.J. Sniffen, J.D. O'Connor, J.B. Russell, and P.J. Van Soest. 1992. A Net Carbohydrate and Protein System for Evaluating Cattle Diets: III. Cattle requirements and diet adequacy. *Journal of Animal Science* 70:3578-3596.
- Fox, D.G., M.C. Barry, R.E. Pitt, D.K. Roseler, and W.C. Stone. 1995. Application of the Cornell net carbohydrate and protein model for cattle consuming forages. *J. Anim. Sci.* 73:267.
- Fox, D. G., and T. P. Tylutki. 1998. Accounting for the effects of environment on the nutrient requirements of dairy cattle. *J. Dairy Sci.* 81:3085-3095.
- Fox, D. G., M. E. Van Amburgh, and T. P. Tylutki. 1999. Predicting requirements for growth, maturity, and body reserves in dairy cattle. *Journal of Dairy Science* 82:1968-1977.
- Fox, D. G., T. P. Tylutki, M. E. Van Amburgh, L. E. Chase, A. N. Pell, T. R. Overton, L. O. Tedeschi, C. N. Rasmussen, and V. M. Durbal. 2000. The Net Carbohydrate and Protein System for evaluating herd nutrition and nutrient excretion. *Animal Science Dept. Mimeo 213*, Cornell University, Ithaca, NY.
- Guiroy, P.J., D.G. Fox, M.J. Baker and L.O. Tedeschi. 2001. Predicting individual feed requirement of cattle fed in groups. *Journal of Animal Science* 79:1983-1995.
- Perry, T. C., and D. G. Fox. 1997. Predicting carcass composition and individual feed requirement in live cattle widely varying in body size. *J. Anim. Sci.* 75:300-307.