NUTRITION AND MANAGEMENT OF FEEDLOT CATTLE

BOB LEE

SUMMARY

Growth of cattle in a feedlot can be accomplished by an almost infinite combination of diets, management systems and physical facilities. Over the past 50 years, this has been demonstrated in various countries throughout the world, especially in the United States, Canada, Australia and Mexico. Lot feeding of cattle can be accomplished with high roughage diets, high concentrate diets, high by-product diets or any combination of these. Production efficiencies, measured by cost of production per unit produced, have shifted nutritional programs in the United States towards a continually higher concentrate diet in the feedlot over the past 20 years. Increased management of feeding programs and animal health programs have been required for a feedlot to use a higher concentrate feeding program. The benefit for the successful feedlots has been increased productivity, lowered productions costs and increased profitability. Feedlots that have not improved their management techniques, while trying higher concentrate diets, have experienced numerous health problems and have decreased their overall profitability.

In a free market system, the feedlots that continue to improve the level of management and increase productivity become more stable and profitable, while feedlots that fail to improve productivity become opportunity feedlots or are purchased by the more productive feedlots. Management and nutrition play a key role in the final outcome of any feedlot.

INTRODUCTION

Cattle are classified as fresh grass grazers (Van Soest 1982) according to their feeding habits- Reference is made toward cattle being the most developed and the most unselective of all grazing ruminants. Through the evolutionary process for the last 40 million years, development of the rumination process was probably linked to a less selective feeding behavior. The end result is an animal that can consume large quantities of food in a short amount of time, then find a safe place to relax and further process the ingested mass by rumination. This evolutionary process fits very well for cattle consuming large quantities of forage or high roughage material, but it is an inherent, physiological problem that must be properly managed if high concentrate diets are fed to feedlot cattle.

Feed efficiency has been improved over the years in all types of farm livestock by using higher energy diets and increasing feed intake. The primary reason has been to . shorten the period of time required to produce a specific unit of gain, whether it be kilograms of meat or kilograms of milk. If the production system is profitable and the production time is shortened without drastically increasing input costs, then the enterprise becomes more profitable. Shortening the production cycle by increasing the concentrate in the diet also dilutes fixed costs for facilities by allowing more animals to be marketed in the same period of time compared to a high roughage diet. This accelerated production schedule requires a corresponding increase in management level to minimize problems that decrease productivity and profitability.

Kantech Research Foundation, 3675 Bluestem Road, Garden City, KS, 67846, USA

The following experiments, dealing with feedlot cattle, tend to show how adaptable cattle are to various production systems, and how proper nutrition and management can enhance animal productivity.

MATERIALS AND METHODS

Experiment 1: Effect of dietarv protein level on performance of yearling steers

Trenkle (1992) conducted a series of studies evaluating percentage protein of feedlot diets ranging from 11.5% and 14% crude protein on a dry basis. He also superimposed an implant treatment with Revalor-S across the protein treatments in order to evaluate if possibly the protein requirements were increased for steers implanted with Revalor-S.

Table 1 Effect of dietary protein and implant on performance

	Percent Dietary Protein				
	11.5	11.5		14.0	
Implant	-	+		+	
In weight, lb.	838	842		838	
Final weight, lb.	1213	1281		1336	
A.D.G., lb.	3.37	3.96		4.48	
% difference due to implant or protein level			14.8%		11.6%
Intake, lb.	19.0	20.6		22.7	
Feed/gain	5.64	5.20		5.06	
% difference due to implant or protein level			7.9%		2.7%
Income over control	-	$85.00		$98.40	
Expense over control	-	$13.90		$63.90	
Net per head		$71.10		$34.50	

The performance was increased over controls with implanting and higher dietary protein levels (2 lb. of soybean meal per head daily). However, the most cost effective return to the producer would be with the 11.5% protein diet with implants. The cost of the soybean meal to bring the diet up to 14% crude protein is very expensive. The conclusions from this study indicate that the protein requirements of implanted large-framed cattle is greater than NRC recommendations. However, it remains to be established if heavier yearlings need to be fed 14% protein, or if 12-13% would be adequate.

Experiment 2: Protein nutrition of feedlot cattle during the receiving and earlv growing period

Zinn (1993) reported an equation for expressing the crude protein requirements of feedlot calves on the basis of live weight, rate of gain and net energy of the diet. Results were computed from eight performance trials to derive an empirical relationship between dietary crude protein and feedlot performance.

The equation is:

$$CPR = .00115W + 2.20G - .806G^2 - 1.027$$

where CPR = daily crude protein requirement (kg)
W = live weight (kg)
G = live weight gain per day (kg/day)

Using the above equation and the data from Trenkle (1992), the calculated percent protein needed to achieve the minimum gains would be 8.2%. The maximum gains (2.203 kg/day) would require 12.2% crude protein in the diet, not 14% as fed in the experiment. Optimizing input costs for expensive feeds such as protein will produce a better economic return to the producer. The equation used makes adjustments for increased performance and increased energy level in the diet causing an increased protein requirement. How much of this can be non-protein nitrogen and how much must be natural protein is not clear and needs to be addressed in future research projects.

Experiment 3: Observations on the effect of grain type on response to supplemental fat

Brandt (1992) reviewed feedlot trials that had been conducted since 1965 and summarized the performance of cattle fed rations based on different grain types with various fat levels and types.

Table 2 Effect of grain type on response to supplemental fat

			% Response over control		
Basal grain type	**Fat level**	**Type**	**A.D.G.**	**D.M.I.**	**F/G**
Wheat	4%	Blend	12.6	3.1	9.5
Barley	4%	Tallow or YG	8.3	-1.1	8.5
Sorghum	4%	YG	6.8	1.5	5.4
Corn	3%	Tallow or blend	3.5	.1	5.4

In general, the summary shows that cattle performance on different grain types respond differently to addition of fat to the complete diet. Wheat and barley diets show the largest performance response to fat addition, while corn diets and sorghum diets respond less to added fat. It is easy to see why some nutritionists give fat a higher or lower energy value than their counterparts, based on past feedlot performance. Possibly, the main difference in energy values for fat is due to the basal grain type fed. In the same paper, Brandt presented data showing an interaction between monensin and fat in feedlot diets.

This finishing study demonstrates the potential for interaction between added fat and ionophores, possibly because both fat and ionophores possess antimicrobial activity and also because ionophores are fat soluble. This study showed a feed efficiency response of approximately 7% for supplemental fat and for monensin/tylan fed separately, but the effects were not additive when fed together. These results led to another study to see if supplemental fat increased the threshold level for an ionophore response. Brandt (1992) conducted a study and evaluated monensin levels of 0, 20 and 40 ppm with 0 or 4% added fat. Interactions existed between supplemental fat and monensin level for A.D.G. (P=.10) and DM intake (P<.02). Supplemental fat improved feed efficiency (P<.025) by steers, with no further significant improvement from monensin addition. Many feedlot nutritionists are puzzled by these findings, and both ionophores and fat are commonly fed in the United States today.

Table 3 Interaction of fat and monensin/tylan on finishing performance of steers				
Item	0% fat		4% fat	
	-MT	+MT	-Mt	+MT
A.D.G., lb.	3.82	3.98	3.83	3.55
Intake, lb. dry	17.33	16.73	17.11	17.30
Feed/gain	6.08	5.64	5.63	5.67
Fat x monensin interaction (P=.07)				

Experiment 4: Wet distillers byproducts for finishing cattle

Larson et al. (1993) reported on findings from feeding wet distillers byproducts and liquid thin stillage to finishing beef cattle.

Table 4 Corn and wet distillers byproducts composition, %DM			
Nutrient	Corn	Wet Grains	Thin Stillage
Dry Matter	86.8	31.4	5.0
Starch	70.3	9.0	22.0
Crude protein	10.1	25.0	16.8
Fat	3.8	13.7	8.1
Ethanol	-	10.7	12.2

Production of ethanol for fuel use from corn grain results in fermentation byproducts that must be disposed of to keep the ethanol plant operational. Traditionally, these byproducts have been dried to keep freight costs more reasonable, since dried byproducts can be transported far more economically than the wet byproducts. Field experiences have shown that wet distillers byproducts are an effective protein and energy source for feedlot cattle.

Table 5 Effect of wet distillers byproducts on animal performance				
Item	Byproduct level, % of DM			
	0	5.2	12.6	40.0
Intake, lb.	25.21	24.64	24.05	21.30
A.D.G., lb.	3.61	3.76	3.85	3.85
Adjusted feed/gain[a]	6.94	6.62	6.33	5.78
[a] Adjusted for ethanol intake				

A significant (P<.01) linear response was observed for byproduct level for feed/gain, ue to the protein and energy value of the wet distillers byproducts. The byproducts are ery high in oil content and higher in fiber content than corn grain. This gives a high nergy feed that also has a ruminal buffering effect. The additional protein could also mprove performance. In this study, the steers also drank 2.5 ± .7 gallon of thin stillage er head per day. Based on a cobalt marker used, it was calculated that 52.7% of the thin tillage consumed bypassed the rumen. Wet distillers grain and thin stillage can be ffectively used in a feedlot situation, but due to their high moisture content, they cannot e economically transported long distances.

Experiment 5: Effect of density of steam flaked grain sorghum on animal performance, mill production rate and subacute acidosis

Reinhardt (1993) reported results of a trial that evaluated animal performance and other factors when the flake density of steam flaked grain sorghum was varied.

Table 6 Performance data for various grain sorghum flake weights

	Flake Weight (lb/bushel)		
Item	22	25	28
Number of pens	12	12	12
Number of steers	112	112	112
A.D.G., lb.	2.99[b]	3.09[bc]	3.21[c]
Intake, lb. DM	18.4[b]	18.8[b]	19.0[c]
Feed/gain	6.13[d]	6.10[de]	5.92[e]
Production data			
Rate, ton/hr.	1.155[f]	1.521[g]	1.929[h]
Energy cost, $/ton	3.79	2.87	2.26

[b,c] means in the same row with different superscripts differ (P<.05)

[d,e] means in the same row with different superscripts differ (P=.15)

[f,g,h] means in the same row with different superscripts differ (P<.0001)

The results of this study show that diet with a very highly processed grain sorghum flake (22 lb./bu.) produced poorer performance than a diet with moderately processed grain sorghum (28 lb./bu.). This is due to the fact that the highly processed grain sorghum is fermented more rapidly in the rumen than the moderately processed grain sorghum. The thin flake tends to cause a subacute acidosis in the animal, resulting in poorer performance. The evolutionary animal behavior discussed at the beginning of this paper is the contributing reason to this problem, i.e., a ruminant can eat large amounts of feed in a short period of time. If this feed is highly digestible and rapidly fermentable, then digestive problems can occur Very highly processed grains may cause performance reductions in cattle when used in high concentrate diets.

Experiment 6: Use of dried bakery products (DBT) for finishing steers

Milton (1993) conducted a study where dried bakery byproduct replaced various levels of corn in the finishing diets of feedlot steers. The dried bakery products were a blend of hard and soft wheat products, pasta, potato chip waste, breakfast cereals, cookies and biscuits.

Table 7 Effect of dried bakery product on feedlot performance

Item	Control	15% DBP	30% DBP
A.D.G., lb.	3.13	3.18	2.97
DM intake, lb.	23.07	23.24	21.58
Feed/gain	7.36	7.29	7.19

Dry matter intake was reduced (P<.11) with the 30% dried bakery product, but no other significant differences were noted on this study. The results of this study show that dried bakery product and dry rolled corn have basically the same energy value when the dried bakery products are used at 30% or less of the diet. This could result in significant feed cost savings to a feedlot, especially when dried bakery product costs $30 per ton and corn costs $100 per ton delivered to the feedlot.

Experiment 7: Factors affecting cattle finishing Drofitabilitv

Mintert et al. (1993) reported the results of analyzing data from 6,696 pens of cattle representing 1.3 million cattle fed in two western Kansas feedlots from January 1980 through May 1991. The data was evaluated to explain which factors accounted for most of the variability in net return per animal.

Table 8 Percentage of total explained variability in net return of steer feeding over time, attributable to selected factors, by placement weight

Explanatory variable	Feeder placement weight		
	600-699 lb.	700-799 lb.	800-899 lb.
	% variability in net return explained		
Fed price (sale price)	54.3	54.2	38.0
Feeder price (purchase price)	16.9	24.8	41.6
Corn price	15.9	8.9	6.3
Interest	2.2	1.0	-0.2
Feed conversion	3.1	3.5	4.8
Daily gain	0.4	1.4	3.7
Total explained	92.8	93.8	94.3
Unexplained variability	7.2	6.2	5.7

Table 9 Percent of variation in steer finishing cost of gain explained by various factors, by placement weight			
	Feeder placement weight		
Explanatory variable	600-699 lb.	700-799 lb.	800-899 lb.
	% variability in net return explained		
Grain price	66.9	65.1	58.4
Feed/gain	22.9	25.7	32.8
Daily gain	3.1	2.6	2.6
Total explained	92.9	93.4	93.8
Unexplained variability	7.1	6.6	6.2

The two tables above (tables 8 & 9) show, from an economic standpoint, how important various factors are for cattle feeding profitability. For the net return, the feeder price, fed price and corn price are easily the most important factors that influence profitability. For cost of gain, the grain price is the most influential factor. Feed/gain is frequently thought to be the most important factor that affects cost of gain, but it accounts for only ¼ of the total variability. From a consulting nutritionist standpoint, reduction in feed conversion is the variable we can do the most with to improve cost of gain. Daily gain contributes very little to net return or cost of gain. Again, performance parameters (daily gain and feed efficiency) can be considered as minor components in a profitable feeding operation compared to purchase price, selling price and grain price. This is true if a feedlot has an advantage over competing feedlots in purchase price, selling price and gram costs. However, as more feedlots become equal to each other in purchase price, selling price and grain costs, then feed efficiency becomes the most important factor that a feedlot can control to gain an advantage over the competition.

Experiment 8: Effects of varying the pattern of feed consumption on performance bv program-fed beef steers

Galyean et al. (1993) reported results of a study designed to measure animal performance when fed intake was allowed to vary. This concept came from feedback from consulting nutritionists and feedlot managers that have for many years believed that variations in feed intake by cattle on high concentrate diets results in less than optimum performance. The theory behind this point is that variation in feed intake sometimes has an obvious effect of digestive disturbances (bloat, acidosis) that must be treated on an individual animal basis. However, subacute acidosis is hypothesized to be a larger problem to overall pen performance than the individual digestive disturbances that are obvious to the producer. Despite this commonly held belief, there has been no published data available from studies designed to test the hypothesis that variation in feed intake produces poorer feedlot performance than level feed intake.

A study was designed with three treatment groups: control (intake held as constant as possible), daily variation (intake adjusted 10% over or under the control group on a daily basis), and weekly variation (intake adjusted 10% over or under the weekly average of the control group).

Table 10 Effects of variation in feed intake on feedlot performance by program-fed beef steers			
Item	Treatment[a]		
	Constant	Daily	Weekly
Number of steers (pens)	36(3)	36(3)	36(3)
Initial weight, lb.	829	835	832
Final weight, lb.	1100	1089	1100
A.D.G., lb.	3.23[f]	3.02[g]	3.18[f]
Intake, dry, lb.	17.2	17.2	17.2
Feed/gain	5.33[f]	5.70[g]	5.42[f]

[a] Constant = same amount of feed offered daily; daily = 10% increases and decreases in intake each day; weekly = 10% increases and decreases in intake each week.

[f,g] Row means that do not have common superscripts differ (P<.10).

This experiment was based on the control cattle being program-fed to a constant amount of feed calculated as a total amount for a 28 day period based on body weight and predicted gain. This type program would result in a more level than usual intake pattern. The researchers suggested that these results could not be directly applied to cattle on an ad libitum feeding schedule, but also noted that as feed intake and body weight increased during the trial, very near ad libitum intakes were observed in the cattle.

I believe that in a true ad libitum feeding situation, allowing a 10% daily variation in intake would decrease feed efficiency more, not less, as compared to the program fed control group. The magnitude of proven feed conversion for the daily variation versus the control group was 6.5%. This amount of performance in feed conversion is about the same response as observed in use of an ionophore. Some people will pay money for a product that gives them 6.5% better feed conversion in the feedlot, but will do nothing from a management standpoint to minimize variation in daily feed intake that could result in as large a performance improvement as an ionophore. Over the years, successful feedlots in the US. have learned that management of the feeding program can yield performance benefits in addition to products added to the feed or given to the animal to improve performance.

Many different methods are employed by different successful feedlots to continually improve feedbunk management and reduce feed intake variations to a minimum. A good feeding program is one that puts the right amount of ration in the right place at the right time. This might sound simple, but is actually much more complex to achieve than first thought.

Various basic points need to be remembered and carried out in the jobs of all feedlot personnel to have a successful feed delivery program. Some related points in a successful feeding program are:

- Proper feeding is a team effort. The team consists of feedbunk manager, nutritionist, veterinarian, truck drivers, maintenance staff, dispatcher, pen riders, mill personnel, office staff and general manager.
- Consistency of feed delivered is essential, quality control must be non-stop.

- Good record keeping and communication of data between departments is essential. Record keeping need not be computerized to be effective, but computerization does help.
- Clean, fresh water is important. Stale waterers will affect feed intake.
- Pen and physical facilities must be maintained to allow all cattle in the pen free movement. Mud must be controlled to avoid affecting intake.
- Effective two-way communication between feedbunk manager and truck drivers, mill personnel and livestock crew is essential. This allows everyone involved to have input concerning the feeding system because animal health and feeding programs are interdependent.

CONCLUSIONS

Based on data presented in this paper, it is obvious that beef cattle are extremely adaptable to various diets, whether high concentrate or high roughage. However, due to evolutionary factors involving feed intake and digestion, some production systems require extensive management to produce consistent, cost effective animal performance. Recent history in beef cattle feeding has shown that high energy, high concentrate diets produce weight gains in a short period of time compared to high roughage diets However, a corresponding increase in management must accompany the increase in level of concentrate fed in order to avoid digestive disturbances that can reduce performance and increase animal health problems.

REFERENCES

BRANDT, R.A. (1992). In "Southwest Nutrition and Management Conference Proceedings), pp. 27-37, editor J.T. Huber. (University of Arizona press).

GALYEAN, M.L., MALCOLM-COLLIS, K. J., GARCIA, D.R. and PULSIPHER, G.D. (1993). Clavton Livestock Research Center Progress Report No. 78.

LARSON, E.A., STOLK R.A., KLOPFENSTEIN, T., SINDT, M., HUFFMAN,, R., and THOMPSON, T. (1993). In "University of Nebraska Beef Cattle Research Report", pp. 43-46 (University of Nebraska Press).

MILTON, C.T. and BRANDT, R.A. (1993). In "Cattleman's Day Report of Progress 678", pp. 104-105, editor B. Brent. (Kansas State University Press).

MINTERT, J.R., SCHROEDER, T.C., LAGEMEIER, M.R. and ALBRIGHT, M.L. (1993). In "Cattlemen's Day Report of Progress 678", pp. 112-115, editor B. Brent. (Kansas State University Press).

REINHARDT, D.C., BRANDT, R.T., FREEMAN, A.S., ECK, T.P. and BEHNKE, K.C. (1993). In "Cattlemen's Day Report of Progress 678", pp. 98-100, editor B. Brent. (Kansas State University Press).

TRENKLE, A. (1992). In "Feedlot Health Review", pp. 36-42, editor J.R. Rains. (Hoechst-Roussel Press).

VAN SOEST, P.J. (1982). In "Nutritional Ecology of the Ruminant", p. 4 (Cornell University Press).-

ZINN, R.A. (1993). In "Southwest Nutrition and Management Conference Proceedings", pp. 10-15, editor J.T. Huber. (University of Arizona Press).