Implants and Feed Additives for Feedlot Cattle

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Introduction

The introduction of diethylstilbesterol to the cattle feeding industry in the early 1950's set a milestone in terms of adding an implant or additive to the feed and improving feedlot performace. The stilbesterol (not presently approved for use) caused feedlot cattle to gain about 9 percent more rapidly and reduced feed required for gain about 7-9 percent. The industry took many years to except and understand the stilbesterol concept. In the late 1970's the first ionophore was cleared for use in feedlot cattle and in less than 60 days following final clearance by FDA for this compound, it was reported that nearly 90 percent of the cattle on feed in this country were receiving Monensin.

Why are Additives and Implants so Popular?

These compounds have received wide usage for two primary reasons. First, in many cases the return on the investment in the additive is sometimes very large. In the latter years of stilbestrol feeding, 15 cents worth of oral DES gave up to $20 worth of extra gain. This return will likely never be matched again, however, there are additives today which easily return 10 to 1 on their cost. Secondly, they are in general easy to use and are predictable in their response. This reason may be even more important in their acceptance because there have always been management practices which have larger potential returns on investment which are not widely practiced. For example, performance testing of cattle should have more potential than did DES feeding.

What Does the Future Hold?

The value of the currently approved additives is that they reduce the cost of producing beef by up to 15 percent. Most of the gain in cost reduction comes in the feedlot and stocker phase of production. It would take combinations of antibiotics, ionophores, and implants to reach the projected improvement level. It would appear that there are single compounds in the final phases of testing which may exceed the levels obtained with combinations today.

Review of Current Additives and Implants

Basis for Antibiotic Feeding. Antibiotics such as chlortetracycline have been fed for many years to increase rate and efficiency of gain of feedlot cattle and to reduce the incidence of liver abscesses. The summary of Burroughs (1959) is presented in Table 1. This summary shows that antibiotics improved both the rate and efficiency of gain.

TABLE 1. Performance Summary (1950's)

Diet	Daily Gain lb.	Daily Feed lb.	Gain/Feed
Better (34)			
Control	2.33	24.1	10.34
+CTC	2.43 (+4.3%)	24.2 (+.5%)	9.96 (+3.7%)
Poorer (31)			
Control	1.42	17.5	12.31
+CTC	1.50 (5.6%)	17.2 (−1.7%)	11.45 (+7.0%)

Burroughs et al, (1959).

The summary of Woods and Foster (1970) is shown in Table 2 below. This summary shows the effects of some of the common antibiotics on liver abscesses. These Nebraska data show that not all the antibiotics are effective for liver abscess control.

TABLE 2. Liver abscess incidence.

State	Control Group No. Cattle	Control Group % Abscess	Drug Treated Group No. Cattle	Drug Treated Group % Abscess
				Aureomycin
NE	19	79	20	15
SD	9	55.6	9	22.2
SD	19	21	20	5
SD	8	5	8	10.5
Weighted Mean		44.4		10.5
				Terramycin
NE	197	21.8	199	14.6
				Bacitracin
NE	99	30.3	100	40
NE	170	39.4	171	40.4
NC	40	72	40	72
SD	9	55.6	8	11.1
SD	19	21	20	0
SD	8	50	5	20
Weighted Mean		40.2		40.6

Foster and Woods, (1970).

Feeding of high concentrate diets will increase the incidence of liver abscesses. This is of great concern to cattlemen today, because the economics of cattle feeding

have resulted in a gradual but continuous reduction in the amount of roughage fed over the years. Table 3 shows the effect of roughage level on the incidence of liver abscesses.

TABLE 3. Roughage Level and Abscess Incidence.

	Roughage Level, %				
	0	5	10	15	High
NE	65	38	32.6	32.2	
NE	56			14	
NE	24.5			0	
NE				19.7	4.7
NE		41.6		33.3	
IL	26		8		
TX	74				3
Means	45.9	38.4	19.2	19.9	4.7

Foster and Woods, (1970).

The effects of liver abscesses on the performance of cattle have been hard to measure. Rate and efficiency of gain were reduced by 3% and 7.1% by abscesses in a summary by Farlin (1980). The value of the liver at slaughter usually does not exceed $3 per animal and, thereby, is a small fraction of the total value of the carcass, but Farlin suggested that a total of $66.50 was lost due to reduced gain, efficiency and liver value due to presence of liver abscess. In addition, cattle buyers often discriminate against cattle suspected to have a high incidence of abscesses. This encourages cattle feeders to feed antibiotics such as Aureomycin (chlortetracycline), Terramycin (oxytetracycline) or Tylan (tylosin) to reduce the incidence of abscessed livers at slaughter. A summary on liver health and feedlot performance by Foster and Woods is presented in Table 4.

TABLE 4. Liver Health and Performance.

	Healthy	Abscessed	
Number Cattle	1879	625	
Daily Gain	2.72	2.62	−3.7%
Dressing Percent	60.87	60.39	− .8%
Adjusted Gain	2.57	2.42	−5.8%
Grade	16.94	16.64	−1.8%

Foster and Woods, (1970).

A more recent summary from Oklahoma State University on liver abscesses and feedlot performance suggests that the better cattle within a group may be more prone to liver abscesses. In this study shown in Table 5, cattle with abscess scores of 1 or 2 gained as well as did cattle free from abscesses at time of slaughter.

Prior to the introduction of the ionophores it could be concluded that some of the antibiotics when fed at low levels reduced the incidence of liver abscesses and improved both rate and efficiency of gain. All abscessed livers represent a slight economic loss at slaughter, but the effect of an abscess on cattle performance depends on the severity of the abscess. Only severe abscesses appear to depress rate of gain.

TABLE 5. Performance and Abscess Severity.

Abscess Score	0	1	2	3
Cattle	2571	214	136	134
Daily Gain, 0-56 d	3.67	3.69	3.67	3.7
56-end	2.91	2.97	2.79	2.62a
0-end	3.24	3.29	3.16	3.07a
Dressing Percent	60.98	61.33	60.92	69.3a
Grade	12.67	12.67	12.68	12.58
Cutability, %	49.27	48.98	49.47	49.56a

Rust et al., 1980.

Implanting Beef Cattle. Twenty five years of research and industry experience has shown no management tool that returns more dollars per dollar invested than does implanting. Practically all feedlot cattle and the majority of stocker cattle are implanted. A good understanding of how implants work, the right times to use them and the proper techniques for implanting may result in greater use of implants and more effective utilization of implants in herds already using them.

What are Implants? Implants are small pellets or devices that are placed under the skin of the ear. Each implant contains a growth stimulant that is slowly released into the blood circulation. There are currently four approved implants for cattle.

Synovex® is cleared for growing (over 400 lb) and finishing cattle. It comes in two forms. Synovex S® is for steers and contains 200 mg of progesterone and 20 mg of estradiol benzoate while Synovex H® is for growing (over 400 lb) and finishing heifers and contains 200 mg of testosterone and 20 mg of estradiol.

STEER-oid® is similar to Synovex-S® in the stimulants used containing: progesterone USP (200 mg) and estradiol benzoate (20 mg).

Ralgro® is a compound isolated from a mold, Gibberella Zea, originally found on corn. While not a hormone, it appears to affect the release of certain hormones in the body and is classified as a protein anabolic (building) agent. Ralgro® is approved for all ages of cattle.

Compudose® is a new long lasting implant made of estradiol-17B mixed with silicone rubber to form an exterior coating on a solid silicone rubber core. The active hormone estradiol-17B is dissolved in the silicone rubber and when implanted in an animal the hormone migrates out of the implant at a constant rate. These implants can be manufactured to have hormone release patterns extending over long periods of time. Compudose-200® is an implant designed to last at least 200 days.

Ralgro®, STEER-oid® and Synovex® are effective for about 100 days. No withdrawal is required for Compudose®, Synovex®, or STEER-oid®. There is a 65 day withdrawal required for Ralgro®.

Why Do Implants Lose Their Effectiveness? The beef animal, when given a proper level of a growth stimulant, will grow at a rate of 6 to 30 percent faster than a non-stimulated control. However, following stimulation, or if the stimulation is removed, this animal will for a period of time grow at a rate much less than the control animal. By using assay procedures, what is happens following implanting with Synovex® has been studied at Oklahoma State University. Figure 1 shows total blood estrogen in a cycling beef cow. The level of estrogen found in a normal steer is also shown on the figure. Whenever steers are subjected to a continuously circulating level of estrogen activity representing ½ to ⅔ the biological potency as that hormone naturally produced by the estrus cow, the estrogen growth response is observed.

Figure 2 illustrates blood estrogen activity in a steer following a Synovex® implant. Note that after about 84 days the level of estrogen drops below the probable stimulatory level. Ralgro® implants are not the same as Synovex® and their mechanism of action is likely different. However, the principles of action are likely very similar. With a single recommended dose of either implant the animals will likely benefit from a reimplant after about 100 days.

FIGURE 1. Total Blood Estrogen in a Cycling Beef Cow

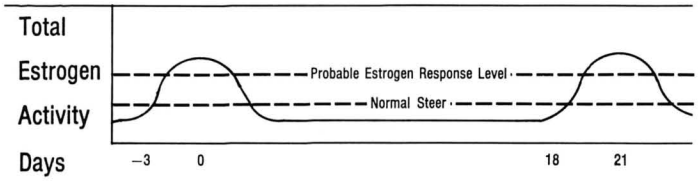
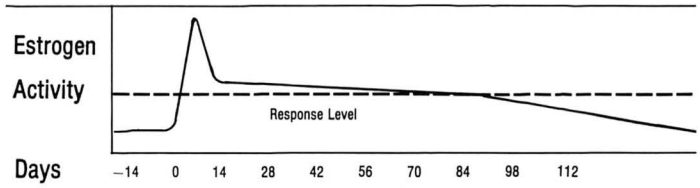


FIGURE 2. Total Blood Estrogen Activity in a Steer Following a Typical Implant



In theory, the Compudose® implant should last at least as long as indicated by the label.

Won't I Get All Kinds of Side Effects? Side effects (raised tailheads, udder development, etc) are rare if proper implanting technique is used.

What Are The Most Common Errors in Technique? The proper location for Synovex® is under the skin in the center ⅓ of the ear. Ralgro® should be implanted in the muscle and fat tissue at the base of the ear. The most common errors are:

1. Crushing the implant. Crushed implants release their active agents too quickly. Side effects may appear quickly and the implant will not be effective for very long. To avoid crushing, insert the needle to its full length, then *withdraw* a distance equal to the space occupied by the implant before inserting the implant. Failure to create space for the implant will cause crushing or result in a cluster or ball of pellets.
2. Depositing the implant into the cartilage. There is no blood flow and no absorption.
3. Depositing the implant into the skin. There is no absorption here either.
4. Pushing the needle through the skin and depositing the pellets on the ground.
5. Severing a blood vessel. Absorption will be too rapid.
6. Infections. Good sanitation should be observed, especially with the Compudose® implant since it is larger than Ralgro® or Synovex®.

Implanting should not be hurried. The failure to get an extra 20-50 pounds of additional weight for $1-2 invested certainly makes a little patience pay off.

How Much Benefit Will Implanting Give?

Growing Cattle. Growing calves grazing pastures adequate to permit 1 lb/day gains or better have increased daily gains from 10-20 percent. If the grazing period will exceed 100 days, reimplantation with Ralgro® or Synovex® must be considered. Compudose® would be active for 200 days and should not require reimplanting in most situations. The decision of which implant to use depends on the length of the grazing period, plans to rework the calves for other reasons (spraying, revaccination), cost of the implant, labor, and sex of calf since Ralgro® and Synovex® are approved for both steers and heifers.

Feedlot Performance. Implanting steers on finishing rations has increased gains by 8-12 percent and improved feed efficiency by 5-8 percent. Similarly, heifer gains were increased 6-10 percent and feed conversion by 4-7 percent. Withdrawal dates must be observed and need to be considered when reimplanting.

How Does Implanting at One Stage of Growth Affect Later Growth?

A Nebraska study by Dr. J. K. Ward showed that nursing phase implants (Ralgro®) did not decrease response to re-implantation during the growing phase. Calves implanted while nursing but not reimplanted during the growing phase, gained faster (1.71 vs. 1.59 lb/day) during the growing phase than calves not implanted during the growing phase, suggesting some carryover response. It should be noted that calves receiving both nursing and growing implants outgained (1.90 vs. 1.71 lb/day) calves implanted only during nursing. All cattle in this study responded to finishing phase implants although calves that had been implanted while nursing did not respond to the finishing implant as well as unimplanted calves.

A Colorado study showed similar results. Steers that had never been implanted responded better to a finishing phase

implant than did steers previously implanted during nursing and growing phases. In this study, steers implanted during nursing, growing and finishing (Ralgro®) weighed 66 lb more than steers that had not received implants.

MGA (Melengesterol Acetate). MGA is a synthetic orally active progesterone and it is approved for administration to feedlot heifers over a range of 0.25-0.5 mg/hd/day to achieve estrus suppression, increased weight gain and improved feed efficiency. Summaries of research indicate that it will give improvements in rate of gain in the range of 3-5 percent and improvement of feed efficiency at about 4-8 percent. Some management benefits as a result of its estrus suppression is reported by feedlot managers. This compound must be withdrawn from the feed for 48 hours before slaughter.

Ionophores in Cattle Feeding At the present time two ionophores are cleared for cattle feeding. The first one cleared was Monensin which is sold under the name Rumensin® and Lasalosid which is sold under the name Bovatec®. There will very likely be other ionophores and other similar compounds cleared in the near future. There are a number of characteristics of the ionophores that have been identified in the scientific literature. Some of these are listed below:

1. Shift ruminal VFA ratios toward more propionate.
2. Reduce methane production.
3. Increase protein bypass.
4. Coccidiosis control.
5. Reduced feed intake.
6. Protein sparing.
7. Decreased rate of passage and rumen turnover.
8. Increase in the digestibility of more difficult to digest feeds.
9. Effective antibiotic against gram positive but not negative organisms.
10. Changes in site of digestion of nutrients.
11. Reduction of acidosis.
12. Reduction of feedlot bloat.
13. No to slight negative effect on the incidence of liver abscesses.

The ionophores have been very widely used and it would be unlikely that a cattle feeder could remain competitive without using an ionophore. The most characteristic effect of the two cleared products is that when included at the recommended levels cattle on high concentrate diets eat slightly less feed and gain about the same as if the additive was not fed. While many joint clearances are not approved at the present time it would appear that ionophores are additive with antibiotics, implants, and MGA.

Expected Results With Rumensin® Monensin is cleared at a feeding rate from 10-30 grams per air-dry ton of feed. In an extensive review of trials Wagner (Oklahoma Cattle Feeders Seminar, 1982) concluded that monensin improved rate of gain 2.5 percent, reduced feed intake 5.2 percent and improved feed efficiency by 7.2 percent in feedlot cattle. Monensin has the added advantage in that it is cleared for feeding with tylosin, an antibiotic which is cleared for liver abscess control.

Expected Results With Bovatec® Lasalocid is cleared for feedlot cattle under two claims. The first claim is to improve *both* rate of weight gain and efficiency of feed utilization when fed at a rate of not less than 25 grams nor more than 30 grams of lasalocid per ton of total ration (90% dry matter). In addition, the level included must provide not less than 250 mg nor more than 360 mg per head per day. The second claim is to improve feed efficiency of beef cattle when Bovatec® is fed continuously at the rate of not less than 10 grams nor more than 30 grams per ton of total ration (90% dry matter). These levels must provide not less than 100 mg nor more than 360 mg per head per day.

In the extensive review of trials Dr. Wagner concluded that on the average lasalocid improved weight gains 6.4 percent, feed intake was decreased 4.6 percent and feed efficiency was improved 9.9 percent. There are at the present time no oral antibiotics cleared for joint use with lasalocid.

Economic Impact of Additives in Cattle Feeding The economic impact of any additive is not constant, but changes with all the costs and variations in animal performance associated with cattle feeding. An economic comparison using current prices can be developed using the Oklahoma State University Feedlot Cattle Simulator. Figure 3 shows a simulation of a 700 pound steer fed a typical high plains feedlot diet with typical costs, but without any additives or implants. If fed cattle sell for $67 next April 18th the steers will lose $6.17 per head. Figure 4 shows the same cattle, except that in this figure the cattle are implanted (for the 140 day feeding period, plus a reimplant at about 75 days is required to obtain this level of improvement). With the same marketing date these cattle would make $14.14 per head. By subtracting the loss in Figure 3 from the profit in Figure 4, the value of implanting these cattle was $20.31 per head less the cost of implanting and reimplanting.

The differences in the two previous simulations also show the important characteristics of implants. They are as follows:

1. Feed intake increased 0.55 pounds per day (2.8% increase).
2. Gain increased 9.96% (feedlot) and 10.93% (pay to pay).
3. Feed conversion improved 6.76% (feedlot) and 7.60% (pay to pay).
4. Final pay weight increased from 1058 to 1098 pounds after 140 day feeding period. (Implanted cattle would not grade as well at the same weight as non implanted cattle—no difference at equal days.)
5. Interest + overhead cost per cwt of gain = $8.52 per cwt of gain on the implanted cattle and $9.45 on the non-implanted cattle.
6. Value of implants was $20.31 per head less the cost of implants.

Adding an Ionophore to Implanted Cattle Comparisons of Figures 4 and 5 show the important economic and cattle effects of ionophore addition to feedlot diets. Subtracting

FIGURE 3. No Additives or Implants

Date	Day	Fat Wt.	Days Feed	Days Feed Cost	Days Lbs.	Gain Average In W	Gain Average Py W	Conversion Days Lbs.	Conversion Average In W	Conversion Average Py W	Cost of Gain Days Total	Cost of Gain Average In W	Cost of Gain Average Py W	Break Even $/Cwt	Profit Head
12/ 1/83	0	665.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.22	−1.45
12/15/83	14	692.	19.06	1.43	3.08	1.90	−.00	6.19	8.16	−.00	.57	.84	−.00	67.36	−2.52
12/29/83	28	737.	19.61	1.68	3.40	2.58	1.33	5.77	6.75	13.07	.59	.62	1.40	66.78	1.60
1/11/84	42	784.	19.85	1.70	3.25	2.83	1.99	6.10	6.44	9.13	.60	.58	.95	66.29	5.58
1/25/84	56	828.	20.17	1.72	3.15	2.92	2.29	6.41	6.39	8.13	.63	.57	.83	66.02	8.14
2/ 8/84	70	871.	19.96	1.71	2.95	2.94	2.44	6.76	6.43	7.75	.67	.58	.79	65.96	9.06
2/22/84	84	912.	20.08	1.72	2.84	2.94	2.52	7.07	6.51	7.59	.70	.58	.77	66.07	8.44
3/ 7/84	98	950.	20.11	1.72	2.72	2.91	2.56	7.38	6.61	7.54	.74	.59	.76	66.32	6.49
3/21/84	112	988.	20.06	1.72	2.60	2.88	2.57	7.70	6.72	7.54	.77	.60	.76	66.67	3.30
4/ 4/84	126	1023.	20.18	1.73	2.53	2.84	2.57	7.99	6.84	7.57	.81	.61	.76	67.10	−1.06
4/18/84	140	1058.	20.02	1.71	2.41	2.81	2.56	8.32	6.95	7.63	.83	.62	.77	67.58	−6.17
4/18/84	140	1058.	20.02	1.71	2.41	2.81	2.56	8.32	6.95	7.63	.83	.62	.77	67.58	−6.17

Beef Gain Simulator Closeout

Input Parameters		Recap At Sale Weight (4/18/84)	
Sex	Steer	In Weight	665
Purchase Weight	700	Out Weight	1058
Purchase Cost/Cwt	62.00	Days Fed	140
Starting Factor	.8	Gain/Head	357
Feeder Grade	5.0	Feedlot Gain/Head	392
Medical Cost/Head	7.00	Average Daily Gain	2.56
Shrinkage %	5.00	Feedlot Average Daily Gain	2.81
Selling Weight	1300	Conversion	7.63
Selling Price/Cwt	67.00	Feedlot Conversion	6.95
Equity/Head	75.00	Total Cost of Gain/Cwt	76.83
Interest Rate %	13.75	Feedlot Cost of Gain/Cwt	61.68
Overhead/Headday	.05	Break Even/Cwt	67.58
Frt + Comm/Head	6.00	Total Interest	26.72
In Date	12/1/83	Total Overhead	7.00
Death 1	.75	Death Loss Cost	5.89
Day 1	30	Profit	−6.17
Death 2	.40	Average Daily Feed	19.51
Day 2	100		
Print Increment	14		
Efficiency Factor	5.00		
Implant Factor	1.00		

Weather Factors

100. 100. 100. 100. 100. 100.
100. 100. 100. 100. 100. 100.

Consumption Factors %

99. 97. 97. 98. 99. 100.
99. 99. 102. 103. 101. 100.

Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
111.	10.	6.28	75.	45.	10	141.20	8.87
Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
222.	10.	7.52	88.	57.	10	191.20	14.38
Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
333.	750.	8.55	96.	63.	120	2398.83	205.10
Totals	.9	8.36			140	2731.22	228.35

FIGURE 4. Steer With Implant Only

Date	Day	Fat Wt.	Days Feed	Days Feed Cost	Days Lbs.	Gain Average In W	Gain Average Py W	Conversion Days Lbs.	Conversion Average In W	Conversion Average Py W	Cost of Gain Days Total	Cost of Gain Average In W	Cost of Gain Average Py W	Break Even $/Cwt	Profit Head
12/ 1/83	0	665.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.22	−1.45
12/15/83	14	695.	19.57	1.47	3.45	2.15	0.00	5.67	7.40	0.00	.52	.75	0.00	67.08	−.58
12/29/83	28	746.	20.19	1.73	3.79	2.90	1.65	5.33	6.18	10.86	.54	.57	1.16	66.13	6.51
1/11/84	42	798.	20.47	1.75	3.62	3.16	2.33	5.66	5.92	8.03	.55	.53	.83	65.33	13.29
1/25/84	56	847.	20.82	1.78	3.49	3.26	2.63	5.97	5.89	7.29	.58	.53	.74	64.83	18.37
2/ 8/84	70	895.	20.59	1.76	3.26	3.28	2.78	6.32	5.95	7.02	.62	.53	.71	64.59	21.52
2/22/84	84	939.	20.67	1.77	3.12	3.26	2.85	6.64	6.03	6.92	.66	.54	.70	64.57	22.86
3/ 7/84	98	982.	20.68	1.77	2.98	3.23	2.87	6.95	6.14	6.90	.69	.55	.69	64.69	22.67
3/21/84	112	1022.	20.58	1.76	2.83	3.19	2.88	7.27	6.25	6.93	.73	.55	.69	64.94	21.03
4/ 4/84	126	1061.	20.63	1.76	2.73	3.14	2.86	7.57	6.37	6.98	.76	.56	.70	65.30	18.04
4/18/84	140	1098.	20.41	1.75	2.58	3.09	2.84	7.91	6.48	7.05	.79	.57	.71	65.71	14.14
4/18/84	140	1098.	20.41	1.75	2.58	3.09	2.84	7.91	6.48	7.05	.79	.57	.71	65.71	14.14

Beef Gain Simulator Closeout

Input Parameters	
Sex	Steer
Purchase Weight	700
Purchase Cost/Cwt	62.00
Starting Factor	.8
Feeder Grade	5.7
Medical Cost/Head	7.00
Shrinkage %	5.00
Selling Weight	1300
Selling Price/Cwt	67.00
Equity/Head	75.00
Interest Rate %	13.75
Overhead/Headday	.05
Frt + Comm/Head	6.00
In Date	12/1/83
Death 1	.75
Day 1	30
Death 2	.40
Day 2	100
Print Increment	14
Efficiency Factor	5.00
Implant Factor	9.00

Recap At Sale Weight (4/18/84)	
In Weight	665
Out Weight	1098
Days Fed	140
Gain/Head	398
Feedlot Gain/Head	433
Average Daily Gain	2.84
Feedlot Average Daily Gain	3.09
Conversion	7.05
Feedlot Conversion	6.48
Total Cost of Gain/Cwt	70.73
Feedlot Cost of Gain/Cwt	57.44
Break Even/Cwt	65.71
Total Interest	26.90
Total Overhead	7.00
Death Loss Cost	5.90
Profit	14.14
Average Daily Feed	20.06

Weather Factors

100. 100. 100. 100. 100. 100.
100. 100. 100. 100. 100. 100.

Consumption Factors %

99. 97. 97. 98. 99. 100.
99. 99. 102. 103. 101. 100.

Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
111.	10.	6.28	75.	45.	10	144.75	9.09
Ration	**Days**	**$/Cwt**	**Nem**	**Neg**	**Days Fed**	**Pounds**	**Cost**
222.	10.	7.52	88.	57.	10	196.38	14.77
Ration	**Days**	**$/Cwt**	**Nem**	**Neg**	**Days Fed**	**Pounds**	**Cost**
333.	750.	8.55	96.	63.	120	2466.81	210.91
Totals	.9	8.36			140	2807.93	234.77

FIGURE 5. Implant Plus Ionophore

Date	Day	Fat Wt.	Days Feed	Days Feed Cost	Days Lbs.	Gain Average In W	Gain Average Py W	Conversion Days Lbs.	Conversion Average In W	Conversion Average Py W	Cost of Gain Days Total	Cost of Gain Average In W	Cost of Gain Average Py W	Break Even $/Cwt	Profit Head
12/ 1/83	0	665.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.22	−1.45
12/15/83	14	696.	18.71	1.41	3.55	2.23	0.00	5.27	6.82	0.00	.48	.70	0.00	66.88	.85
12/29/83	28	749.	19.30	1.65	3.89	2.99	1.74	4.97	5.73	9.84	.51	.53	1.06	65.68	9.89
1/11/84	42	802.	19.55	1.67	3.70	3.25	2.42	5.28	5.50	7.39	.52	.50	.77	64.68	18.62
1/25/84	56	852.	19.84	1.70	3.56	3.35	2.72	5.57	5.48	6.74	.55	.49	.69	64.00	25.61
2/ 8/84	70	900.	19.57	1.67	3.31	3.36	2.86	5.91	5.53	6.50	.58	.50	.66	63.60	30.58
2/22/84	84	946.	19.62	1.68	3.16	3.34	2.92	6.20	5.62	6.42	.62	.50	.65	63.44	33.69
3/ 7/84	98	989.	19.57	1.67	3.01	3.30	2.95	6.50	5.72	6.41	.65	.51	.65	63.44	35.21
3/21/84	112	1030.	19.43	1.66	2.85	3.26	2.94	6.81	5.83	6.44	.69	.52	.65	63.58	35.23
4/ 4/84	126	1069.	19.42	1.66	2.74	3.20	2.93	7.09	5.94	6.50	.72	.53	.66	63.83	33.86
4/18/84	140	1106.	19.13	1.64	2.58	3.15	2.90	7.43	6.05	6.57	.75	.54	.66	64.15	31.54
4/18/84	140	1106.	19.13	1.64	2.58	3.15	2.90	7.43	6.05	6.57	.75	.54	.66	64.15	31.54

Beef Gain Simulator Closeout

Input Parameters

Sex	Steer
Purchase Weight	700
Purchase Cost/Cwt	62.00
Starting Factor	.8
Feeder Grade	4.4
Medical Cost/Head	7.00
Shrinkage %	5.00
Selling Weight	1300
Selling Price/Cwt	67.00
Equity/Head	75.00
Interest Rate %	13.75
Overhead/Headday	.05
Frt + Comm/Head	6.00
In Date	12/1/83
Death 1	.75
Day 1	30
Death 2	.40
Day 2	100
Print Increment	14
Efficiency Factor	6.75
Implant Factor	9.00

Recap At Sale Weight (4/18/84)

In Weight	665
Out Weight	1106
Days Fed	140
Gain/Head	405
Feedlot Gain/Head	440
Average Daily Gain	2.90
Feedlot Average Daily Gain	3.15
Conversion	6.57
Feedlot Conversion	6.05
Total Cost of Gain/Cwt	66.37
Feedlot Cost of Gain/Cwt	53.73
Break Even/Cwt	64.15
Total Interest	26.61
Total Overhead	7.00
Death Loss Cost	5.87
Profit	31.54
Average Daily Feed	19.04

Weather Factors

100. 100. 100. 100. 100. 100.
100. 100. 100. 100. 100. 100.

Consumption Factors %

99. 97. 97. 98. 99. 100.
99. 99. 102. 103. 101. 100.

Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
111.	10.	6.28	75.	45.	10	138.37	8.69
Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
222.	10.	7.52	88.	57.	10	187.74	14.12
Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
333.	750	8.55	96.	63.	120	2339.44	200.02
Totals	.9	8.36			140	2665.55	222.83

FIGURE 6. Implant Plus Ionophore Plus CTC (Not Approved at Present Time)

Date	Day	Fat Wt.	Days Feed	Days Feed Cost	Days Lbs.	Gain Average In W	Gain Average Py W	Conversion Days Lbs.	Conversion Average In W	Conversion Average Py W	Cost of Gain Days Total	Cost of Gain Average In W	Cost of Gain Average Py W	Break Even $/Cwt	Profit Head
12/ 1/83	0	665.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.22	−1.45
12/15/83	14	697.	18.79	1.41	3.66	2.32	0.00	5.13	6.59	0.00	.47	.68	0.00	66.77	1.61
12/29/83	28	751.	19.39	1.66	3.99	3.09	1.84	4.85	5.57	9.35	.50	.51	1.01	65.46	11.57
1/11/84	42	806.	19.64	1.68	3.80	3.35	2.52	5.16	5.36	7.13	.50	.49	.74	64.37	21.19
1/25/84	56	858.	19.93	1.70	3.65	3.45	2.82	5.46	5.35	6.53	.54	.48	.67	63.62	28.98
2/ 8/84	70	907.	19.68	1.68	3.40	3.46	2.96	5.78	5.40	6.31	.57	.48	.64	63.18	34.70
2/22/84	84	954.	19.70	1.68	3.24	3.44	3.02	6.07	5.49	6.25	.60	.49	.63	62.97	38.48
3/ 7/84	98	998.	19.63	1.68	3.08	3.40	3.04	6.37	5.59	6.24	.64	.50	.63	62.93	40.63
3/21/84	112	1040.	19.47	1.66	2.92	3.35	3.03	6.67	5.69	6.28	.67	.51	.63	63.04	41.21
4/ 4/84	126	1080.	19.44	1.66	2.80	3.29	3.01	6.95	5.80	6.34	.71	.52	.64	63.26	40.37
4/18/84	140	1117.	19.15	1.64	2.63	3.23	2.98	7.28	5.91	6.41	.73	.53	.65	63.55	38.54
4/18/84	140	1117.	19.15	1.64	2.63	3.23	2.98	7.28	5.91	6.41	.73	.53	.65	63.55	38.54

Beef Gain Simulator Closeout

Input Parameters	
Sex	Steer
Purchase Weight	700
Purchase Cost/Cwt	62.00
Starting Factor	.8
Feeder Grade	4.5
Medical Cost/Head	7.00
Shrinkage %	5.00
Selling Weight	1300
Selling Price/Cwt	67.00
Equity/Head	75.00
Interest Rate %	13.75
Overhead/Headday	.05
Frt + Comm/Head	6.00
In Date	12/1/83
Death 1	.75
Day 1	30
Death 2	.40
Day 2	100
Print Increment	14
Efficiency Factor	7.25
Implant Factor	9.00

Recap At Sale Weight (4/18/84)

In Weight	665
Out Weight	1117
Days Fed	140
Gain/Head	417
Feedlot Gain/Head	452
Average Daily Gain	2.98
Feedlot Average Daily Gain	3.23
Conversion	6.41
Feedlot Conversion	5.91
Total Cost of Gain/Cwt	64.71
Feedlot Cost of Gain/Cwt	52.52
Break Even/Cwt	63.55
Total Interest	26.63
Total Overhead	7.00
Death Loss Cost	5.88
Profit	38.54
Average Daily Feed	19.11

Weather Factors

100.	100.	100.	100.	100.	100.	
100.	100.	100.	100.	100.	100.	

Consumption Factor %

99.	97.	97.	98.	99.	100.
99.	99.	102.	103.	101.	100.

Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
111.	10.	6.28	75.	45.	10	138.90	8.72
Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
222.	10.	7.52	88.	57.	10	188.56	14.18
Ration	Days	$/Cwt	Nem	Neg	Days Fed	Pounds	Cost
333.	750.	8.55	96.	63.	120	2347.72	200.73
Totals	.9	8.36			140	2675.18	223.63

the profit of $14.14 Figure 4 from the $31.54 in Figure 5 shows that the value of the ionophore is $17.40 less the cost of the ionophore. Typical costs assuming an average intake of 300 mg per day would be $2.60 leaving a value to the cattle feeder of $14.80 per head.

The differences in the two previous simulations also show the important characteristics of ionophores. They are as follows:

1. Average feed intake reduced from 20.06 to 19.04 pounds per day (a decrease of 5%).
2. Average daily gain increase 1.94% (feedlot).
3. Feed conversion improved 6.64% (feedlot) and 6.81% (pay to pay).
4. Final pay weight increased from 1098 to 1106 pounds after 140 days on feed. (Ionophores show a slight increase in carcass value when many tests are summarized.)
5. Interest + overhead cost per cwt of gain = $8.52 per cwt of gain for implant only and $8.30 for implant plus ionophore.
6. Gross value of the ionophore was $17.40 and the net value was $14.80.

There are other advantages to the feeding of an ionophore not covered in the tables. Some of these are:

1. The safer use of higher levels of concentrate.
2. Reduced incidence of feedlot sudden death and bloat.
3. Less problems with feedlot coccidiosis and related costs.

There is adequate evidence that the effects of the currently marketed implants are additive with the ionophores. The old literature would indicate that the effects of implants and antibiotics are also additive. This might be expected because of the different mechanism of action of the implants. There is much less information available as to the additiveness of the antibiotics such as CTC, OTC, or Tylan with the cleared ionophores. Only Tylan is cleared with monensin and it is only cleared for liver abscess control. CTC is cleared by itself for improvement of both rate of gain and feed efficiency when fed at continuous levels of 70-100 mg per head per day. CTC is not at the present time cleared for use with an ionophore. However, limited evidence suggests that antibiotics which gave increases in rate and efficiency of gain in the absence of an ionophore will be additive with the ionophore.

Implants Plus Ionophores Plus Continuous Low Level Antibiotics The economic value of implants plus ionophores plus continous low level feeding of CTC can be seen by comparing Figures 5 and 6. The antibiotic caused:

1. Average daily feed intake unchanged to very slight increase.
2. Average daily gain increased 2.75% (feedlot) and 2.53% (pay to pay).
3. Feed conversion improved 2.4% (feedlot) and 2.31% (pay to pay).
4. Final weight increased 11 pounds after 140 days on feed.
5. Interest + overhead cost per cwt of gain = $8.30 per cwt of gain for Figure 5 and $8.06 for the combination of implants, ionophores and antibiotics.
6. Gross value of the antibiotic is $7.00 and the net value is estimated at 6.48 when using CTC.
7. Losses due to liver condemnations were not included in the analysis, but in some cases the cattle would be worth more.

Feed Additives of the Future The introduction of monensin by Lilly will be as big a landmark in the beef industry as the Model-T Ford was to the automotive industry. This discovery opened the door to a whole new concept in improving the efficiency of ruminant animals. The economic impact of the current additives is very conservatively estimated in Figures 4-6. In many cases some could justify making the responses twice as large as in the figures. The second or third generation of ionophores (i.e. Salinomycin or Narasin) seem to be able to achieve improvements in feed efficiency in the middle and upper teens and they also seem to give large increases in average daily gains. Other compounds, while not ionophores, may work the same or even be complementary to an ionophore. There are a number of these being tested, one of which was reported to increase the gains of grazing animals 16% when the compound was administered in a mineral mixture.

The future for development of even more exciting additives is real and will help consumers by reducing beef production costs and may even help the beef industry turn a profit.