FEEDLOT MANAGEMENT PRIMER

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FEEDLOT MANAGEMENT PRIMER

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Chapter 1. Purchasing Cattle

THE USDA FEEDER CALF GRADES

Why A Grading System Is Used: A grading system provides a common language for describing various types of cattle. Transactions can be made without a buyer seeing the cattle. In the case of feeder cattle, a grading system allows one to predict the feedlot performance and carcass characteristics of the finished cattle. The current United State Department of Agriculture (USDA) grading system is based on frame size and muscle thickness (USDA, 1980).

Nine possible combinations (three frame sizes, three muscle thicknesses) of feeder cattle grades exist for thrifty animals, as well as an Inferior grade for unthrifty animals. The Inferior grade includes feeder cattle which are unthrifty due to mismanagement, disease, parasitism, or lack of feed. An animal grading Inferior can qualify for a muscle thickness and frame size grade at a later date, provided the unthrifty condition is corrected. "Double-muscled" animals are included in the Inferior grade, although such animals have a large amount of muscle. They are graded U.S. Inferior because of their inability to produce carcasses with a "standard degree" of marbling (intramuscular fat).

Frame

Frame size is used because frame is an inherited trait that is not greatly affected by normal management practices. Larger frame cattle typically reach an equal backfat thickness at heavier weights than smaller frame cattle. The three frame scores used are **Large**, **Medium**, and **Small**, referred to as **L**, **M**, and **S**, respectively.

Large Frame (L): Large frame cattle are thrifty, tall and long bodied for their age. Steers would be expected to produce the amount of external fat opposite the 12th rib normally associated with the U.S. Choice grade when their live weight exceeds 1200 pounds (usually .5 of an inch). Heifers would be expected to produce Choice carcasses when their live weight exceeds 1000 pounds and external fat at the 12th rib is .5 of an inch.

Medium Frame (M): Medium frame cattle are thrifty and moderate in height and body length for their age. Steers would be expected to produce U.S. Choice carcasses with

about .5 of an inch fat at 12th rib at live weights of 1000 to 1200 pounds. Heifers would be expected to produce Choice carcasses with about .5 of an inch of fat at the 12th rib at live weights of 850 to 1000 pounds.

Small Frame (S): Small frame cattle are thrifty but are shorter in height and body length than specified for Medium frame cattle. Steers would be expected to produce U.S. Choice carcasses with about .5 of an inch fat at 12th rib at live weights less than 1000 pounds. Heifers would be expected to produce Choice carcasses with about .5 inch of fat at the 12th rib at live weights of less than 850 pounds.

Putting A Frame Grade On A Calf: The frame size portion of the grade standard must be determined by an evaluation of the animal's skeletal size in relation to its age. For example, two feeder cattle with the same height and body length but differing substantially in age would not be the same frame size. The appearance of feeder cattle can be use to estimate age. As feeder cattle mature, their ears decrease in size in relation to their heads; the muzzle becomes wider; the head becomes longer in relation to its width; and the tail increases in length and exhibits a more prominent switch.

Frame size and breed should not be automatically equated (Boyles et al., 1992). It is very possible for the larger cattle in a small mature size breed to be as large as the smaller cattle in large mature size breed.

Frame Size

Large Frame	Half inch of fat-12th rib
Tall and long for age	Steers, 1200 lbs or more Heifers, 1000 lbs or more
Medium Frame	Half inch of fat-12th rib
Slightly tall and slightly long for age	Steers, 1000-1200 lbs Heifers, 850-1000 lbs
Small Frame	Half inch of fat-12th rib
Small frame and shorter-bodied for age	Steers, less than 1000 lbs Heifers, less than 850 lbs

(Minish and Fox, 1982)

Thickness

Thickness is related to the muscle-to-bone ratio at a given degree of fatness to carcass yield grade. An example would be a thinly muscled animal having a Choice, Yield Grade 3 carcass, while the carcass of a thickly muscled animal may be Choice, Yield Grade 2. The three muscle thickness grades are designated by **Number 1**, **Number 2**, and **Number 3**.

Fat can visibly alter the perception of muscling. Therefore muscle thickness is appraised at a constant degree of fatness (slightly thin). Some feeder cattle may carry more than a thin degree of fat and should be appraised for the degree of muscling they would have possessed at a slightly thin fat cover.

Number 1: Number 1 muscle thickness feeder cattle typically have a high proportion of beef breeding. They must be thrifty and thick throughout. They are full in the forearm and exhibit muscularity over the back and through the loin with moderate width between the legs. Cattle can exhibit thickness with even a slightly thin covering of fat; however, cattle eligible for this grade may carry varying degrees of fat.

Number 2: Number 2 muscle thickness feeder cattle are thrifty and somewhat narrower throughout both the fore- and hindquarters. The forearm is thin and the back and loin have a sunken appearance. The legs are set closer together. Cattle exhibit this narrowness with a slightly thin covering of fat; however, cattle eligible for this grade may carry varying degrees of fat.

Number 3: Feeder cattle in this grade are thrifty and have less thickness of muscle than the minimum requirements specified for the Number 2 grade.

Summary

The USDA Feeder Cattle Grading System or any other system you use is a method of sorting cattle. Ideally, cattle should be sorted into similar types and sizes for a uniform nutrition program for all the animals in a pen. A certain amount of sorting may still need to be done when cattle arrive at the feedlot. Because of the genetic variation in cattle and the lag time associated in filling the feedlot, more than one feeding pen is recommended.

DEVELOPING A PRICE FOR CATTLE

A simple way to evaluate cattle feeding and marketing alternatives is to use "break-even" analysis. This is a way of comparing total cost and total return at various output levels. When returns equal cost, the operation is breaking even (Paine and Garton, 1972). To calculate a break-even point, use the following formula:

$$\frac{(IW \times IP) + (G \times C)}{FW} = FP$$

IW is the initial weight purchased

IP is the initial price of the animal going into the program

G is the expected pounds of gain during the feeding program

C is the cost per pound of gain

FW is the final weight sold

FP is the final price needed to break-even on the investment

Example 1:

Suppose a 500-pound feeder that cost $.78 per pound is fed to make a net gain of 200 pounds at an expected cost of 50 cents per pound of gain. The resulting final weight will be 700 pounds. What is the final price needed to cover cost of investment?

IW = 500 IP = 0.78 G = 200 C = 0.50 FW = 700 FP = ?

$$\frac{(500 \times .78) + (200 \times 0.50)}{700} = \$0.70$$

The equation for developing a break even price is relatively simple. Determining accurate numbers is another matter. Economic projection articles and local auction barn prices are a good place to start for cattle prices. Gain projections may need to be obtained from personal experience or you might check with other producers that have similar feeding programs. The real "pencil sharpening" is on cost of gain. Standard components in cost of gain are feed, vet, electric, labor, interest, marketing, and other yardage charges.

Calculating a Break-Even: *Purchase Price*

Another way to use the break-even analysis formula is to work it backwards to determine the break-even purchase price, break-even cost of gain, weight of steer or heifer to purchase, or amount of gain to try to put on in the feeding program.

Example 2:

Suppose a cattle producer thinks they can sell 1100 pound cattle $.63 per pound. In their pervious experience, gains have been 2.7 pounds per day. They can purchase calves that weigh about 550 lbs. The estimate for cost of gain is $.51 per pound of gain. What is the most they can pay for these calves?

IW = 550 IP = ? G = 550 (1100-550) C = $0.51 FW = 1100 FP = $0.63

$$\frac{(550 \times ?) + (550 \times 0.51)}{1100} = \$0.63$$

$$(550 \times ?) + (280.50) = 0.63 \times 1100$$
$$550 \times ? = 693 - 280.50$$
$$? = 412.50/550$$
$$? = \$0.75$$

If your algebra skills aren't what they used to be, the following formulas can be used to answer the following questions.

1. What price can I pay for calves?

$$\frac{(FP \times FW) - (G \times C)}{IW} = IP$$

2. What sort of gain must I get?

$$\frac{(FP \times FW) - (IW \times IP)}{C} = G$$

3. What is the maximum cost of gain I can handle for this rate of gain and at these animal prices?

$$\frac{(FP \times FW) - (IW \times IP)}{G} = C$$

4. At what weight should I sell my cattle?

$$\frac{(IW \times IP) + (G \times C)}{FP} = FW$$

Summary

Break-even analysis will allow the feedlot operator some idea of how much they can pay for their calves. Breakeven prices can be calculated for the entire feeding period or only a certain part of the feeding program. By looking at different parts of the feeding program (e.g. growing versus finishing) a producer can determine where the most returns to labor and management can be obtained.

Chapter 2. Shipping and Receiving Cattle

INCOMING SHRINK

Effect On Incoming Cattle: The weight loss of cattle during transport is commonly called shrink. There are two types of shrink. One is exudative, which is the loss of urine and feces. The second type of shrink is tissue loss. Tissue loss is the loss of fluid from the cells and cattle require more time to regain this type of shrink. The following are five factors that affect amount of shrink:

1. Time 2. Distance 3. Age 4. Sex 5. Type-Condition.

The most critical factor is time in transit. Therefore, truckers should deliver cattle as soon as possible. The following are some estimates for shrink with respect to time (Fox et al., 1985):

Hours in a Moving truck	%Shrink	Days required to Recover Payweight
1	2	0
2-8	4-6	4-8
8-16	6-8	8-16
16-24	8-10	16-24
24-32	10-12	24-30

Distance is included as a factor because some people think in terms of distance rather than time. One estimate is a 3% shrink for the first 100 miles and .5% to 1% for each additional 100 miles.

Age, sex, and type-condition are interrelated because the real factor is fat composition of the animal. The fatter the cattle are, the less shrink encountered. This is because fat contains less water than muscle. Older cattle tend to have more fat than younger animals. Heifers are usually fatter than steers of the same age. Larger frame cattle have a higher lean to fat ratio than medium frame cattle of the same age. Of course health of the cattle will also have an effect.

Preventing Shrink: You may not be able to prevent shrink in cattle that you purchase some distance from your feedlot but the following practices may reduce the amount of shrink and minimize the accompanying stress (Brownson, 1973):

1. Avoid loading and moving cattle during inclement weather.

2. Insure careful and nonabusive handling is practiced at loading and unloading.

3. Inform the cattle buyer or trucker that the cattle should arrive as soon as possible after loading.

4. Make sure trucks and all corral equipment are in good working order.

5. Provide adequate protection during inclement weather while in transit.

6. Dry feeds are more desirable than wet feeds for cattle prior to shipping.

7. Provide proper space allocation to each animal.

Truck Space Requirements For Calves

Average Weight	Number of Calves per Running foot of truck floor (92 inch truck width)
200 lbs	2.2
300	1.6
400	1.2
450	1.1

(Grandin, 1988)

THE BUSINESS OF RECEIVING CATTLE

The truck driver's shipping invoices should be checked before unloading the truck. When the cattle arrive that are fresh, give the buyer a call and let him know you're pleased. If you receive a problem load, discuss this with the order buyer so they know of the problem and can prevent such problems in the future.. Providing written specifications will eliminate many misunderstandings. Records of purchase weight, delivery weight, and numbers of dead or down on the truck should be available when talking with the buyer about a set of cattle.

WHEN AND HOW TO PROCESS CATTLE

Process cattle within 24-36 hours of arrival. One option is to process them on the day of arrival. A second option is to allow them to eat hay and drink water, rest overnight and then process them the next morning. Use the latter option with stressed cattle or postpone the most stressful procedures if cattle are especially stressed or evidence indicates they may be incubating impending disease. Temperatures of cattle just off the truck are not reliable indicators of illness (Lofgreen, 1988). To minimize stress, move cattle to their pens at their pace.

Process cattle in small groups so they don't have to wait too long before going through the

chute (Ritchie et al, 1990). During hot weather, process in the morning or evening. Evidence from Meat Animal Research Center in Nebraska indicates that body temperatures do not return to normal until 1:00-2:00 AM. They suggest processing at 2-3:00 AM if cattle are heat stressed. Do not over- use electric prods or cause excitement. Designate animals with temperatures over 104 degrees F as sick. Temperatures may not be possible to take on all cattle, but take temperatures on cattle that appear stressed.

Don't use large needles that result in leakage of vaccine out of the injection sites (SubQ: 16 or 17 gauge, 1/2-3/4 inch long; IM: 16 or 18 gauge, 1-1.5 inches long). Sanitation should be practiced in the processing area. Use injections sites located around the neck region.

RECEIVING "CALF" MANAGEMENT

Newly arrived calves do not readily eat upon arrival in the feedlot. On day one in the feedlot, only 22% of the calves may eat. By day three, approximately 40% may still not be eating. And on day 10, an average of 15% of the cattle may not be eating. Starter rations should be fed for 3-4 weeks after arrival.

WATER: The best location for water troughs is along the fenceline where cattle tend to walk upon arriving in a new pen. Clean waterers daily for the first 5 days with newly arrived cattle. Cleaning waters is desirable plus it makes noise so cattle can locate the water. Adding an electrolyte solution to the water troughs that calves drink from immediately after being unloaded at the feedlot may be an excellent way to guard against dehydration.

HAY: Good quality, long stem grass hay that is free of dust, mold, and weeds should be placed in the feedbunk or on the apron the first few days calves are in the pen in order to entice them to the bunk. Also beginning with the first day in the lot, the receiving ration should be sprinkled on top of the grass hay. Use between 0.5% to .75% of the calf's body weight to start out with (Wagner et al., 1992). After the first day, reduce the amount of hay offered and increase the amount of starter ration fed. The objective is to get cattle on their starter ration as soon as possible. This may only take 1-2 days for nonstressed calves and may take about a week for stressed calves. Alfalfa has a high quality protein but may cause bloat problems. A mixture of alfalfa hay and grass hay would be more acceptable. Grinding hay and including it directly in the receiving ration is preferred. However, long stem hay should be fed in the ration only during the first 2-3 days after arrival.

CONCENTRATES: Coarsely ground or rolled grain is preferred over whole grain during the receiving period (Wagner et al., 1992). The actual starter ration should contain from 60% to 80% concentrates. If cattle are destined for a high roughage program, the starter ration should be about 40-50% concentrates. Another option for cattle destined for grass pasture is a hay diet with 2 pounds of a 40% protein pellet. If silage is to be part of the

receiving program, it should be provided at least 2 times a day to prevent it from deteriorating in the bunk. Use of grass pastures for recently weaned calves has been successful for some operators, however, early detection and treatment of sickness may be more difficult.

PROTEIN: The starter ration should contain about 16% crude protein on a dry matter basis, depending on intake. Dry matter intake is often less than 1% of body weight during the first week of arrival. Diet concentrations of protein (and other nutrients) need to be increased based on feed intake level in order to meet requirements. Recent work by the Ohio Agricultural Research and Development Center (OARDC), Wooster has suggested that up to 23% crude protein (dry matter basis) during the first week, comprised partially of a by-pass protein, can improve gains during the first week (Fluharty and Loerch, 1992). Animal sources of by-pass protein may be less palatable which means that a flavor enhancer such as molasses may need to be added. One thing to keep in mind when feeding receiving diets containing 70-80% concentrates, and high levels of crude protein is that these diets are highly digestible. Therefore, stools will be much more loose than if the calves were being fed a diet with a high roughage content that was less digestible. The loose stools clear up in approximately two weeks, and should not be confused with a diarrhea condition resulting in dehydration. Calves are not initially capable of utilizing urea or other nonprotein nitrogen sources very effectively. In addition, as urea decomposes in the bunk, as sometimes occurs in hot weather, it gives off an ammonia odor. Possibly, urea can be added up to 0.5% of diet dry matter in receiving diets, but higher levels may depress feed intake.

MINERALS: Potassium content should be at least 1.0%. Studies by Hutcheson (1990) have suggested 1.4% potassium in the diet for cattle that have suffered excessive shrink of greater than 5%. Supplementation of potassium can be done through mineral supplements, alfalfa hay or dehydrated alfalfa pellets. Supplemental zinc may have some benefits (350-390 mg/hd/day). Under most circumstances providing trace mineral salt to the cattle at the rate of 0.5% of dry matter will meet their trace mineral requirements, excluding potassium and zinc. Copper and zinc levels should be evaluated for calves previously grazing tall-fescue pastures (Brazle). Mixing trace mineral salt in the ration is preferred over providing it free choice to assure the cattle are consuming the needed minerals. Chelated minerals have high levels of bioavailability and being evaluated for their use in meeting mineral requirements (Chester-Jones and Di Costanzo, 1994). The elevated levels of minerals and vitamins in receiving rations should be discontinued after feed intake has reached normal levels. These elevated "receiving" levels are considered extra label use by the FDA in regular growing-finishing rations (Wagner, 1993).

VITAMINS: Provide about 2000-3000 International Units (IU) of vitamin A per pound of dry matter. Receiving diets containing between 50 and 100 IU of vitamin E per pound may be adequate for most circumstances. Supplementing vitamin E through the diet appears to be more beneficial than by injection intramuscularly during processing of cattle (Rust,

1992).

The B complex vitamins are generally produced in sufficient quantities in the rumen and use of B vitamins has not consistently improved performance. However, if cattle have been off feed for some time, supplemental B vitamins, particularly niacin and thiamin may be beneficial (Wagner et al., 1992). Lee et al. (1985) observed that calves fed supplemental B vitamins (600 mg niacin, 200 mg thiamin and 750 mg choline per head) plus vitamin E gained more weight than calves fed vitamin E alone. Hutcheson (1990) observed a response to 125 ppm of niacin for healthy calves and 250 ppm for stressed calves.

Nutrient Recommendations Receiving Stressed Calves

Dry Matter, %	80-85	Sodium, %	.2-.3
NEm, mcal/lb	.70-.75	Sulfur, %	.08-.15
NEg, mcal/lb	.45-.55	Copper, ppm	10-20
Calcium, %	.6-.8	Iron, ppm	100-200
Phosphorus, %	.3-.5	Manganese, ppm	20-40
Potassium, %	1.0-1.4	Zinc, ppm	75-100
Magnesium, %	.2-.3	Cobalt, ppm	.1-.2
Crude Protein,%	16[a]	Selenium, ppm	.3
Vitamin A, IU/lb	2000-3000	Vitamin E, IU/day	50-100

[a]Some benefits may be realized by phase feeding diets which provide 20-23% CP week 1, 17% CP week 2 and 14% CP week 3) (Protein concentration decreases as intake increases to provide the same amount of protein daily.

IONOPHORES AND OTHER PRODUCTS: A step-up program (starting with 125 mg/hd/day) is recommended for monensin (Rumensin™) if intake at normal levels is a problem. A similar step-up procedure (150 mg/hd/day) could be used with lasalocid (Bovatec™) if intake is a problem at normal levels. There is general acceptance that Bovatec is more palatable than Rumensin. Ionophores should not be included in receiving diets for weaned calves until calves are eating well. The use of ionophores in yearling cattle receiving diets may be useful for the reduction of rumen acidosis and bloat. Producers should be aware that some new products have come into the market place. The products are bambermycins (GainPro™), laidlomycin propionate (Cattlyst™), and virginiamycin (Vmax™), as of the printing of this manual.

COCCIDIOSTATS: Coccidiosis is characterized by low appetite and watery, sometimes bloody, diarrhea. If coccidiosis prevention is desired, add an anticoccidial to the diet (Deccox™, Amprolium™, and Bovatec™, Rumensin™, etc.). Coccidiostats cannot cure the disease once an outbreak of bloody scours has occurred. Consider the concerns expressed above for use of ionophores in starting rations for weaned calves.

ANTIBIOTICS: Oral antibiotics may reduce sickness and increase performance. However, the primary tool for reducing shipping fever is a good health program. Several common feed antibiotics have proven effective, including oxytetracycline, chlortetracycline and oxytetracycline-sulfamethazine (AS-700). They are only effective if consumed in recommended amounts.

An alternative to feeding antibiotics, is injection of antibiotics at the time of processing (Rust, 1992). Highly stressed cattle will benefit from medication at processing time. If 10-20% of the cattle have been treated for respiratory distress, mass medication may be beneficial.

BUFFERS: The main benefit of sodium bicarbonate isn't for moving cattle more quickly to full feed; it is for preventing problems when bringing cattle up on difficult feeds. When used in rations of wheat, bakery wastes or other "volatile" forms of starch, sodium bicarbonate moderates rumen pH. Once cattle are on full feed, however, the buffer's effect declines. A suggested dosage would be 1 oz/hd/day. Higher levels may increase sickness (Brazle).

PROBIOTICS: Response to these products have been inconsistent. Cattle that have encountered significant stress during transport show a greater response to these products. In general, cattle shipped more than 400 miles are more likely to demonstrate a benefit to probiotic therapy (Rust, 1992).

DEWORMING: Depending upon origin, consult your veterinarian concerning the best product to use. Most studies indicate a benefit to routine deworming of feeder cattle unless cattle history and/or fecal egg counts indicate otherwise (Kuhl). However, egg counts are a poor predictor of worm load. History is more valuable. If in doubt, worm once at the beginning of the feeding period.

CHROMIUM: The element chromium has been shown to be of some benefit for stressed calves. Moonsie-Shageer and Mowat (1993) observed that chromium supplementation improved performance and immune function of stressed calves fed a corn silage-based diet (11.03% CP) that contained 0.16 ppm of chromium from a chromium yeast culture. More research is being conducted to clarify the possible use of chromium.

RECEIVING "YEARLING" MANAGEMENT

Yearling cattle can normally be considered to be "bunk broke." Therefore there may be more problems with an over consumption of the starter diet rather than under consumption, which is a problem with younger calves. Pritchard (1993) suggested starting to feed the finishing diet the second day after arrival at 2.3x maintenance level, increasing this to 2.5, 2.7 and 2.9x maintenance, at weekly intervals. Ionophore inclusion, at full dose, is much less of a problem for yearlings and may actually help moderate intake. Protein levels of

12-13% should be adequate.

VACCINATION PROGRAMS

Vaccines are commonly administered to calves entering a feeding program. However, the bovine respiratory disease complex (BRDC) is a complex syndrome that involves the interactions of a number of viruses, bacteria, and stress factors. The very number of different vaccination programs and vaccines available suggest that no one program, or possibly even any program, is completely satisfactory, in preventing BRDC or shipping fever. Vaccines should be viewed as tools in our prevention of BRDC, and it should be realized that they have limitations.

Vaccination programs for the feedlot should be developed between the producer and veterinarian and consider the farm's goals, expected outcomes, and cost/benefit. Some general points may be useful for consideration:

1. Vaccines are intended for use in stimulating an immune response in an animal that results in both a humoral (antibody and cytokine-mediated) and cellular response that offers protection by preventing infection or neutralizing the factors, such as toxins, that cause disease. This response is optimal only in a normal, reasonably healthy animal. An animal responding satisfactorily is said to be immunized. Vaccination **does not equal** immunization.

2. **Time** is needed for an adequate response to vaccines. Significant antibody levels may not be reached for 14 to 21 days in many cases and may only be reached following a booster dose in others, such as when killed vaccines and toxoids are given.

3. The presence of **maternal antibody** (gained from colostrum), which may persist up to 5-6 months-of-age, may interfere with the development of an adequate immune response.

4. **Multiple strains** of some viruses and bacteria exist in the field. Vaccines may not always be available which protect against all strains. The current situation with bovine viral diarrhea virus is an example of this.

5. **Live and killed vaccines** are both available and each has distinct advantages and disadvantages. Modified-live virus (MLV) vaccines tend to stimulate protection sooner than killed vaccines and may do so in a susceptible animal with one dose. MLV vaccines are generally cheaper than killed virus vaccines but require a normal immune system to work. Killed vaccines usually require at least 2 doses 3-4 weeks apart for optimal protection but are free from potential contaminants such as free live virus. Killed virus vaccines generally do not cause the immune suppression sometimes seen with live vaccines and are usually safe in pregnancy.

6. **Poor vaccine handling** techniques can kill modified-live vaccines. Any vaccine can become contaminated and make them dangerous to use.

7. The immune system of any animal can be impaired by lack of adequate nutrition and pre-existing disease.

8. Not all available vaccines stimulate protective immunity.

STATUS OF CATTLE

The ideal animal entering the feedlot would already be immune to the common pathogens that cause disease. This is usually not the case, and the animals status and potential to respond to a vaccine are influenced by such things as:

1. **Age:** Calves and yearlings differ because of the potential presence of maternal antibody and their prior opportunity to come in contact with viruses and bacteria, thus developing an immune response.

2. **Herd-of-Origin:** The source of the calves represents the opportunity for calves to become exposed and immune to various pathogens and is quite different from one herd to the next.

3. **Nutritional status:** Animals which are deficient in energy and protein or deficient in micronutrients may not be capable of a normal immune response.

4. **Previous vaccine experience:** On-farm vaccination programs and preconditioning programs differ considerably and may or may not result in the animal becoming immune or in becoming immune to pathogens of interest in the feedlot.

5. **Presence of existing infections:** Stressed calves may already be incubating infections on arrival to the feedlot and incapable of responding to vaccines.

6. **Stress load on the animal:** Stressors such as weaning, mixing cattle, feed and water deprivation, dehorning, castration, branding, loading and unloading, and travel are **additive**. These stresses depress the immune response to both vaccines and field pathogens. Therefore, handle the cattle as quietly and carefully as possible to avoid further stress during processing.

Usually 3 general groups of cattle, with respect to vaccine need, will enter feeding programs.: 1) pre-weaning conditioned, cattle, 2) fresh, farm-origin or auction market calves, and 3) stressed or "stale" calves.

Preconditioned or preweaning conditioned calves.

These animal will have been given various vaccines and treatment as dictated by differing programs. "Certification" and accompanying paperwork may increase confidence that these procedures were performed as desired. Adjustments to the feeding of concentrates and weaning may be as important, or more important, than vaccinations. If animals are truly vaccinated according to manufacturer's recommendations prior to weaning or stresses of shipment, additional vaccine on arrival to the feedlot may be unwarranted and uneconomical. This group of calves has the greatest potential to receive benefit from vaccines.

It has been suggested that vaccination of calves against viral and bacterial agents 30 days before sale will reduce calf weaning weight by about 2%, but compared with non-vaccinates, may reduce sickness by about 10-20% and death by 20% or more with similar feed conversions and gain. This group of animals may be desirable for feeder calf purchasers who are risk averse and who have little opportunity to spread risk over large numbers. Likewise, the producer who retains ownership of his calves through the feeding period may be able to capture all the health benefits of these programs and fine tune the extra feed cost and management considerations to limit or eliminate the potential losses incurred in the cow/calf side of production.

Fresh cattle, no vaccination history.

In spite of its widespread practice, argument exists about the value of vaccination of cattle on arrival at the feedlot, and a controlled study is difficult because control of the variables involved is troublesome. Existing independent controlled research results have been mixed and do not clearly support a positive recommendation for routine vaccination. Vaccines may prevent the development of disease later in the feeding period, however, the onset of disease often precedes the development of an effective immune response. Vaccines that stimulate a booster response in calves with inadequate vaccine status or previous disease exposure or those which stimulate a local protective response (such as nasal IBR vaccine) may be helpful. Some studies suggest that vaccination on arrival with leukotoxin-based pasteurella vaccines may be of benefit in the early post arrival period.

Stressed cattle.

Highly stressed feeder cattle often show signs of illness on arrival at the feedlot or shortly thereafter. The overall appearance of the cattle, history, and presence of temperatures of over 104^{o}F in some of the cattle after they have rested from transportation and unloading (12-24 hrs) may indicate impending disease problems. The reason for waiting to take rectal temperatures is that temperatures taken immediately after cattle are unloaded may be misleading. On hot, sunny days, rectal temperatures can increase as

much as .5°F/hour, and on cold, wet days can decrease .5°F/hour for every hour they are standing and waiting to be processed. The best time to take rectal temperatures is prior to feeding in the early morning. Opinions vary considerably on use of vaccine in these cattle, and controlled research results on vaccine effectiveness in this group are scarce. Generally, it is wise not to add to the stress of these animals with vaccine and other processing. Our basic understanding of the immune system suggests that these cattle are unlikely to respond as desired. Experience and consultation with a veterinarian will dictate which procedures, other than vaccination, should be performed near arrival and which should be postponed.

Core vaccination usage - one more opinion

The agents most commonly associated with the BRDC in the feedlot are: infectious bovine rhinotracheitis virus (IBR), parainfluenza (PI_3), bovine virus diarrhea (BVD), bovine respiratory syncytial virus (BRSV), and Pasteurella hemolytica and Pasteurella multocida (bacteria). In addition, several other viruses, bacteria, and mycoplasmas have been incriminated. Not all of these agents will be present in a given group of animals, and vaccines do not exist for all of them. It is accepted that the usual course of events is for viruses to infect the animal and damage the respiratory tract lining and/or to reduce the calf's vigor with subsequent bacterial invasion and multiplication.

Some research has suggested that IBR virus and Pasteurella hemolytica can cause significant disease without the aid of other infectious agents. A new live P. hemolytica and P. multocida may be effective with one injection. It is certain that, experimentally, these agents alone can cause significant disease. Vaccines for these agents should ideally be given prior to exposure or stress, however, vaccination on arrival may be of some benefit. Newer vaccines for Pasteurella hemolytica appear to offer significant benefit if cattle have time to respond. Two doses of leukotoxin-based Pasteurella hemolytica vaccines are usually recommended, and 2 doses of killed IBR vaccine are needed for adequate protection against these agents. Nasally administered, live IBR vaccines have been available for a long time and appear to be safe. They have an advantage over intramuscularly administered vaccines in that they stimulate a local immune response in the nasal passages where the field virus initially reproduces, and the response may be non-specific and rapid enough to offer some protection against infection by other viruses.

Infections with BVD virus are usually mild in a normal animal. Their usual effect is to depress immune function temporarily. However, some strains exist which are very virulent and cause serious disease. At this writing, it is unclear whether available vaccines offer good protection against all strains. This virus should be included in preconditioning programs, but the benefit of administration on arrival at the feedlot is open to debate. It is safe to recommend that cattle which have been on feed for some time and are well started should be protected by NOT adding new cattle to their pen or group to avoid exposure regardless of vaccination status.

BRSV and PI_3 viruses damage the respiratory lining and aid in establishing bacterial infections. Reports of serious outbreaks of respiratory disease caused by BRSV have been difficult to duplicate under controlled conditions with virus taken from sick or dead calves. We do not yet understand the complete pathogenesis of this disease. Work in other species suggests that complex virus/bacterial interactions, involving bacteria which are not normally considered pathogens, may play a part some viral infections. Vaccines for these viruses may be beneficial if they can be given prior to exposure or stress of sale and shipment.

Vaccines for the diseases caused by the Clostridia group (blackleg, malignant edema, enterotoxemia) have been available for a long time ("5-way", "7-way", etc). Evidence now exists to show that significant tissue damage from intramuscular injection of these products will occur. Recently, reduced average daily gain was noted following repeated injections of these products in some groups of calves suggesting a negative effect from their intramuscular use. In addition, in one recent review of the causes of death in calves suddenly dying in a large feedlot, enterotoxemia was not shown to be causal in a significant number of animals. And lastly, the true cause of "sudden death" in feedlots, long suspected to be caused by a Clostridia spp., is not yet really known. These findings suggest that repeated vaccination with "7-way" vaccines may offer little benefit and may do harm. If cattle enter the feedlot with a previous history of vaccination for these diseases or if it is likely that they have received vaccines for them, there is little reason to recommend boosters, especially repeated ones, following arrival. These vaccines should be given subcutaneously if so labelled

The field of vaccine development is wide and the competition for market share in the cattle industry is keen. Vaccines of today are significantly better than those available just a few years ago. New technologies and better understanding of disease development are helping us develop more effective vaccines. However, vaccines remain only one tool in our attempt to maximize feedlot animal health.

HOSPITAL PENS

Larger feedlots may want to consider having separate facilities for sick cattle. A rule of thumb is to have enough sick pens to hold 2-5% of the feedlot capacity (Baker et al., 1983).

Loss of appetite is a common symptom of most sick cattle (Laudert, 1991). It can be difficult to get sick animals to eat. In general, provide a clean, fresh feed that will encourage consumption.

Feed intake is highly correlated with water intake. Water sources should be cleaned daily

to prevent build-up of unpalatable materials. Heat water or remove ice during cold weather. Troughs may need to be drained periodically in hot weather.

Small quantities of medium to high quality long stem hay should be offered daily, in addition to whatever roughage is included in the mixed rations. Hay should be offered in a feeder or bunk to prevent contamination.

The mixed rations should be blended to contain about 30% roughage. No more than 10-15% of the total mixed ration should come from silage. Dusty feeds such as finely chopped or ground hay and finely processed grains should be avoided. Molasses or liquid feeds can be added to the rations to reduce fines and dustiness.

It is recommended that sick cattle be fed more often than once per day. The act of feeding may stimulate eating behavior. Do not force sick cattle to clean-up stale, wet feed.

Hospital pens should be cleaned frequently and bedded if possible. Competition at the bunk should be minimized by allowing 18 to 24 inches of space per head (Griffin et al., 1993).

Cattle that appear to be recovering from a sickness might be moved to another pen if competition at the feed bunk with the very sick becomes a problem. Cattle in this convalescent pen should be allowed to consume a ration similar to that being fed to the healthy cattle.

Hospital rations can be formulated with nutrient specifications similar to receiving rations for stressed calves. Because sick cattle have reduced digestion in the rumen, they cannot utilize the same level of urea or other nonprotein nitrogen (NPN) sources as healthy cattle can. Often sick cattle have not been on feed long enough to adapt to NPN and this adaptability is quickly lost in cattle which go off feed.

Salt and minerals should be offered free choice in the bunk in addition to that provided in the mixed rations. Since sick cattle are deficient in trace minerals, it is best to offer a trace mineralized salt. Minerals should be fed in the loose form as cattle are less likely to stand and lick blocks when sick. Only small amounts of both should be offered at a time to maintain freshness.

Chapter 3. Bunk Management

By minimizing digestive disorders we can keep cattle on feed and maximize performance. Poor bunk management and not the ration being fed can be "the first domino to fall" resulting in digestive disturbances such as bloat, acidosis, and liver abscesses.

Cattle feeders should strive to have uniform day to day consumption of fresh, high-quality feed. The bunk management tools described below can aid in preventing large fluctuations in intake caused by acidosis and recovery from a bout of acidosis. Determining how much feed to offer requires a certain amount of skill and good judgement. Cattle are big fermentation vats (ruminants) and fermentation vats work best under constant conditions (Pritchard, 1993). Careful bunk management during the winter months when ice, snow and freezing rain are a problem is especially important since weather conditions alter consumption patterns.

SCORING SYSTEM

One method of monitoring intake and determining how much to feed is to use a feedbunk-scoring system on a scale from zero to five. A score of zero implies that the feedbunk is empty or "slick". A score of zero-minus (0-)means the bunk has been empty for more than an hour. A score of zero-plus (0+) means the bunk is empty except for a few fines or clumps of feed. A score of one means something less than or equal to one inch of feed is left in the bottom of the bunk. A score of 2 means that 2 inches of feed is left. 3 means three inches and so on.

THE FEEDBUNK SCORING SYSTEM

Score	Bunk Description
0-	Empty for more than 1 hour
0	Empty bunk for less than 1 hour
0+	A few fines or clumps in bunk
1-	Thin layer, 1 kernel deep
1	Less than 1 inch of feed in bunk
2	Less than 2 inches of feed in bunk
3	Less than 3 inches of feed in bunk

Normally, if the score is zero for two consecutive days, increase the feed delivered to cattle by 5-10 percent. If the score is two or more, reduce the feed offered by 5-10 percent.

A bunk sheet should have a place for date, pen of cattle, amount of feed delivered and a bunk score. A feeder should have at least 4 days of records whenever determining how much feed to put in the bunk (Pritchard, 1993). Scoring bunks should be done the same time each day. Looking back, the bunk score, combined with the amount of feed provided can tell you if intakes are going up, coming down or holding steady. Scores constantly in the 2 to 3 range may lead to feed wastage and reduced feed efficiency due to the possibility of large fluctuations in feed intake.

MONITORING THE CATTLE

CATTLE OBSERVATION: You also need to be looking at the cattle when you make a decision. If the bunk is empty (slick), do the cattle look like they are hungry or do they look content? If they look content, wait for a second or third day of slick bunks before increasing the amount of feed. One cool night or a small front can cause steers to slick a bunk that normally would not be slick. Increasing the feed delivery may only cause them to back off feed in the next 2 to 3 days. If they truly appear hungry, increase the feed delivered 5 percent today and hold it there tomorrow to find out if they can actually handle the extra feed. If they do handle the feed, try increasing it again on the third day.

STOOL OBSERVATION: Tall firm stools are a sign the cattle are consuming significant levels of roughage. Flat brown stools indicate that the cattle are consuming a higher amounts of grain but are not incurring digestive upsets. Flat gray stools are a sign of acidosis. Flat gray stools may be observed before an actual drop in intake occurs. Pens that have a majority of flat brown stools and a few gray stools are a sign that cattle are optimizing intake.

MONITORING THE ENVIRONMENT

SEASONAL VARIATION: Feeding schedules may need to be changed during different seasons of the year. Cattle may eat more during the day and less during the night in the winter. Conversely, cattle may eat more during the night than during the day in hot weather. Cattle that look hot at 6 A.M. will not eat much that day. In winter, the footing on feed aprons can become difficult, discouraging intake, especially in heavy cattle.

WEATHER CONDITIONS: Mud and changing weather cause erratic intake patterns by cattle. Intake frequently increases prior to a storm, declines during the storm, and increases after the storm. A feeder might consider adding more roughage (5-8%) to the diet or using the previous step-up ration until cattle get reaccustomed to the increased intake. Cattle may consume their daily allotment of feed within as little as 2 hours time,

after not eating any significant amount for 10 to 20 hours. A situation for bloat or acidosis exists even though 24-hour consumption patterns look fairly regular.

MONITORING THE FEED

FEED MIXING: If every handful of feed coming out of the bunk is not uniform, the cattle are not all on the same diet. This situation can cause some cattle to go off feed within groups that may not be observed on the feed sheet. Differences in cattle condition may appear that are not explained by genetic composition of the cattle.

TIMES A DAY FEEDING: Dry feeds based on dry grain and hay may be fed only once per day. Data from South Dakota indicates feeding once a day in the evening was as good as feeding twice a day and was better than feeding once a day in the morning (during summer months). Dry feeds will be fresher for cattle if fed twice a day during rainy or snowy weather. High moisture rations such as those based on silage or high moisture corn, may need to be fed twice daily to avoid molding and spoiling during hot weather and freezing during cold weather.

FEED ACCUMULATION: Feed should not be allowed to accumulate from feeding to feeding. Dry matter intake will decline if this is allowed to occur for very long. Upon cleaning out large accumulations of stale feed, cattle may engorge themselves on the new, fresh feed and some cases of "grain bloat" may occur. The other scenario that may occur is the cattle will engorge themselves on the fresh feed in a short amount of time and "slick" the bunk and not consume the next batch of feed you provide.

Clumps of feed in an otherwise empty bunk will probably not be consumed by the cattle and thus should be cleaned out before fresh feed is added. Clumps of feed in a bunk that has been empty for less than an hour would receive a score of zero/plus. A bunk receives a score of zero/minus if it has been empty for more than hour and contains clumps of feed.

SLICK BUNKS: It is not considered poor management to have cattle clean the bunks once a day, as long as cattle are not out of feed to the extent they become restless or engorge when fed again. If it goes much longer than 1 hour on a high-energy diet, there is risk of overeating, acidosis (grain bloat) and irregular intake patterns.

FINES: Take time to investigate the type of material in the bottom of the bunk. Make sure finely ground meals and heavy ingredients such as minerals are not all falling to the bottom of the bunk. This can happen when small particle feeds such as ground protein or mineral are fed with large particle feeds such as whole shelled corn or ground hay. If such fines do appear in the bottom of the bunk, consider adding moisture in the form of silage, molasses, water or other wet products to help hold the fines in suspension.

SELF FEEDERS: Many of the same principles apply to cattle producers utilizing self feeders. Check the feeders on a regular basis. Avoid feeding wet feeds and keep the total moisture content of the ration to less than 14 percent. Make sure fines are not accumulating in the bottom of the bunk. This problem is minimized when the various feed ingredients have a similar particle size. Additionally, self feeders need to be examined more than once a day during wet weather to clean out spoiled feed. During hot/wet weather conditions, diets containing a high amount of urea may become unpalatable if allowed to become wet, and are not promptly removed.

WATER: Feed intake is related to water intake. A slow water fountain during hot weather will reduce intake. Frozen water fountains shut off intake. Clean water fountains on a regular basis. If irregular intake continues to be a problem, check the water quality and perhaps the fountain for stray voltage.

Water requirements for feedlot cattle (Gallons/Day)

	Weight	Temperature	
Animal Type	(lbs)	40°F	70°F
Growing Calves	400	4.0	5.8
	600	5.3	7.8
	800	6.3	9.2
Finishing Cattle	800	7.3	10.7
	1000	8.7	12.6

THE USE OF IONOPHORES: Ionophores can help control variations in daily intake and reduce occurrence of acidosis and bloat.

Chapter 4. Feedstuffs

The feedstuffs available to Ohio feedlot operators is vast and varied. Therefore, the feedstuffs discussed in this section should only be considered a partial list.

WATER

Clean, fresh water should be supplied at all times. Drinkable water is usually between 40 and 60^{o}F (Boyles et al., 1988). Steers that have access to cool drinking water during hot weather will gain 0.3 to 0.4 pounds more per day than those drinking warm water. Occasionally check waterers with heaters to detect a *"runaway."*

Dip a thermometer into the water but do not allow it to rest on the bottom. Touching the heated bottom of the pan can result in higher temperatures than actual water temperature. Check the temperature over several cold days. Water temperatures of at least 40^{o}F should minimize mechanical problems and maintain animal performance.

Stray electric current in a self-heating trough can reduce water consumption and thus reduce feed intake. Shut off the electricity and check the inside for rodent nests. Make sure the connections are dry and there is a clean, tight ground.

Outbreaks of urinary calculi or water belly can be associated with weather conditions. Cold weather may reduce water intake, which reduces water flow through the bladder and kidneys. This reduced water flow allows kidney stones to develop. Hard water does not cause urinary calculi problems but may be a factor if the hardness affects water palatability.

A hose should never be placed under the surface of the water in an animal watering tank or in a chemical sprayer tank. The tank might fill over the outlet of the hose, resulting in a loss of water pressure and back siphoning when a hose or faucet is turned off. The entire water system may then become contaminated by impurities.

Dirty water is a source for disease organisms, and disease can spread rapidly if animals drink from the same trough. Sick animals should be isolated and the trough disinfected and cleaned. Sprinkling baking soda in the fountain periodically may reduce algae growth.

Create an elevated base around waters. Make the base wide enough so animals can easily put their front legs on it, but not their hind legs. when they are drinking. Animals will not normally place only their hind legs on this base and therefore will not defecate in the water. Make the surface rough so they will not slip.

DRY CORN

Whole Shelled Corn: Dry whole shelled corn has been equal to or slightly superior to ground or rolled corn in high concentrate beef cattle rations. Processing may be considered when the rations contains 20% or more roughage. It is questionable if dry corn should be processed unless at least 20 pounds of corn silage are fed daily, or more than 23% of the ration dry matter is roughage. Whole corn appears to have a roughage or "scratching effect" which helps maintain healthy tissue in the rumen wall of cattle and lowers the incidence of liver abscesses that are often a problem when cattle are fed high concentrate rations (Sewell, 1991).

There is also a "moisture content level" which should be considered when using whole shelled corn. If corn is less than 12% moisture, it probably should be processed. Some nutritionist have recommended a moisture level range of 13-15%. Dry growing conditions may cause some corn to be less than 12% moisture. Some larger feedlots commonly use a surfactant (an acid product) and water mixture to moisten the grain. The surfactant dissolves the grain's waxy outer layer, allowing more water absorption (Roybal, 1987). Smaller feedlot operators might consider adding 3-5% water during mixing to dry, flinty corn.

Whole-shelled corn is well suited for use in self-feeders. This system usually does not contain any roughage. A pelleted supplement is mixed with the corn and fed in self-feeders. A free choice salt-mineral mix is also available. Usually, digestive problems are not encountered if cattle are comfortable and close to feed and water at all times. Occasionally, problems arise during a winter storm due to changes in intake. Providing about 1-2 pounds of roughage might be considered in these situations.

Bunk management is critical with whole shelled corn. If cattle are allowed to get hungry, they are more likely to gulp the feed, rather than chew it, and utilization will be poorer (Roybal, 1987). However, do not allow old, stale feed or fines to accumulate in the feed bunk since that will also initiate fluctuations in intake. There should be about 5-10 inches of bunk space per head in self-feeders (minimum of 3 inches), depending on age and weight of cattle. Adjust the opening in self-feeders so that only a small amount of feed is in trough at all times.

Processed Corn: Processing corn can improve feed utilization in some circumstances. Processing corn can improve the mixing characteristics of the ration if other ingredients are in the meal form. The various feedstuffs in a ration are less likely to separate if they are of a similar particle size. Grinding or rolling corn are two of the least expensive methods for processing corn. Breaking the grain into 3 to 4 particles or grits is acceptable. No particular advantage has been observed in blending whole and ground corn (Messman et al., 1989). However, this might be considered if the ground grain is too fine and bloat-

acidosis problems are prevalent. Steam flaking is another option but is not commonly done by small farmer-feeders.

Certain grains, such as barley and wheat, require processing prior to feeding. The main thing to remember is to keep the end-product as coarse as possible. It is better to have a few whole kernels, which may only be partially digested, than to have a fine, dusty feed which can lead to bloat-acidosis problems and low feed intake.

HIGH MOISTURE CORN

When to Harvest: At maturity, a visible black layer develops in the base of the kernel near where the kernel joins the cob (McGuggey and Lillman, 1976). At maturity, moisture content of the kernel is 30 to 35 percent or greater. A few cold nights or a heavy frost can cause black layer formation at higher moisture levels. Recommended moisture ranges for harvesting are 24 to 30 percent. Corn kernels will lose 1/2 to 1 percent moisture per day in the field when they reach this stage (Mader et al., 1983).

High Moisture Corn Storage: High moisture corn can be stored in the whole or ground form. Ground high moisture corn is normally stored in bunker or trench silos and whole high moisture corn is stored in upright, oxygen limiting silos (Mader et al., 1983). Ground or coarse rolled corn can be stored in upright silos. The large bagging systems can also be used for storage. High moisture feeds should be left in storage for 21 days before being fed.

	Kernel Moisture, %		
Type of Silo	Ideal	Minimum	Maximum
Sealed	27	20	33
Top unload	30	22	35
Bagged	27	20	35
Bunker	30	25	35

(Bucholtz et al., 1992)

Breaking the kernel into 2 to 5 pieces will be adequate in concrete upright silos that are in good condition. Running the blower at a high rate of speed may be sufficient for processing. The kernels should be broken into 5 to 10 pieces for bunker silo storage. Look at the corn after bringing it in from the field to see how much more processing is needed. A 1/2 to 5/8-inch screen is about right for corn (Mader et al., 1983). In general the lower the moisture, the finer the grind.

Storage in Oxygen-Limiting Upright Silos: It is customary to store whole high moisture shelled corn in oxygen limiting silos. A breather bag may be included at the top of the silo

to allow removal of grain creating a vacuum and to compensate for temperature changes. It is advisable to run out a small amount of grain after each load so as to establish a gravity flow pattern.

Storage in Bunker and Upright Silos: Conventional upright silos must be in good condition for high moisture grain. If in doubt, check with the manufacturer about extra bands for reinforcement. Seal the doors with plastic. If filling is interrupted, the surface should be temporarily covered. Seal the top of the silo with a plastic cap that is 1 to 2 feet larger than the circumference of the silo. In top unloading silos, modification of the unloader may be necessary to prevent the unloader from burying itself if the unloader was designed for use with silage.

Bunker silos should be covered with plastic. The plastic sheets should overlap and be sealed with dirt or gravel and then cover the entire plastic surface with tires. An alternative is to cover with a molasses-based material.

The removal rate during winter should be 2 to 3 inches per day. The rate may need to be greater than 4 inches during warmer weather to prevent spoilage.

Processing High Moisture Corn For Cattle: In high- or all-concentrate diets (greater than 80%), high moisture corn can be fed whole to beef cattle. Processing is at least questionable if the ration contains less than 15% roughage. Normally, a number of the originally stored whole kernels are broken during storage. High moisture corn should be processed by a coarse grind or roll if fed in medium- to low-concentrate diets. Fine grinding can actually hinder performance.

Feeding Management: High moisture corn ferments faster than dry corn in the animal's rumen. Therefore, there may be a greater risk of going off-feed, acidosis, or founder with high moisture corn than with dry corn. Finishing rations should have roughage levels of 10 to 15% on a dry matter basis so as to prevent potential problems if there is any processing. Ideally, it is desirable for the corn and the roughage to be mixed together to avoid sorting and digestive upsets. A course chop (greater than 1/4 inch) is suggested for hay or silage. Bunk management is critical to reduce fluctuating intake and acidosis problems. Because of limited bunk life, high moisture is not well suited to self-feeding systems.

In very rare cases, more problems with "water belly" or urinary calculi will occur with high moisture corn than with dry corn due to differences in availability of phosphorus. You should probably maintain at least 0.7% calcium in the diet. A supplement of 0.5% ammonium chloride can be used once the problems in calcium and salt intake have been resolved and if a problem still exists.

Blending slower fermenting grains, such as dry corn, with high moisture corn can reduce

acidosis and improve feed efficiency. Nebraska research suggests that a grain mix of 50-75% high moisture corn and 50-25% dry rolled corn is more efficient than a 100% high moisture corn or 100% dry rolled corn grain mix. Mixtures of these corn types can improve feed efficiency and gain by 3-4%. The greatest improvement will be during the first 21-28 days.

BARLEY

Barley is an excellent feed for cattle and may be substituted for corn in various rations. Feeding values of barley for cattle are 88% to 90% that of corn. Feed barley frequently contains protein in excess of 13.5% (As fed). One can normally feed less protein supplement when feeding barley compared to corn. The economic value of barley compared to corn should take into account the cost of protein supplement. Stained or discolored barley is discriminated against at the malting plant. The feed value, however, of the blemished grain is not compromised.

Fiber content will vary inversely with test weight. NRC (National Research Council) considers 36 lb. test weight barley (77% TDN) to be 7% lower in total digestible nutrients compared to normal barley 87% TDN, 48 lb test weight). Barley fiber has little value as a roughage factor.

It is important that barley be coarsely processed before it is fed to cattle. Whole barley is only about 80% as useful as rolled or ground barley. A common problem is to grind or roll the barley too fine. An adequate level of processing is to break the kernel into just 2 pieces and have some breaks in the kernel surface. Cattle may maintain more consistent feed intake patterns with maximum levels of barley not exceeding 70% of the ration. Additional grain can be provided from some slower fermenting grains. Novice producers may want to use lower levels (40-50%) until they gain experience.

OATS

Starting On Feed: Oats is an ideal grain for starting cattle of feed because of its high hull and fiber content. Many experienced cattlemen prefer to start weaned calves on oats as the only or major grain, gradually shifting over to higher-energy grains as the animals become adapted to grain consumption. Oats may constitute 50 to 70% of the grain mix while cattle are becoming accustomed to a full feed. The level of oats should be reduce over time to 0-30 percent of the diet. However, on an energy basis, oats are usually much more expensive than corn.

Processing Oats: Calves chew oat grain sufficiently well until approximately 8-10 months old. Little or no benefit is gained from processing oats prior to this time. Grinding oats is usually not required for young calves, unless the grain fed with the oats is also ground.

Bushel Weight and Energy Content: Oats quality and bushel test weight vary substantially among varieties, geographic location, growing season temperature and rainfall. Very high temperatures during the kernel filling and maturation period, incidence of certain plant diseases such as crownrust, and several other environmental factors can adversely affect oat grain quality. Information to date suggests little difference in energy value of varieties for ruminant animals due to variety alone. However, varietal differences associated with wide differences in bushel test weight suggest substantial differences in energy content.

USDA Grades of Oats

U.S. No. 1 oats	36 lbs/bushel plus
U.S. No. 2 oats	33 lbs/bushel plus
Heavy oats	38-40 lbs/bushel
Extra-heavy oats	40 lbs/bushel plus

Bushel test weight is closely related to energy content and inversely related to fiber content. Test weight is recognized as the only practical means outside the laboratory to describe quality variations in oats. For each pound bushel test weight less than 32 pounds, assume a 2.5% lower energy value. For each pound bushel test weight above 32 pounds, assume a 2% higher energy value per pound.

WHEAT

Wheat can be used to replace a part of the grain ration when protein prices are high and wheat is relatively cheap compared to other grains. As a general rule, limit wheat to 50% of the grain portion in finishing diets. However, some experienced feeders use larger amounts of wheat successfully.

Processing Wheat: Although the kernel must be cracked or broken, over processing will result in the production of many fines that are undesirable since the rate of wheat starch digestion in the rumen is very rapid. Therefore, an excessive amount of fine particles will cause generally low and erratic intakes, digestive upsets and poor performance. If wheat is dry-rolled, it should be rolled or ground as coarsely as possible while still breaking all the kernels. Rolling rather than grinding generally results in fewer fines. Steam flaking wheat can improve animal performance. Mixing grains should occur after grain processing rather than before. Wheat could more likely be processed with barley or oats than with corn.

Problems of Feeding Wheat: Once on full feed, feed should be kept before the cattle at all times. It is not advisable to change back and forth from wheat to other feed grains when feeding high concentrate rations. Wheat is a fast fermenting grain in the rumen. Problems of depressed feed intake, acidosis and abscessed livers have been reported. They are the basis for recommendations on limiting the amount of wheat in the ration,

mixing it with other grains, and for feeding at least 15% roughage. The addition of ionophores has made it possible to reduce some of these digestive problems and feed higher levels of wheat.

Levels of wheat greater than 50% of grain portion of the diet have been fed when wheat is relatively inexpensive compared to other grains. Also, as grain becomes a lower portion of the diet, such as in cow diets, wheat may become the sole grain source. Wheat is not recommended in creep diets.

Sprouting: Wheat showing more than 2% percent sprouted kernels is classified as sprouted wheat. The nutritional value of grain protein does not appear to be depressed, providing the sprout is not lost. The value of sprouted wheat for ruminant feed is apparently only slightly affected, if at all by moderate sprouting as demonstrated in a Washington State study.

One aspect of the feeding of field sprouted grains that must be mentioned is the fact that mold and fungal infestations are more likely with sprouted grain. Care must be taken to avoid feeding moldy wheat to livestock to prevent mycotoxin poisoning.

The following table contains various concentrates with their relative energy values compared to corn and suggested levels of use in feedlot diets:

Value of various energy sources compared to corn in feeder rations with ration restrictions

	Value Compared to Corn (%)	Ration Restriction (maximum %)
Corn	100	100
Animal fat	160-180	5
Barley	88-90	100
Beet pulp, dried	88-95	50
Millet	90-100	50
Milo	85-95	100
Molasses	70	5
Oats	88-94	25
Rye	80-85	20
Wheat	100-105	40
Wheat bran	65-80	10
Wheat middlings	70-85	20

Source: University of Nebraska Beef Cattle Report, 1972

ROUGHAGES AND SILAGE

Roughage are included in finishing rations 1) to contribute to the physical nature of the rations and 2) to provide nutrients (Guyer et al., 1972). Grass hay, alfalfa hay, silage, corn cobs, straw and others can be used to alter the physical nature of the ration. Roughages vary a great deal in their nutrient content. Five pounds of "as fed" corn silage can be an excellent roughage and a valuable energy source.

Roughages can be processed so that they can be handled mechanically and be more uniformly mixed with the other ration ingredients. Hay need only be coarsely chopped. From 1/2 inch to 1 inch is the recommended chop length. Hay chopped to longer lengths will create separation problems when mixing. Corn cobs should be ground through a 1/4 inch screen. Silage should be cut at approximately 3/8-1/4 inch or if harvested at less than 60% moisture, should be run through a recutter screen (Guyer et al., 1972).

When the roughage is mixed into the total ration, suggested roughage levels are 5-10% of the total dry matter of the diet. When facilities are not available for uniform mixing, roughage levels of 15-20% should be considered. Good quality silage should be about 30-40% moisture and contain 45-50% grain on a dry matter basis.

PROTEIN SOURCES AND NPN

Many of the common natural protein sources are by-products of the cereal and vegetable-oil milling process. Protein sources are usually priced higher than feed grains but a protein deficiency is usually more expensive than a slight surplus of protein in the diet. The National Research Council (NRC) requirements for beef cattle are considered minimum values for nutrients such as protein. Therefore, it is not uncommon to feed protein levels slightly higher than those recommended by NRC. The NRC recommendations for protein will be higher in their next edition, scheduled for release in 1996. This increase reflects increased requirements associated with growthier cattle, common use of implants, and lower feed intakes with high concentrate diets not commonly fed.

Soybean meal: There are a number of sources of natural protein but the most common for Ohio feedlot operators is soybean meal. The various sources of soybean meal (mechanically extracted or solvent extracted) do not appear to be significant when choosing a source of soybean meal for beef cattle. Today, most soybean meal is derived during the solvent-extraction process of oil extraction. Price per unit of protein will be the major factor to consider when choosing most protein sources.

Soybeans: Feeding soybeans is not a new concept (Morrison, 1947). Trenkle et al. (1993) observed that cattle fed soybeans gain as well as those fed soybean meal. Heat treatment or extruding the beans did not appear to be beneficial. Davenport et al. (1988)

suggested that some bypass protein may be of benefit when feeding growing calves a corn silage-based when utilizing ground soybeans. It is not recommended to blend raw soybeans with urea. Feed only enough soybeans to meet the protein requirements. The high oil (fat) content of soybeans can cause digestive problems if fed at excessively high levels.

Bypass Protein: Bypass protein is that protein which escapes (bypasses) digestion in the rumen. This bypass protein is potentially digested in the lower tract of the animal. The animal has two sources of protein: Bypass protein and microbial protein. For finishing cattle, microbial protein is usually sufficient to meet the animal's requirements (Klopfenstein and Goedeken, 1986). Young animals on lower energy diets or consuming lower quality feeds may benefit from some bypass protein supplementation. High protein diets with blood meal (a high bypass protein source) may give large benefits in performance early in the receiving period for calves (Fluharty and Loerch, 1991). However, the choice of supplemental protein source should be based upon price, availability, and projected improvement in performance (Fluharty and Loerch, 1993). Protein sources with high bypass potential are brewers grains, distillers grains, distillers grains plus solubles, corn gluten meal, dehydrated alfalfa (20%), blood meal, meat meal, and fish meal (Stock et al., 1984). Additionally, the amount of soybean meal protein that bypasses the rumen increases as the concentrate level of the diet increases, due to a decrease in rumen pH.

Nonprotein Nitrogen (NPN): The use of urea or other NPN compounds can often reduce protein costs. One pound of pure urea provides 2.92 pounds of protein, giving it a protein equivalent of 292%, but feed grain urea contains other ingredients to prevent caking and lumping, and these lower the protein equivalent to approximately 262-281%. The 281 urea is the most common source. Fertilizer grade urea is similar to feed-grade urea, but contains no additives to keep it free-flowing and often is mixed with other nitrogen compounds not recommended for livestock use.

Feeds are analyzed for nitrogen in the laboratory to determine their crude protein. Protein averages 16% nitrogen. Thus, the percent nitrogen multiplied by 6.25 gives the percent crude protein analysis. Urea contains 42 or 45% nitrogen, therefore, the protein equivalent of urea is: 6.25 x 45 = 281% or 6.25 x 42 = 262%. In another words, one pound of urea contains enough nitrogen to make 2.62 pound to 2.81 pounds of protein.

Rations containing NPN should be mixed uniformly and not topdressed. Dry supplements may absorb moisture and bridge in the bin if they contain more than 10% urea. Urea in meal type supplements may sometimes separate out as the feed is unloaded. Check to see if a lot of urea (crystals) are in the bottom of the feed wagon or bunk. Feeding silage or molasses will reduce the separation problems. Ideally, urea containing supplements should be mixed into the ration on a daily basis.

Plant protein appears to be more efficiently utilized compared to NPN sources when starting cattle on feed. Animals under 450 lbs gain more efficiently on natural protein. Calves at 450-600 lbs on a growing ration can make use of some urea provided they receive at least 4-5 lb of grain/head/day (Baker, et al., 1983). Animals over 600 lbs make the most efficient use of urea. Cattle lose their tolerance to high levels of urea rather rapidly, and after they have been off feed for 1 or 2 days, they may need to be adapted again to high levels of urea. The most important factor influencing the amount of urea a ruminant animal can use is the energy content of the ration (Goodrich et al., 1976).

In general, urea should not supply more than one-third (33%) of the protein equivalent in a ration. For a high corn finishing diet, this would mean that all the supplemental crude protein can come from urea. Calves weighing less than 750 lbs will benefit from some natural protein in the supplement. In addition, it is not uncommon for some individuals to figure on 20-25% protein equivalent basis for safety reasons. The pounds of urea which may be fed per head daily can be figured this way (Goodrich et al., 1976): Urea (lbs/day) = .075 + (.011 x Pounds of Grain fed)

Including urea into diet at a maximum rate of 0.45% of the diet has given excellent results with most types of rations (Strasia and Gill). If natural proteins are expensive, it may be more economical at times to go to levels up to 0.8% of the ration as urea. However, gain and efficiency may be reduced particularly in calves weighing less than 750 lbs.

Maximum amounts of urea for yearlings and calves

Concentrate content of the ration	Pounds of urea	
	Yearlings[a]	Calves[b]
81-100, %	0.28	0.20
61-80, %	0.24	0.17
40-60, %	0.19	0.14
Less than 40%	0.12	0.10

The maximum levels in this table are in reference to maximum levels so as to not greatly exceed protein requirements rather maximum safety levels.

[a]Yearlings: 650 lbs and heavier

[b]Calves: 450-650 lbs

Source: Goodrich et al. (1976)

Prior to the introduction of ionophores, it was observed that there was a 3-5% lower performance of cattle fed high moisture grains and urea as the sole supplemental nitrogen source. Davis (1982) suggested that the comparable performance achieved with urea vs. natural protein source in his trials was attributable to feeding Rumensin, due to its effect on increasing ruminal starch digestion and decreasing microbial-protein degradation, in agreement with the work of Bartley and Nagaraja (1982) and Nagaraja and Bartley (1982) with both Rumensin and Bovatec.

Supplemental minerals will be needed if urea is used to replace natural protein sources. Trace minerals that are usually added to high-urea rations are cobalt, zinc and sulfur (Sewell, 1979). A nitrogen-to-sulfur ratio of 10-15:1 is recommended for urea supplements. This level of sulfur is recommended for the total ration. Goodrich et al. (1976) recommended 2 grams of sulfur should be fed per head per day when urea-containing rations are fed. Sulfates are more efficiently used than is the elemental form of sulfur.

Most cases of urea toxicity are due to poor mixing of the feed or to errors in calculating the amount of urea to be added to the ration (Stanton, 1981). Urea toxicity is characterized by restlessness, tremors, excessive salivation, rapid breathing, lack of coordination, bloat, tetany, and death. These symptoms usually occur in the order listed and at a very rapid rate.

A veterinarian should be called to treat cases of urea toxicity. As an emergency measure, 1 gallon of vinegar may be administered via stomach tube (Goodrich et al., 1976). This procedure will not be of much value after tetany has become a symptom.

Urea must be mixed thoroughly in with grain. If you grind your own feed, make a premix of urea and 200-300 lbs of grain and then add the remaining grain. It is very difficult to obtain uniform mixing of urea when it is added as the last ingredient to a nearly full mixer. Allow the mixer to run for 5 to 10 minutes after the last feed ingredient has been added. It can be difficult to add urea to high moisture (15%) grains because the moisture can cause the urea to clump and convert to ammonia. The addition of 3 to 5% molasses will increase the palatability of urea. Avoid mixing urea with raw soybeans.

Other forms of nonprotein nitrogen exist besides urea. Biruet is formed by heating urea. It is less soluble and is broken down at a slower rate than urea (Goodrich et al., 1976). The slower rate of decomposition makes it less toxic than urea when fed in large doses or when fed in low energy diets. Urea has also been combined with starch from grain and the sugars in molasses through heat and chemical treatment to slow the release of ammonia (Sewell, 1979).

Feed tag laws require the feed tag to have the percent crude protein equivalent derived from nonprotein nitrogen. For example, a feed tag on a protein supplement may state the following:

Crude protein.....not less than 38%
Crude protein from NPN.....not more than 14%

1 pound x 14% Crude Protein from NPN = .14 pound CP from urea
.14/281% = .05 pound of urea

Chapter 5. Minerals

Minerals needed in large amounts in the diet are termed "macro minerals." These include calcium, phosphorus, potassium, magnesium, sodium and sulfur. Minerals needed in small amounts are called "micro" or "trace minerals." The micro or trace minerals of most concern are cobalt, copper, iron, iodine, manganese, selenium, and zinc. Methods of mineral supplementation vary. Minerals may be added to a diet individually, mixed in a protein supplement, fed as a separate mineral mix, or a combination of the following methods. Different mineral sources vary in "bioavailability." Bioavailability is defined as the proportion of the ingested element that is absorbed, transported to its site of action and converted to a physiologically active form (Spears et al., 1991) and thus should be more than simply absorption.

Salt: Salt can be included in a complete ration at a rate of 0.3% of the ration (DM Basis) when it is uniformly mixed and separation of ingredients is not a problem. Cattle feeders wishing to use feedlot manure as fertilizer should keep salt levels at 0.2-0.3% of the ration. These levels do not contribute to salt pollution.

Calcium and Phosphorus: A calcium to phosphorus ratio of less than 1:1 or more than 8:1 may reduce performance. The typical calcium to phosphorus ratio is 1.5 to 2.0:1 for beef cattle. However, high levels of calcium from legumes do not appear to depress gains in growing rations (bioavailability of 31-41%). Maximum calcium levels are sometimes included in computer software to prevent limestone being used simply as a "filler" in least-cost computer rations. Calcium carbonate levels in excess of 1% of the ration dry matter may depress performance.

Diets high in fat require additional calcium. A 0.2% calcium addition is recommended when 2-5% added fat occurs (Axe, 1991). Basically, a 1% increase in fat corresponds to a 0.1% increase in supplemental calcium.

Potassium: Cattle require .6 to .8% potassium in the diet. Finishing cattle on high concentrate or all-concentrate rations will probably require supplementation of this mineral. Excessively high levels of potassium interfere with magnesium absorption, resulting in increased incidence of phosphatic urinary calculi.

Sulphur: Sulphur supplementation should be considered when non-protein nitrogen is added to diets of beef cattle. This is also a consideration when high levels of corn silage are fed. A nitrogen to sulfur ratio of 10-15:1 ratio is suggested.

Cobalt: Cobalt requirements have not been set but approach 0.1 ppm on a dry matter basis. The first sign of a cobalt deficiency in cattle is depressed appetite. Because cobalt is a component of vitamin B-12, it's requirement might increase with higher levels of

propionate production in the rumen (Strasia and Owens) which corresponds to high grain feeding.

Copper: High levels of sulfur, molybdenum, calcium and zinc can reduce copper absorption. A copper to molybdenum ratio no less than 4:1 should insure adequate copper availability (Petersen, 1987). Milo and barley-based diets contain sufficient concentrations of copper, but corn- or wheat-based diets require supplemental copper (Strasia and Owens).

Iodine: Normally, iodine must be supplemented to a feedlot diet. Cold stress increases the turnover rate of iodine and cause an even greater need for iodine (Strasia and Owens).

Iron: Many trace mineral packages contain iron oxide. This compound is added for its red color and not for its iron content since iron oxide is very low in bioavailability. Other iron sources are needed if there is a deficiency. Ferrous sulfate is high in bioavailability while ferrous carbonate is moderate in bioavailability.

Manganese: High levels of calcium or phosphorus will increase the need for manganese.

Selenium: Most selenium compounds are quite volatile. Have a good air control system and use a gas mask when handing and mixing concentrated selenium pre-mixes.

Zinc: Corn-, milo or barley-based diets are usually zinc deficient. Wheat ranges from being adequate to having levels four times the zinc requirement (Strasia and Owens). Bulls and steers may have more problems with a zinc deficiency than heifers and some strains of Holstein-Fresian cattle will have higher zinc requirements.

Mineral Requirements for Growing/Finishing Cattle

Calcium, %	0.4-0.6
Phosphorus, %	0.3-0.4
Potassium, %	0.6-0.8
Magnesium, %	0.2-0.3
Sodium, %	0.08-0.1
Sulfur, %	0.05-0.2
Copper, ppm	6-10
Iron, ppm	50-100
Manganese, ppm	20-50
Zinc, ppm	50-75
Cobalt, ppm	0.1-0.15
Selenium, ppm	0.1-0.2
Iodine, ppm	0.2-1.0

All values are 100% Dry Matter Basis.

Chapter 6. Vitamins

The vitamin needs of growing cattle mostly concern vitamin A, D and E. The most important vitamin is vitamin A. Feed 20,000 to 30,000 I.U. of vitamin A per head daily. Vitamin D supplementation is not needed if cattle have access to sunlight. Adding 2 to 5 I.U. of vitamin E per pound of high-grain ration devoid of roughage has improved feedlot performance.

Vitamin A: A vitamin A deficiency in feedlot cattle may result in reduced feed intake, reduced gain, and poor feed conversion. These symptoms may become more pronounced in cattle that are almost ready for market at the onset of hot weather.

Vitamin E: Supplying cattle with 500 IU per day of vitamin E during the last 100 days on feed can increase shelf-life of beef at the grocery store.

B-Complex Vitamins: B-complex vitamins such as riboflavin, niacin, pyridoxine, biotin, folic acid and B_{12} are normally synthesized in the rumen at a sufficient rate to meet the needs of non-stressed cattle. Vitamin B_{12} synthesis may be low if cobalt is deficient in the diet.

Chapter 7. Creating Diets or Balancing Rations

Computer Software: Methods do exist for balancing rations or creating feedlot diets with just a pencil and paper. However, given the complexity of feedlot diets, computer ration balancing software can reduce the time in looking at various ration options. Various universities and agriculture software companies have created such software for sale. The cost of such software can range from $40 to $4000, depending upon what you require. Universities and feed companies also offer such services. The only caution is that all this software can be "inherently stupid" and create a nutritionally balanced diet but which may be actually difficult, if not dangerous, to feed. A basic understanding of beef cattle nutrition and feedstuff characteristics is required to create feasible rations with computer software.

ENVIRONMENTAL ADJUSTMENTS FOR THE NUTRITION PROGRAM

The recommendations contained in most beef cattle production books are for cattle exposed to conditions relatively free of thermal stress or a temperature range of about 59 to 77 degrees Fahrenheit. Extremes in temperature influences the behavior and metabolic processes. All these changes go together to change returns to labor and management (profit/loss). Adjustments can be made to the diets so that we can predict performance and profits (Ames et al., 1981).

1. Adjust nutrient value of roughages

Roughages tend to be more highly digested during warm conditions than when the same diet is fed to cattle exposed to cold temperatures. Presently, no adjustment is recommended for concentrates fed to beef cattle. Adjustment for thermal effects on digestibility can be made to diet component values for feed or diets by the following general formula:

$$A = B + B((C_f(T-20))$$

A = Value adjusted for environment

B = Diet component value (TDN, NEg, NEm, CP)
(NEg and NEm in Mcal/kg)

C_f = correction factor (0.001 for TDN, NEg, NEm)
(0.0011 for CP)

T = Effective ambient temperature (*The term ambient refers to other factors that affect temperature. An example would be "wind chill" if cattle are constantly exposed to cold wind and have no shelter.)*

* Must do temperature calculations in Centigrade and not Fahrenheit:

F = 9/5(C) + 32 C = 5/9(F - 32)

Example: Adjust nutrient value for grass hay for 10°F

$A = B + B((C_f(T - 20))$

B = 1.21 Mcal/kg of NEm

C_f = 0.001 (correction factor for NEm)

T = -12°C = 5/9(10 - 32)

A = 1.21 + 1.21((0.001(-12 - 20))
A = 1.17 Mcal/kg of NEm

2. Adjust for voluntary feed intake changes

In general, voluntary intake of feed tends to decrease as ambient temperature increases and intake increases when ambient temperatures decrease. Estimation of feed intake both within and among animals becomes more variable and less predictable as ambient temperature varies from 68 degrees Fahrenheit.

SUMMARY OF VOLUNTARY FEED INTAKE OF BEEF CATTLE IN DIFFERENT THERMAL ENVIRONMENTS

Thermal Environment	Intakes Relative to Values Tabulated in *Nutrient Requirements of Beef Cattle*
> 95 F	Cattle on full feed - 10 to 35% depression Cattle near maintenance - 5 to 20% depression
77 to 95 F	Intakes depressed 3 to 10%
59 to 77 F	No change
41 to 59 F	Intake stimulated 2 to 5%
23 to 41 F	Intake stimulated 3 to 8% Sudden cold temperatures or storms may result in digestive problems in young cattle
5 to 23 F	Intakes stimulated 5 to 10%
< 5 F	Intakes during extreme cold or during blizzards and storms may be temporarily depressed

Example: Adjust voluntary feed intake for 10°F (normal: 14 lbs)

Dry matter intakes stimulated 5 to 10%
14 lbs x 1.10 = 15.4 lbs

3. Increase available energy for maintenance energy requirements

Basal metabolic rates tend to be lower in animals with prior exposure to warm weather and elevated in animals with prior exposure to cold conditions. In beef cattle, adjustments based on seasonal changes in the thermal environment (mean monthly temperature) would be most appropriate, although it is likely that cattle never fully acclimate to the extremes in regions where there are marked seasonal fluctuations in ambient temperature. The estimates for net energy requirement for maintenance (NEm) is based on the relationship:

$$NEm = aW^{.75}$$

NEm = net energy for maintenance (Mcal/day)
a = 0.077 when no environmental stress incurred
W = live weight in kilograms

For each degree of prior exposure to ambient temperatures above or below 20°C, 0.0007 should be subtracted or added respectively to "a" in the above equation. Thus for cattle with prior exposure to temperatures of 30, 20, 10 and 0°C, the value "a" become 0.070, 0.077, 0.084, and 0.091, respectively.

FEED MIXING

The mixed ration should look the same throughout the bunk or in the self-feeder. While inadequate mixing can be a common problem, you can also mix too long in a vertical mixer. Sorting out can occur due to differences in particle size and weight of the various feedstuffs. Ingredients that are added in small amounts (for example: vitamins and minerals) should be mixed with one or two buckets of grain before being added to the mixer. The following is a recommended method of adding supplements to a vertical grinder mixer:

1. Add half the grain.

2. Add the supplement.

3. Add the rest of the grain.

4. Add the roughage.

5. Mix for five minutes at the feeding site to eliminate separation occurring during travel to the feeding location.

Rescheduling the use of selected equipment for peak demand periods to off-peak periods or manually shutting off some of the equipment with large motors, can save charges. However, be careful to avoid short cycling (i.e. frequent starts and stops) which can damage equipment. The feedlot operator should consult with the electric company to analyze the rate structure and identify when peak loads occur and how they can be reduced. An independent consultant or the electrical utility's representative can help choose the best system for load management.

FEED RESOURCE ECONOMICS

DETERMINING THE VALUE OF FEEDS

Nutrition cost accounts for 50% of the costs of maintaining a cow herd and 80% of the cost of feeding cattle. Therefore it is important to be able to determine how much your nutrition program is costing you.

Producers commonly ask which feeds are the best price. The first place to start is accurately pricing the feed that will be delivered to the animals. Price quotes on unprocessed feed may only be a starting point. Take into account delivery charges as well.

Market Price: Market price may be considered if the feed is already on the farm. Market price should be considered if you are trying to decide if the feed should stay on the farm and be fed or sold and another feed purchased for feeding. An example might be oats when it is relatively high priced on the market.

Cost of Production: Cost of production will be important when raising your own feed and you want to make sure you can maintain a cash flow. Actual cost of production will vary with the size of the operation and the amount of equipment used.

Based on Nutrients: When you supply feeds for livestock, you are actually supplying nutrients. These nutrients are usually energy (TDN, NE_l, NEg, and NEm), protein (CP, DP, or amino acid), and minerals (principally Ca and P). Prices vary with the same feedstuff depending on which nutrient value is used.

Pricing One Nutrient at a Time: We will initially review pricing one nutrient at a time. The following method demonstrates how to determine whether alfalfa hay or soybean meal is the best buy as a protein source.

Alfalfa Hay	Soybean meal
$80/tn	$200/tn
2000 x 16% CP(as fed)=320 lbs CP	2000 x 44% CP(as fed)=880 lbs CP
$80/320 lbs CP = $0.25/lb CP	$200/880 lbs CP = $0.23/lb CP

**Soybean meal is the cheaper protein source*

Price per unit of nutrient will not be the only determining factor in choosing which protein source to use. Method of delivery must also be considered. Feeding a meal form of protein supplement will require feed bunks versus just placing hay bales in a pasture or bale ring.

Nitrogen sources, such as urea, are an excellent supplement for high grain diets. Urea and biruet can be utilized in pasture situations but utilization will not be 100%. However, biuret has somewhat higher utilization values than urea on forage-based diets. The ideal way to use nonprotein nitrogen sources is to feed small amounts at frequent intervals.

Approximate Urea utilization (%)

Conditions	Supplement Fed Once/Day Consumption Is Rapid	Blocks or Liquid Supplement
Medium-quality hay Silage Summer pasture	40-60%	80%
High-energy diets	90-100%	90-100%

The following example demonstrates the use of "cost per unit of protein" for comparisons of protein supplements when urea is fed once a day with a medium quality hay diet (approximately 50% utilization). We will use the information that is available on the feed tag.

Product A: 40% CP

Product B: 40% CP, not more than 20% nonprotein nitrogen crude protein equivalent.

NUTRIENT UTILIZATION

Product A	Product B
40% Crude Protein $300/ton	40% Crude Protein $260/ton 20% CP equivalent from NPN
	20 x 50% = 10
	Therefore 30% CP (40%-10%=30%)
$300/2000 lbs. = $.15	$260/2000 lbs. = $.13
$.15/.40 = $.375/lb of CP	$.13/.30 = $.433/lb of CP

Many times supplements containing urea will still be the better buy even with the reduced utilization. Keep in mind, use the utilization level rather than the feed tag value when balancing diets.

Another method of pricing feeds based on nutrients is with ratios or what is sometimes called constants. One feed is used as a standard to price other feeds. We will use soybean meal ($230/tn) in the following example to price sunflower meal and dried distiller grain on protein.

Feedstuff	%CP (as fed)	Ratio or Constant	Value per Ton
Soybean meal	44	44/44 = 1.00	1 x $230 = $230
Sunflower meal	38	38/44 = 0.86	.86 x $230 = $198
Dried distillers grain	28	28/44 = 0.64	.64 x $230 = $147

There is a temptation to use the same ratios or constants all the time. This can become erroneous with feeds that vary in nutrient value such as hay, silage, barley, and oats. The relative prices of feeds also depends on the feeds selected as standards (in this case it was soybean meal).

The previous examples did not take into account by-pass protein potential. This is protein that is not digested in the rumen but rather in the intestine. By-pass protein, that is actually digested in the intestine, is more energy efficient for production. Certain feeding programs, such as dairy lactation diets, can take advantage of by-pass protein.

Calculating Value Based on Two Nutrients: Most feeds contain more than one nutrient. A common method is to use ratios or constants. Our standards in this example are corn and soybean meal.

	Nutrients (as fed)				
Feedstuff	TDN	CP	Corn ratio	SBM ratio	Price per Ton
Corn	79	9	79/79 = 1.00		$80
Soybean meal	75	44		44/44 = 1.00	$200
Oats	68	12	68/79 = 0.86	12/44 = 0.27	?

Value of Oats: (.86 x $80) + (.27 x $200) = $122.80/ton

This method is simple but sometimes gives erroneous results. Is oats really worth $122.80? *Probably not. Let's try another method.*

Another method is to calculate what a nutritionally equivalent mixture of corn and soybean meal would cost compared to a ton of oats. We can make a corn-soybean meal mixture similar to the oats by the use of protein-energy ratios. We will use the feeds and prices from the previous example.

	Nutrients (as fed)				
Feedstuff	TDN	CP	Protein-Energy Ratio	$/Ton	$/lb
Corn	79	9	9/79 = .11	$80	.04
Soybean meal	75	44	44/75 = .59	$200	.10
Oats	68	12	12/68 = .18	?	?

1. Determine mix of corn and soybean meal using a Pearson Square

Corn: .11 .41 (.41/.48) = 0.8542 *85% Corn*
.18 (oat ratio)
SBM: .59 .07 (.07/.48) = 0.1458 *15% SBM*
.48 1.0000

2. Determine nutrient composition of corn-soybean meal mix

	TDN	CP
Corn:	.8542 x 79% = 67.4818%	.8542 x 9% = 7.6878%
SBM:	.1458 x 75% = 10.9350%	.1458 x 44% = 6.4152%
	78.4168% TDN	14.1030% CP

3. Determine Amount of Corn-SBM mix equal to ton of oats

Oats: 2000 lbs. x 68% = 1360 lbs. TDN

1360 lbs/78.4168% = 1734 lbs. of corn-SBM mix

Oats: 2000 lbs. x 12% = 240 lbs. CP

1734 lbs x 14.1030% = 244 lbs. CP supplied by corn-SBM mix

4. Determine value of oats

1734 lbs. of corn-SBM mix:

		% in Mix			
Corn:	1734 x	85.42%	= 1481 lbs x $.04	=	$59.24
SBM:	1734 x	14.58%	= 253 lbs x $.10	=	$25.30
					$84.54

Therefore oats is worth $84.54 per ton

There are various software packages available that calculate the value of different feeds based on standard feeds such as corn and soybean meal. You might occasionally check the output with the previously demonstrated procedure to make sure it is giving you an accurate price.

Pricing Pasture: Pricing pasture may require other methods. The simplest method is to simply use what the neighbors are charging. Another consideration is land value. One could consider the cost of other feeds, such as a grain and hay diet, to get the same rate of gain.

Pricing Silage: The following are some methods for determining the value of silage. A rule of thumb is that silage is worth 1/3 the value of grass hay. If grass hay is worth $60/ton - Then silage (As fed) is worth $20/ton

This procedure assumes a constant between the energy value of silage and hay. It has been stated earlier to use caution in using constants, but it is a "quick and dirty" way of determining price of silage. Another "quick and dirty" formula can be used to determine the value of corn silage based on the price of corn grain:

Price of corn per bushel = A

Bushels of corn in a ton of silage = B

Storage & handling cost per ton of silage = C

Additive cost per ton of silage = D

Silage Price/ton = [(A x B) + C + D] x %Silage Dry Matter/35%

The bushels of corn grain per ton of corn silage varies between 5-7 bushels per ton. A storage and handling cost of $4 to $10 may be used if actual production data are not available. The following is an example

Example 1: [($2.00/bu x 5) + $8 + 0] x 30%/35% = $15.43/tn

Example 2: [($2.00/bu x 5) + $8 + 0] x 40%/35% = $20.57/tn

In the second example the increased dry matter increased the value of the silage. This formula can probably be used with dry matters between 30% and 40%. Silage quality and storage losses outside the range of 30% to 40% will override this method of calculating value.

One can figure approximately 10% loss of silage in a stave silo and 15 to 20% loss in a bunker silo. Government deficiency payments may alter the actual cost of production of corn silage.

Sampling Feed For Laboratory Analysis: It is still more accurate to take a sample of silage and have it analyzed by a laboratory. Don't take a sample until the silage has gone through the ensiling process. Silage is not silage until at least 3 weeks of storage time. Hay should be sampled in the fall since summer and early fall rains will decrease it's nutrient content if stored outside.

Chapter 8. Feed Additives

One of the best management strategies for reducing feedcosts and improving gain is the use of feed additives. However the size of this "Feedlot Primer" would have to be greatly increased in length to adequately discuss the various brands available and their unique dosage requirements and attributes.

IONOPHORES

Ionophores are antibiotic class that alters rumen fermentation characteristics. The result is improved feed efficiency at the same or higher level of gain compared to a diet without ionophores. The ionophores Rumensin™ and Bovatec™ are probably the most familiar ionophores for producers because they have been on the market for a relatively long time. Some recently approved ionophores are Cattlyst™ and Vmax™. Ionophores are also fed for other reasons, including coccidiosis control and control of acidosis and bloat problems. Vmax™ also appears to be effective for liver abscess control. Although not classified as an ionophore, GainPro™ has some ionophore characteristics.

Ionophores are fed to approximately 90% of all feedlot cattle in the U.S. They are particularly beneficial for cattle fed high grain (less than 12% roughage) diets because of their role in reducing acidosis and bloat. See label recommendations for each. Ionophores may not improve feed efficiency in diets with greater than 4% tallow, but they would still be effective insurance against acidosis and bloat.

ANTIBIOTICS

Antibiotics have been used to improve gain and feed efficiency of cattle. Antibiotics are added to feed to minimize secondary bacterial infections and to control liver abscesses. Antibiotics available are chlortetracycline, oxytetracycline, bacitracin, and tylosin. Withdraw of antibiotics for varying periods of time prior to slaughter will be required depending upon the compound and the level at which it is fed.

ESTRUS SUPPRESSANT

Melengestrol Acetate™ (MGA) can be added to feedlot heifer rations. It improves rate of gain and feed utilization. This is accomplished by suppressing estrus or heat. Withdraw time for MGA is 48 hours.

BUFFERS

Buffers are sometimes used to moderate pH changes in the rumen (Stock and Mader,

1985). Buffers can be used when adapting cattle to high grain diets or when feeding concentrates such as wheat at high levels. Various buffering agents include sodium bicarbonate, limestone, sodium bentonite, and magnesium oxide. Sodium bicarbonate and limestone can be fed at about 1% of the diet dry matter.

YEAST CULTURES

Basic rumen studies suggest that live yeast cultures can stimulate growth of cellulolytic microorganisms in the rumen. Yeast cultures do not appear to affect digestibility, however, yeast cultures appear to alter the shape of the degradation curve causing a reduction in the lag phase before digestion commences. Therefore the digestibility is not changed but the rate of degradation is increased. Birkelo and Berg (1994) observed that a yeast culture product improved performance of yearling cattle fed corn-based finishing diets containing less than 10% roughage. Birkelo and Rops (1994) observed that a yeast culture product did not improve performance of growing calves limit-fed a high concentrate diet. More research is needed to evaluate the most appropriate situations for the use of yeast cultures.

IMPLANTING STRATEGIES FOR FEEDLOT CATTLE

Ear implants can increase rate of gain and improve feed efficiency of cattle. There are 11 implants currently available for this purpose (Pritchard, 1993b). There are numerous strategies based on the number of implants and combinations of implants that can be used from weaning to slaughter. Implant suitability depends on cattle age, sex, frame size, weight, days on feed, projected rate of gain, and implant history.

Duration of use and level of active ingredients (termed type in this article) are important criteria for developing a strategy of implant use. Type or potency refers to the combination of primary and secondary biological effects of the active ingredient(s) of the implant (Pritchard, 1993b). The duration values in the following table reflect manufacturer's recommendations and industry practices.

Classification of implants for weaned calves with regard to active ingredients and duration of use.

Implant	Type (Level of Ingredients)	Duration (Days)
Compudose	BB	150-200
Implus-C	AA	60-70
Implus-S or H	BB	100-130
Finaplix-S or H	AA	80-100
Ralgro	AA	60-70
Synovex-C	AA	60-70
Synovex-S or H	BB	70-100
Revalor	CC	80-100
Finaplix + Synovex or Implus or Ralgro	CC	80-100

Adapted from: Pritchard (1993b)

Total gain can be improved if cattle are re-implanted over time. However, the gain response is reduced as cattle are reimplanted (Pritchard, 1993b). While the first implant may increase gain 20%, re-implanting with the same product 70-100 days later may increase gain only 15%. A suitable strategy may be to start with a lower potency implants (Type AA and BB implants) and use higher potency implants (Type BB and CC implants) in cattle approaching finish weight.

Any implant strategy should take into account the expected finish date of the cattle. One can expect animal performance to be depressed if cattle are fed beyond the active duration of the final implant. Implants increase animal and carcass weight. Small-, medium-, and large-framed cattle respond similarly to implants (Pritchard et al., 1990). Use moderation in your implant program if your cattle are already borderline for maximum industry standards for animal and carcass weight.

Occasionally, there is over-use of implants. Estrogenic compounds can increase riding and prolapses. Androgenic compounds can increase the number of dark cutters. Both classes of implants can reduce body fatness (good!) and quality grade (bad!) at a constant body weight.

CC-Type implants should usually be used only once and the best time to use them is as the last implant before slaughter. However, with long fed Holsteins, begun at about 400 lbs, one might consider using CC-type implants twice. The first CC-type implant given 160-200 days prior to finishing and the second CC-type implant administered 80-100 days prior to finishing. Develop your implant strategy so that the last CC-type implant is not given at less than 80 days or more than 100 days prior to slaughter.

The implanting strategy will work but only if proper implanting techniques are used. Check the directions for proper implant site location in the ear. To avoid crushing the implant, insert the needle to it's full length and then withdraw a distance equal to the space to be occupied by the implant. Crushed implants can result in bullers and reduced duration of implant effect. Some implanting guns do this procedure for you. Good sanitation should be observed. Infection will reduce the effectiveness of the implants or cause them to be expelled from the ear. If the ears are wet you should probably wait until they are dry. Implanting needles should be checked for burrs because any obstruction can damage the implant. In addition, burrs tear tissue at penetration sites and greatly increase the likelihood of infection and abscessation. Proper implanting means doing it correctly not necessarily doing it rapidly.

Chapter 9. Feeding Programs

STANDARD FEEDING PROGRAMS

Standard feeding normally means the cattle consume feed *ad libitum* (all they want). Some attempt to moderate daily intake fluctuations can be done with bunk management. Cattle can be put on forage, hay-based, silage-based or moderate gain level diets to grow at moderate rates of gain. These systems are well suited to many producers who are limited by facilities or by having abundant supplies of forages to use. After the cattle have grown to about 750 lbs, they are placed on high grain, finishing diets. These programs are best suited to medium frame cattle. This will allow them to finish at heavier weight. Large frame cattle are better suited to high grain finishing diets following weaning. Although large frame cattle can perform very well on forage-based diets, caution should considered since they will also finish at greater than desirable weights. Type of cattle, price margins, and feed supplies will dictate the optimum system for each producer.

LIMIT FEEDING STRATEGIES

Limit feeding strategies have two potential applications for cattle feeders (Loerch, 1995). Backgrounders can limit intake of a high grain diet to achieve any rate of gain desired. This strategy should be considered when corn is a less expensive source of energy than hay. Limit feeding can also be used for finishing cattle to improve feed efficiency and increase carcass leanness.

LIMIT FEEDING BACKGROUNDING CATTLE: Corn grain is the least expensive harvested feed per unit of energy available to cattle feeders in Ohio. As a result, it may be economically advantageous to feed high energy corn based diets at intakes which are restricted (Murphy and Loerch, 1993; Loerch et al., 1995). Research at Ohio Agricultural Research and Development Center (OARDC) indicates that cattle which are limit fed corn to achieve gains of 2.0 pounds per day until they reach 750 pounds have similar performance during the finishing phase (full feed of a high grain diet) as cattle fed a corn silage growing diet prior to finishing. Steers were fed 9.2 lb per head per day of whole shelled corn (1.3% of body weight) plus 2.2 lb per head per day of a 37 percent protein supplement.

LIMIT FEEDING FINISHING CATTLE: Recent research at the OARDC Beef Center suggests that feed efficiency may be improved if cattle are fed at intakes which are slightly less than ad libitum (Murphy and Loerch, 1993). In these trials cattle were fed 10-20 percent less feed than counterpart steers allowed to eat free choice. Cattle were all fed to the same final weight (1,150 pounds). Each 10% decrease in intake decreased rate of gain by about .2 lb per day. As a result, it took the limit fed cattle 15-25 day longer to get to market weight. However, the limit fed cattle used 100-250 pounds less fed to achieve

market weight even though they were on feed longer. There were also advantages to limit feeding in terms of carcass composition. Limit fed cattle had carcasses with 15-25% less fat than the full fed cattle. This was achieved without decreasing marbling score or quality grade. The system described above would provide little economic benefit for cattle feeders in today's marketplace. The improvement in feed savings would probably be offset by the need to feed cattle longer. This should change if a value based marketing system were in place which rewarded carcass lean.

The bottom line is that it may not always be best to allow cattle to set their own intake. By manipulating intake, producers may be able to improve feed efficiency, cut costs and produce a more desirable carcass.

Producers wanting to implement a limit-feeding program should make sure all the cattle can eat at the feed bunk at one time. Otherwise, dominant cattle will consume more feed than needed and probably incur acidosis conditions.

HOLSTEIN BEEF PRODUCTION

Stage 1. 0 to 20 Weeks of Age: Success in Holstein feeder calf production is greatly determined by the ability of any producer ot obtain a group of calves that are 1 ot 5 days old (bob, deacon, or baby doll calves) that are healthy and uniform (Carter, 1991). Minimizing sickness and death loss is probably more profitable than maximizing gain during this stage. The ideal situation would include the feeding of at least 1 gallon of colostrum before 12 hours of life by the dairyman, dipping the navel with iodine, and withholding the calf from the market until it is at least 3 days-of-age.

Many calves are started in existing veal production facilities using individual feeding stalls and an "all-in, all-out" program (Comerford). They are usually maintained in stalls for approximately 7 weeks before being moved into group pens. Often other types of are used to start the calves, such as modified pens or even calf hutches, until they are old enough to be group housed after weaning from milk replacer. Occasionally, calves are maintained in group feeding programs from the beginning. A general management schedule might include:

Week 1 Provide a clean, dry stall with adequate ventilation. Provide a high quality milk replacer to minimize digestive upsets and to reduce stress and diarrheas. Quality and digestibility of the protein source along with sufficient fat (usually 18-20%) are critical during the first 2-3 weeks. Some producers will feed electrolyte solutions instead of milk for the first 1 or 2 feedings. Check the navel and dip in iodine (7%) if not dry. Continue to inspect and dip the navel until it has dried and fallen off. Inspect the calves for injuries and evidence of diarrhea.

Develop a comprehensive health program with your veterinarian. This may include a vaccination program for calves of this age if history and previous experience warrant. Controversy exists as to which vaccines to use at this time and the schedule. It is desirable to elicit immunity to common pathogens as soon as possible, but vaccine-induced problems have been reported in very young calves. Ear tag and consider implanting with a growth promotant. Alternatively, some producers prefer to delay implanting until the calves enter the feedlot. Provide a high quality starter grain around day 5 and delouse with a safe product.

Weeks 2 to 4 — During this time calves are acclimated to starter feeds and can be castrated and dehorned. Producers who do these procedures themselves should use a technique that they can perform skillfully, efficiently, and in a sanitary manner.

Week 5 — Booster vaccinations for respiratory diseases may be considered with additional vaccines for enterotoxemia and the other clostridial diseases included. Recent research has shown that intramuscular clostridial vaccines can cause a reduction in feed intake and gain in older cattle so producers must consider the overall health and stress level of the calves before administering them. Some farms have benefitted by using salmonella vaccines at this time and the newer core antigen (endotoxin) vaccines to assist in preventing disease due to salmonella.

Week 6 — Discontinue milk replacer abruptly when calves are consuming adequate starter (2-3 pounds) and are healthy.

Week 7 — Move to group pens.

The nutritional management of holstein calves destined for beef production is not the same as for those used for dairy heifer replacements or for veal production. Drew Vermeire (1991) prepared the following table:

	Comparison		
	Herd replacement	Veal	Bob calves
Grain	yes	no	yes
Roughage	yes	no	no
Water *ad libitum*	yes	no	yes
Calf birth weight, lbs	95-115	105-115	85-100
Milk rep. intake, lbs	25-30	500-530	25-30
Milk rep. feed rate	constant	variable	constant
Major nutrient source	grain	milk	grain
Milk Replacer:			
Crude Protein, %	18-28	20-22	20-22
Fat, %	10-20	16-17	18-20
acidified	no	no	yes
protein source	milk/soy	milk	milk
Selenium, ppm	0.1-0.3	0.3	0.3
Iron, ppm	80-100	35	80-100
Vitamin A, IU/lb	15-35,000	25,000	30,000
Vitamin D, IU/lb	3-7500	5000	10,000
Vitamin E, IU/lb	10-35	20	135
Fat source *	T/L	T/L/C	T/L/C
Medication, g/ton	50-300	1200	1200

* T=Tallow, L=Lard, C=Coconut

Allow the calves to rest for 6-12 hours after placing them in their pens (Vermeire, 1991). Water or an electrolyte solution should be available. An energy- containing electrolyte solution might be considered during the first 2-4 feedings (Vermeire, 1991). Calves should be started on 4.5 ounces of milk replacer powder in 3.5 pounds of water twice a day (Elliot et al., 1991). In cold weather, start at 5-6 ounces of powder twice a day. The powder level is raised 1 ounce per week until 6-8 ounces twice a day is reached. A common medication level for milk is 3-4 mg chlortetracycline per pound of body weight twice daily with one ounce of neomycin 325 per 20 calves twice a day (Elliot et al., 1991). Watery diarrhea, cold mouth and extremities, and sunken eyes the first 10 days of life are signs of infections. Treatment is 4-6 quarts of electrolytes for 24 hours with no milk. Diarrhea after 10 days may be a more severe problem. Calves are exposed to grain at 5-10 days (Elliot et al., 1991; Vermeire, 1991). Products such as amprolium, decoquinate and lasalocid should be part of normal coccidiosis prevention. Opinions vary on whether corn is to be rolled or fed whole in starter rations (Vermeire, 1991). However, rolled corn is the most common practice.

Stage 2. Weaning/Growing: Wean calves when: 1) they are consuming 2-3 lbs starter per day; 2) the calves have consumed 25-30 lbs milk replacer per head; and 3) calves are healthy (Vermeire, 1991). Abruptly weaning means giving calves milk replacer for one meal and no milk replacer the next or subsequent meals. Sometimes it is advisable to reduce the milk replacer by one-half several days before weaning to allow for adjustment to dry feed. Avoid free access to salt the first 2 weeks (Elliot et al., 1991). One common practice in this area is to provide these calves a pellet supplement at approximately 1 lb per day and all the whole shelled corn they will eat. Hay is provided free choice but is not normally consumed in great quantities. The adjustment from starter feed over to the postweaning ration may take 3-4 weeks. Coccidiosis prevention is normally done by using lasalocid or decoquinate in the feed.

Stage 3. Finishing: Considerable research has been done to compare various forage to grain ratios in feedlot diets of Holstein steers. A summary of trials with high corn silage diets by Cornell researchers indicated continuous high silage diets as all or part of the total feeding period would increase the weight at which the steers would grade Choice compared to those on high concentrate diets. Other reports have shown the Holstein steer to have a higher maintenance requirement than a beef steer, and this would contribute to reduced feed efficiency. This is probably the reason for the popularity of the whole corn-little or no roughage programs. Holsteins tend to deposit marbling at a relatively early stage of maturity.

Typically Holsteins must be about 15-26 months of age to make the choice grade and the market weight of the animals (weight at which 75% will grade choice has been fairly consistent ranging from 1200-1300 lbs. However, weight at which they will grade Choice will increase if they are fed for lower rates of gain during the growing/finishing period.

Chapter 10. Nutritional Disorders

ACIDOSIS

Acidosis is the most common nutritional disorder in the feedlot. A large amount of highly fermentable feeds, such as cereal grains, consumed in a short amount of time can result in the production of more lactic acid than can buffered by the rumen. This results in water from the circulatory system being drawn into the rumen (body becomes dehydrated) and pronounced changes in the blood Ph. Signs will usually be acute or sub-acute. Survivors of acute acidosis may have chronic problems such as fungal rumenitis, liver abscesses, bloat, and founder or laminitis.

Acute acidosis: Animals that are not adapted to readily fermentable feeds are more susceptible to acidosis (sometimes called grain overload) than animals that have been carefully adjusted. However, even animals conditioned to full feed can be susceptible under some conditions such as feed changes and temporary restrictions in feed availability. Acutely affected animals will usually develop signs within 12-24 hours of overeating. They will be completely off feed, depressed and unwilling to move, weak, and dehydrated. They may appear blind, grind their teeth, grunt, and occasionally kick at their belly. Fullness and distension of the abdomen (rumen) may be observed. A foul smelling diarrhea may be observed unless the condition is so acute that the animal dies before it can develop.

In severe cases animals will lie down, unable to rise. They generally lie quietly with their head tucked to the side. Body temperature may be subnormal and the pulse is weak. Death usually occurs within a few hours after the animals go down.

Animals that survive may suffer from damaged ruminal lining and destruction of rumen microflora leading to a fungal overgrowth of the rumen and death. Some deaths may occur as long as 3 weeks after a herd episode of overeating and acidosis. Less severe rumen lining damage may lead to liver abscesses and growth impairment. Laminitis, or founder, may follow acute acidosis, and evidence of subacute laminitis in the form of overgrown and deformed hooves may be present 30-60 days later.

Subacute acidosis: Animals with less acute and severe signs may still eat but may not consume as much as normal or be off feed for only a short time. The only overt signs of subacute acidosis may be reduced gains and the presence of diarrhea in the form of flat gray stools. Because rumen lining damage may still occur in the absence of severe signs, these animals may develop chronic rumen damage and liver abscesses.

Weather conditions can cause fluctuations of intake of an otherwise acceptable ration. Storm conditions can cause cattle to consume a greater amount of feed before and after the storm. Muddy conditions which can alter feed intake. A drop in barometric pressure

can indicate oncoming storm conditions. Conditions that promote intake of the regular ration in a shorter amount of time can cause acidosis. Hot, humid weather will cause cattle to eat a greater proportion of their feed at night, rather than during the day.

Improper mixing of feed can cause acidosis. As previously discussed improper bunk management can be a cause of acidosis. Only occasional cleaning of water troughs will also affect intake. Inclusion of an ionophore may help reduce intake fluctuations.

Treatment-Acute Acidosis: If cattle are noticed soon after consuming large amounts of grain and before they drink water, problems may be avoided by keeping them away from water for up to 24 hours (Baker et al., 1983). Some common treatments are oral administration of mineral oil and/or sodium bicarbonate along with activated charcoal, anti-endotoxin therapy, and surgical emptying of the rumen in some cases.

BLOAT

Bloat occur when rumen gas production exceeds the rate of gas elimination. Gas then accumulates causing distention of the rumen. The skin on the left side of the animal behind the last rib may appear distended.

Although bloat is often classified as being either pasture or feedlot bloat, it is probably more accurate to identify it as being either free-gas bloat or frothy bloat. Frothy bloat is more common in cattle eating legumes or lush grass than in feedlot cattle. Free-gas bloat is more common in feedlot cattle.

Frothy Bloat: In situations of foamy or frothy bloat, gas production is not greatly increased but the gases are trapped in the foam. Frothy bloat in feedlots usually develops slowly over several weeks and often become chronic. Poloxalene is an effective "deformer" for frothy bloat.

Free-Gas Bloat: Many of the same factors causing acidosis are associated with free-gas bloat. Therefore proper bunk management and other preventative measures should be practiced for prevention of bloat.

Treatment: Free-gas bloat can usually be relieved by inserting a 3/4" rubber hose into the rumen via the esophagus. If "hosing" does not give immediate relief, a defoaming agent (poloxalene) should be administered through the hose to break the surface tension of the ingesta. A pint of mineral oil is also a defoamer. Drenching should be avoided because of the danger of inhalation by the bloated animal which can cause immediate death or lead to pneumonia. A trocar should be used as a last resort. Chronic bloaters should be shipped for slaughter.

LIVER ABSCESSES AND FOUNDER

Many factors contributing to acidosis and bloat also affect the incidence of liver abscesses and founder.

Abscessed Livers: Some cattle are genetically more prone to liver abscesses. Irregular feed intake or sickness can also contribute to an increased incidence of abscessed livers. Continuous use of low level antibiotics such as chlortetracycline, oxytetracycline, and tylosin can be very effective in control of liver abscesses with animals on a high grain diet. Approved combinations of ionophores and antibiotics are now available.

Founder: Founder is usually associated with abrupt changes from high roughage to high grain diets. Typical signs of founder are lameness and long hooves. Brahman-type cattle appear to be more susceptible to founder when fed high grain diets.

SUDDEN DEATH SYNDROME

The animal that dies later in the feeding period represents greater loss to the feeder. Causes of sudden death include:

1. Bloat
2. Clostridial enterotoxemia
3. Acidosis
4. Ruptured liver abscesses
5. Pneumonia

Necropsy of dead animals is crucial to define the cause of death and prevention plan strategies. A recent study has indicated a majority of these deaths are caused by bloat and pneumonia and that more frequent observation may reduce many such deaths.

URINARY CALCULI

The term "urinary calculi" describes mineral deposits in the urinary tract (Emerick and Wohlgemuth, 1985). These deposits may block the flow of urine in male cattle. Prolonged blockage generally results in rupture of the urinary bladder or urethra, releasing urine into the surrounding tissues or abdomen. This produces the condition referred to as "water belly. Two types of urinary calculi predominate in cattle and sheep: (1) the phosphatic type formed principally under feedlot conditions and (2) the siliceous type occurring mainly in range animals.

Clinical Signs: Animals afflicted with urinary calculi may at first appear restless with frequent straining in an unsuccessful attempt to urinate. They may repeatedly stamp their

feed and kick at the abdomen. In some cases when urinary blockage is not complete, urine may dribble slowly from the sheath. After complete blockage of urine flow, the bladder or urethra finally ruptures releasing urine into the body cavity and surrounding tissues. At this stage the animal may show a complete loss of appetite and stand quietly or lie down. A ruptured urethra results in a large swelling under the skin in front of the scrotum.

Phosphatic Urinary Calculi: A high phosphorus level and calcium-phosphorus imbalances promote this type of urinary calculi. Lower water consumption by animals during the winter is believed to be an important reason for the higher urinary calculi incidence associated with that season. Hard water is often blamed for the occurrence of urinary calculi. However, calcium and magnesium that constitute the "hardness" of water have been found to promote protection against phosphatic urinary calculi. The best prevention method to maintain a 2:1 to 1.2:1 calcium to phosphorus ratio.

FOOT ROT

Foot rot is not a nutritional disorder but preventative measures are available via feeding. Chemotherapeutic agents used in feed include: zinc methionine (Zinpro^{TM}), oxytetracycline, chlortetracycline. However, these products are not a replacement for keeping lots clean and dry.

Chapter 11. Shipping Finished Cattle

SHIPPING FINISHED CATTLE

Move cattle quietly and quickly avoiding excitement or running of the animals to avoid excess shrinkage and "dark cutters." Do not bruise the cattle. Make sure facilities are in good repair. Make sure the trucker can load the cattle "quietly." Do not mix bullers with the other cattle if possible. Keep careful medical records on any cattle that are treated to insure withdrawal requirements are met.

METHODS OF MARKETING

All the cattle can be sold from the pen if they all appear to be done. The alternative is to "Top Out" or Top Off" cattle in a pen. Topping off pens should be considered when a pen has differences in age, weight, and condition present. A feeder can top off a pen once or twice and then sell the remainder.

Selling Direct: The feeder needs to have knowledge of carcass beef price, the strength of the dressed beef market, and the potential quality and yield grades of the cattle owned (Fox, 1976). A 1000 lb steer at about the fatness of low choice can be expected to have a carcass weight of about 600 lbs or a dressing percent of 60%. If the price quoted is 70 cents per pound of live weight, then the carcass value is .70/.60 = $1.17 per pound.

It may be advisable to sell based on live price and weight if you are concerned about the ability of the cattle to grade or when the market is strong and competition is good. Weighing conditions (shrink) that are fair to all concerned should be agreed upon. If you are not satisfied with the weighing conditions (shrink), you might consider a guaranteed dressing percent. If cattle are muddy or dressing percent is in doubt, then you might sell based on a flat over-all carcass beef price. If you feel that the cattle are better quality than the price offered, sell them based on carcass weight and a price schedule for different quality/yield grades.

It should be agreed upon prior to sale who stands the comdemnation and bruises and if standard slaughtering and trimming procedures are followed for all cattle processed. It should be known how soon the cattle will be processed (tissue shrink probably starts after 12-14 hours off feed), what slaughter information can be obtained, and how soon payment is made.

Selling at Auction: A preferred method of selling cattle may be at a local auction barn. It is a good idea to let your local auction know when you have cattle ready and they can advise you when there will be buyers present for your type of cattle.

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