E-1005

Beef Quality Assurance

Oklahoma Cooperative Extension Service
Division of Agricultural Sciences and Natural Resources
Oklahoma State University

Oklahoma Beef Council

The Oklahoma Beef Quality Assurance Advisory Committee members represent the following organizations:

American Farmers and Ranchers

Association of Bovine Practitioners

Dairy Farmers of America

Oklahoma Beef Council

Oklahoma Cattlemen's Association

Oklahoma Cooperative Extension Service

Oklahoma Farm Bureau

Oklahoma Livestock Marketing Association

Oklahoma State University

Samuel Roberts Noble Foundation

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Beef Quality Assurance

4th Edition

August 2018

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President for Agricultural Programs and has been prepared and distributed at a cost of 000 cents per copy. Revised 0818 GH.

The Programs You Invest In

Where Your Checkoff Dollars Are Invested

Promotion
Includes advertising, merchandising, new-product development and promotional partnerships with restaurants and supermarkets designed to stimulate sales of beef and veal.

Research
Provides the foundation for checkoff-funded activity. Information and promotional projects are developed based on reasearch relating to nutritional value of beef and beef products, beef safety and pathogen research, product-enhancement research, market research and new product development research.

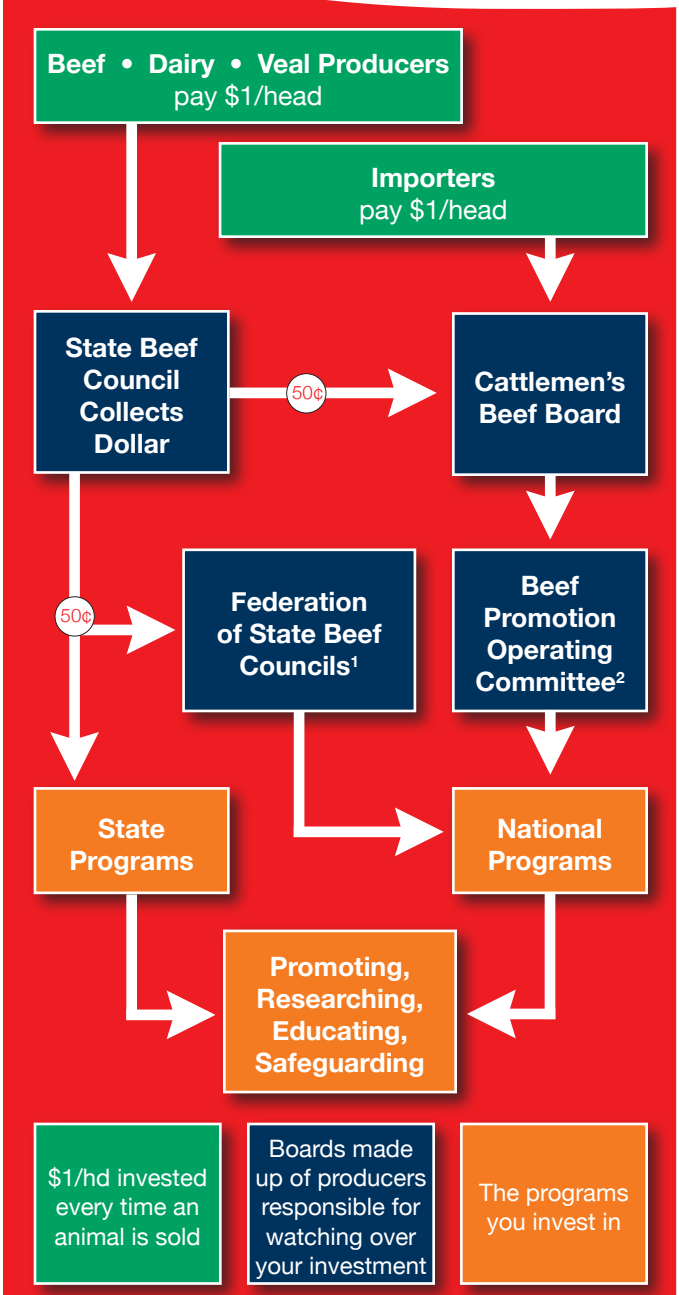
Consumer Information
Endeavors to enchance beef's image through nutritional data and other postive messages targeted to news media, food editors, teachers, dietitians, physicians and other infulential individuals and groups.

Industry Information
Strives to promote an understanding of the beef industry and maintain a positive marketing climate by helping provide factual information and correct misleading publicity about food safety, environmental and animal-welfare issues.

Foreign Marketing
Seeks to identify and develop international markets for U.S. beef and veef variety meats.

Producer Communications
Aims to inform producers and importers about how checkoff dollars are being invested and to comunicate program results.

Your Beef Checkoff Dollar — From Investment to Results



[1]States may invest a portion of their 50 cents in national programs through the Federation of State Beef Councils.
[2]The Beef Promotion Operating Committee has 10 members from the Cattlemen's Beef Board and 10 members from Qualified State Beef Councils. By law, the Operating Committee must contract with national industry-governed organizations to administer checkoff programs. Some of the primary contractors include National Cattlemen's Beef Association (NCBA), American National CattleWomen (ANCW), the U.S. Meat Export Federation (USMEF) and the Meat Importers Council of America (MICA).

Printing of the Beef Quality Assurance Manual is funded by the Oklahoma Beef Council.

History and Mission of Beef Quality Assurance

The Beef Quality Assurance (BQA) program was first implemented in 1982 by producers, the United States Department of Agriculture, and the Food Safety Inspection Service (USDA-FSIS). The purpose was to avoid violative drug residues in beef. Since that time, the BQA program has been expanded to include other factors that influence overall beef quality (Figure 1). The BQA principles are similar to those developed by Pillsbury for the quality control program for supplying food to the NASA space program. Their program, the Hazard Analysis Critical Control Point Program (HACCP), gained USDA acceptance and is presently the outline for quality assurance programs in packing houses and processing facilities. Using HACCP, control points have been identified in the beef production system and during these control points producers can implement management practices to improve and prevent any potential hazards while securing food safety and quality.

Through the efforts of the American Association of Bovine Practitioners and national and state cattlemen's associations, national BQA guidelines were established (Figure 2), based on the The "Cattle Industry's Guidelines for the Care and Handling of Cattle." The foundational document for these guidelines was the "Producer Code for Cattle Care" developed in 1996. The objective of the Oklahoma BQA program is to educate cattle producers and other industry professionals re-garding the BQA guidelines and to encourage the adoption of BQA principles. The overall goal of the Oklahoma BQA program is to improve beef quality characteristics by minimizing the occurrence of violative residues, pathogen con-tamination and carcass defects and by improving carcass leanness, cutability and palatability. The Oklahoma BQA program is a cooperative effort between beef producers, the Oklahoma Beef Council, Oklahoma Cooperative Extension Service and other industry groups. The BQA Program acts as a catalyst to encourage use of the latest science and technology, to meet expectations about beef quality and safety.

Figure 1. The BQA Program is intended to maximize consumer confidence concerning beef.

Industry Quality Challenges – Quality Audits

The importance of BQA can be seen when reviewing the top quality defects identified in a series of National Beef Quality Audits. These audits were intended to document carcass characteristics and defects in the cattle harvested and processed for beef in the United States. To date, six audits have been conducted (1991, 1995, 2000, 2005, 2011 and 2016) surveying cattle that had been fed high grain diets in feed yards prior to harvest. These audits are referred to as fed-cattle or fed-beef audits. Additionally, four Market Cow and Bull Quality Audits have been conducted (1994, 1999, 2007 and 2016) to represent average characteristics and defects of nonfed sources of beef.

Fed-cattle Quality Audits

University researchers collected data in 30 beef packing plants representing more than 70 percent of the federally inspected slaughter in the U.S. The audits were generally conducted May through November. Frequencies of specific quality defects and carcass traits are shown in Table 2. Approximately 25,000 cattle are represented within each year of this data set.

Several of the quality indicators have changed with time. For example, the percentage of fed-

The BQA Mission: **To maximize consumer confidence and acceptance of beef by focusing the producers' attention on daily production practices that influence the safety, wholesomeness, and quality of beef and beef products through the use of science, research, and educational initiatives.**

National Beef Quality Assurance Guidelines

Feedstuffs and Sources

- Maintain records of any pesticide/herbicide use on pasture or crops that could potentially lead to violative residues in grazing cattle or feedlot cattle.
- A quality control programis in place for incoming feedstuffs. Programs should be designed to eliminate contamination from molds, mycotoxins or chemicals of incoming feed ingredients. Supplier assurance of feed ingredient quality is recommended.
- Suspect feedstuffs should be analyzed prior to use.
- Ruminant-derived protein sources cannot be fed per FDA regulations.
- Feeding by-product ingredients should be supported.

Feed Additives and Medications

- Only FDA approved medicated feed additives will be used in rations.
- Medicated feed additives will be used in accordance with the FDA Current Good Manufacturing Practices (CGMP) regulations.
- Follow Judicious Antibiotic Use Guidelines.
- Extra-label use of feed additives is illegal and strictly prohibited.
- To avoid violative residues — withdrawal times must be strictly adhered to.
- Where applicable, complete records must be kept when formulating or feeding medicated feed rations.
- Feed records are to be kept a minimum of three years.
- Operator will assure that all additives are withdrawn at the proper time to avoid violative residues.

Processing/Treatment and Records

- Following all FDA/USDA/EPA guidelines for product(s) utilized.
- All products are to be used per label directions.
- Extra-label drug use shall be kept to a minimum, and used only when prescribed by a veterinarian working under a Valid Veterinary Client Patient Relationship (VCPR).
- Strict adherence to extended withdrawal periods (as determined by the veterinarian within the context of a valid VCPR) shall be employed.
- Individual treatment records will be maintained with the following recorded:
  1. Individual animal
  2. Date treated
  3. Product administered and manufacture's lot/ serial number
  4. Dosage used
  5. Route, location, and person administering the product
  6. Earliest date animal will have cleared withdrawal period
- When cattle are processed as a group record the following:
  1. Group or lot identification
  2. Date treated
  3. Product administrated and manufacture's lot/ serial number
  4. Dosage used
  5. Route, location, and person administering the product
  6. Earliest date animals will have cleared withdrawal period
- All cattle fed and non-fed shipped to slaughter will be checked by appropriate personnel to assure that all treated animals meet or exceed label or prescription withdrawal times for all animal health products administrated.
- All processing and treatment records should be transferred with the cattle to next production level. Prospective buyers must be informed or any cattle that have not met withdrawal times.
- Records should be kept a minimum of three years.

Injectable Animal Health Products

- Products labeled for subcutaneous (SQ) administration should be administered SQ in the neck region only (no exceptions, regardless of age.
- All products labeled for intra-muscular (IM) use shall be given in the neck region only (no exceptions, regardless of age).
- All products cause tissue damage when injected IM. Therefore all IM use should be avoided if possible.
- Products cleared for SQ, IV, or oral administration are recommended.
- Products with low dosage rates are recommended. For multiple injection sites, proper spacing should be followed.
- No more than 10 cc of product is administered per IM injection site.
- The dewlap is an acceptable SQ injection site location.

Care and Husbandry Practices

- Follow the 'Quality Assurance Herd Health Plan' that conforms to good veterinary and husbandry practices.
- All cattle will be handled/transported in such a fashion to minimize stress, injury, and/or bruising.
- Facilities (fences, corrals, load-outs, etc.) should be inspected regularly to ensure proper care and ease of handling.
- Strive to keep feed and water handling equipment clean.
- Provide appropriate nutritional and feedstuffs management.
- Strive to maintain an environment appropriate to the production setting.
- Bio-security should be evaluated.
- Records should be kept for a minimum of three years.

Figure 2. National Beef Quality Assurance Guidelines.

cattle with horns has declined substantially since 1995. Perhaps the majority of this improvement is due to trends in breed selection among producers (more polled cattle), although it is also possible more producers are dehorning cattle compared to previous years.

The 2016 audit noted more cattle without a brand and fewer side brands. There were more cattle with no horns, but more carcasses with bruises. Bruises were generally less severe, with 77 percent rated as minimal in nature. Minimal bruising results in less than one pound of surface trim loss. Of those with bruising, 21 percent were classified as major, resulting in a 1- to 10-pound trim loss. The number of blemishes, condemnations and other attributes that impact animal value remain relatively small. Of livers harvested, more than 30 percent were condemned. Tongue and head condemnations have decreased.

According to results from the most recent audit (2016), the sum of loss due to quality defects, in quality grade, yield grade, weight and condemnations average more than $48 per head.

Market Cow and Bull Quality Audits

In 2016, audits were conducted at 18 packing plants, representing approximately 50 percent to 60 percent of the federally inspected slaughter of market cows and bulls. In this work, holding-pen audits were conducted at the packing facilities as well as slaughter-floor and cooler audits. Table 3 shows the frequencies of defects identified in the holding-pen audits.

Of particular interest is the high incidence of hide damage from brands, scratching, and scarring. In fact, almost 6 percent of beef cows had multiple brands and 30 percent of beef cows had at least one rib brand, which causes the greatest devaluation to the hide.

Researchers classified more than 7 percent of the beef cows as thin to extremely thin. A high percentage of cows in thin condition are also reflected in the 35 percent of the live animals (beef cows) that were classified as having inadequate muscling. The degree of muscling in cattle can be attributed to genetics, previous plane of nutrition and/or animal health. As cows decline in body condition, they lose

Table 1. Examples of control points impacting the BQA program.

Process	*Control Point*	*Potential Quality Concerns*
Breeding and genetics	Planned breeding system Sire selection Replacement female selection Culling	Carcass characteristics Health Performance Temperament
Herd health and cattle handling	Processing cows and calves: at branding at weaning Receiving breeding cattle Receiving and processing stocker cattle Shipping cattle	Bruises Drug residues Injection site lesions Carcass characteristics Health Temperament Dark cutters
Transportation	Trailer design and size Driving techniques Cattle handling during loading/unloading Biosecurity	Cattle injury Bruising, injury Dark Cutters Health
Parasite control	Internal parasite control External parasite control Performance Hide damage	Injection site lesions Withdrawal times
Nutrition and grazing management	Herbicide application Blending feed Purchasing feed Thin cows	Drug residues Feed additives Ruminant derived protein
Culling management	Timely marketing Shipping culls Condemnation Downer cows Health	Carcass characteristics Bruising

Table 2. Frequency of carcass, hide, and offal defects and carcass traits.

	1991	*1995*	*2000*	*2005*	*2011*	*2016*
Frequency of carcass, hide, And offal defects, %						
Moderate to severe mud and/or manure	-	-	26.2	16.0	9.0	9.9
Horns	31.1	32.2	22.7	22.3	23.8	16.7
One or more brands	44.5	52.3	50.7	38.0	44.8	25.7
One or more bruises	39.2	48.4	46.7	35.2	23.0	38.9
Dark cutters	5.0	2.7	2.3	1.9	3.2	
Liver condemnations	19.2	22.2	30.3	24.7	20.9	30.8
Lung condemnations	5.1	5.0	13.8	11.5	17.3	18.2
Tripe condemnations	3.5	11.0	11.6	11.6	9.3	16.3
Head condemnations	1.1	0.9	6.2	6.0	7.2	2.7
Tongue condemnations	2.7	3.8	7.0	9.7	10.0	2.0
Carcass condemnations	-	0.1	0.1	0.0	0.0	
Carcass weight, lb	759.9	747.9	787.0	795.8	824.6	860.5
USDA Quality Grade, %						
Prime	2.2	1.3	2.0	3.0	2.3	4.0
Choice	52.7	46.7	49.1	54.3	62.3	68.8
Select	36.9	46.7	42.3	37.3	34.4	23.6
Standard/other	7.6	4.6	5.6	4.1	1.1	3.6
USDA Yield Grade, %						
1	10.0	12.6	12.2	16.5	25.0	9.5
2	33.9	45.3	37.4	36.3	46.5	36.5
3	39.6	34.2	38.6	33.1	23.0	39.4
4	13.6	7.1	10.4	11.8	4.6	12.1
5	2.9	0.8	1.3	2.3	0.9	2.5

Source: National Beef Quality Audit.

Table 3. Frequency (%) of defects identified in holding-pen audits of non-fed cattle.

	Percent of Cows		
	1999	2007	2016
Eye lesions	4.3	3	1.0
Lumpy Jaw	1	0.4	1.2
Small horns and scurs	10	8.4	5.3
Large horns	13	10.8	4.5
Brands, beef cows only	60.0	31.3	35.7
Inadequate muscling, beef cows only	44.4	61	35
Body condition score of 1 or 2 (extremely thin, beef cows only)	2.3	10.0	7.6
Body condition score of 8 or 9 (extremely fat, beef cows only)	4.5	4.2	3.6

Source: National Market Cow and Bull Quality Audit.

Inadequate marbling costs the industry $26.81 per head of fed-cattle marketed and excessive fat and/or inadequate muscling costs the industry $20.92 per head.

Table 4. Incidence of bruises and severity of trim loss in market cows and bulls.

	Percent of Cows		
Severity of Bruises	1999	2007	2016
Extreme	2.4	5.4	1.4
Major	21.6	12.4	4.9
Medium	41.7	30.9	45.1
Minor	77.2	36.7	67.3

Source: National Market Cow and Bull Quality Audit.

Table 5. Incidence of Injection-site Lesions in the Round.

	1998	1999	2000	2017
Dairy Cows	60%	51%	35%	15%
Beef Cows	31%	26%	20%	7%

Source: National Market Cow and Bull Quality Audit, Executive Summary, 2016

muscling, as well as fat. A much lower percentage of cows were classified as being obese or extremely fat.

Bruising severity has made a vast improvement since the 2007 audit. (Table 4). Certainly, bruising can be caused by many things besides horns, such as poorly designed and maintained cattle working facilities, overzealous and impatient human handlers and overcrowding in working facilities and trucks.

Meeting the Challenges – BQA Guidelines

Management to Improve Carcass Composition and Quality

Fed-cattle

Improving quality and consistency of fed-beef carcasses begins first with understanding the industry targets for carcass traits and selecting carcass targets that are appropriate for the specific operation's type of cattle and production environment and/or production system. Targets for carcass defects (injection-site blemishes/lesions, bruises, dark cutters, liver condemnation, etc.) are zero. Industry targets for carcass weight, yield grade, quality grade, ribeye area and other characteristics vary, depending on the marketing program for which the cattle are being targeted. For example, USDA currently has registered approximately 90 Certified Beef Programs, all of which have varying carcass targets. Specifications for each of these Certified Beef Programs can be viewed at the following website: ams.usda.gov/services/auditing/certified-beef-programs.

Based on the National Beef Quality Audit data, carcass composition remains the area where the greatest amount of fed-beef value can be recaptured. Inadequate marbling costs the industry $15.75 per head of fed cattle marketed (2016 NBQA), while inappropriate yield grades, as a result of excess fat and/or inadequate muscling, costs the industry $5.93 per head as compared to $15.60 per head in 2011. This decrease in loss of value is reflected because few carcasses are actually assigned a yield grade and more emphasis is given to the marketing of that animal to specific programs. To further achieve improvements in these areas, general fed-beef carcass targets are suggested in Table 6.

Producers need to establish and follow a methodical plan to make significant progress in improving feed yard performance and carcass composition of their cattle. The first step in this plan should be to determine the relative performance and carcass characteristics of cattle at present and to identify a marketing program that best fits cattle management programs. For producers who typically sell calves at weaning or do not care to retain ownership on large numbers of calves, the Oklahoma Steer Feedout is available as a low-risk opportunity to gather this type of information. Information regarding the Oklahoma Steer Feedout can be found at: dasnr54.dasnr.okstate.edu:8080/beefextension2018. Ultrasound is also a viable way to capture carcass data on both breeding and fed animals prior to harvest. Certified technicians from the Centralized Ultrasound Processing Lab (CUP) can be found at: cuplab.com/FindATechnician.aspx. The information gathered through this process is essential in identifying potential marketing programs fitting cattle and production systems best. Until carcass targets associated with various marketing programs are identified, the producer cannot establish clear goals for improvement.

Table 6. Target Concnesus for 2016.

Trait	Target
Yield Grade	YG 1-10%; YG2 – 45%; YG3 – 40%; YG4 – 5%
Quality Grade	Prime 5%; Upper 2/3 Choice 35%; Low Choice 35%; Select 25%
Carcass Weight	600-800 lb 20%; 801-900 lb 30%; 901-1000 lb 50%

Once carcass targets and current performance have been established, the second step is to use the information gathered to set clear goals for improving feed yard and carcass performance. For example, reducing average yield grade of steer progeny by .25 units within three years, or increasing percentage of cattle grading average choice and above by five percentage units within three years may be appropriate goals. The third step is to develop and initiate an action plan to facilitate goal achievement, and the final step is to monitor progress.

Many factors are involved in determining final carcass composition (fat versus lean) and marbling. Some of the major factors known to influence carcass composition are genetics for muscularity (cutability) and marbling, time on feed, age placed on feed, nutritional history prior to being placed on feed, implant regime, season of the year and incidence and severity of sickness. Several of these factors interact with one another to further complicate the issue.

Genetic tools, such as breed selection; sire selection culling and replacement heifer retention; sire selection and mating systems are likely the most powerful tools available to producers in influencing feed yard performance and carcass composition. While feed yard performance and carcass composition become more important with time, care must be taken to avoid overemphasizing selection for these traits at the risk of ignoring or even damaging other important genetic traits. Cow herd reproductive performance, milk production and mature size are examples of traits that must be balanced or improved with time, while improvements in carcass composition are achieved.

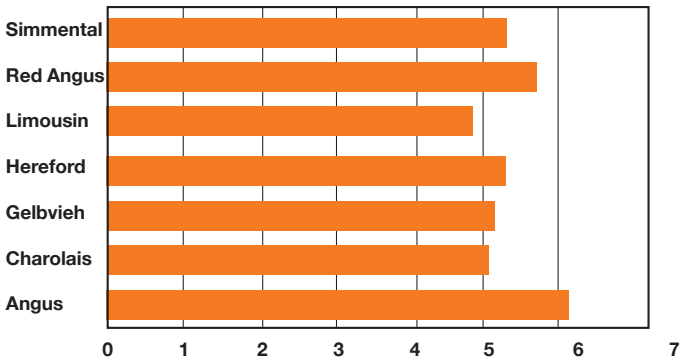


Figure 3. Breed of sire influences on marbling score. (Courtesy Kuehn & Thallman)

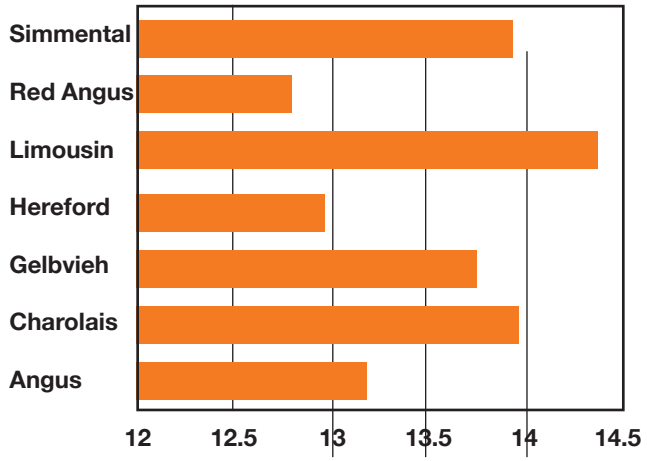


Figure 4. Breed of sire influence on rib eye area. (Courtesy Kuehn & Thallman)

Breed or breed type has a major influence on carcass characteristics. Researchers at the USDA Meat Animal Research Center report across-breed EPD tables on an annual basis. This allows producers to adjust EPD's to a specific baseline and accurately compare sires from two different breeds. Across breed EPD tables can be found in the Beef Improvement Federation's (BIF) website at: beefimprovement.org. Figures 3 and 4 show average marbling score and rib eye area (REA), respectively for selected breeds. Calves sired by Angus and Red Angus have higher marbling scores compared to calves sired by Charolais, Gelbvieh, Limousin, Simmental and Hereford. Conversely, calves sired by exotic breeds of cattle (Charolais, Limousin, Gelbvieh and Simmental) produce carcasses with higher REA (higher cutability), compared to calves sired by English breeds of cattle (Angus, Red Angus and Hereford).

It should be recognized that sires are available within each breed that excel in producing carcasses with higher than breed average quality grades and lower than breed average yield grades. By selecting a breed or breed combination of cattle, and by applying selection principles and mating systems appropriate for the production system and marketing program, producers can make substantial improvement in feed yard performances and carcass characteristics over time.

Age placed on feed is often thought to play a major role in feed yard performance and carcass characteristics. This variable is frequently closely related to and compounded with days on feed. It is not uncommon for cattle to be placed on feed anywhere from two months to 18 months of age in the U.S. However, two very common production systems in Oklahoma are to place calves on feed at weaning— about six months to eight months of age (calf-fed) or to place them on feed as yearlings, when they are anywhere from 11 months to 16 months old. Obviously, time on feed varies dramatically depending on the rate of gain during the stocker phase, frame size of cattle, fleshiness of the cattle at different times and market conditions. Several experiments have been conducted to document differences in carcass characteristics and feed yard performance among calf-fed versus yearling-fed production systems. In general, when cattle from both production systems are fed to a constant back fat endpoint, yearling-fed cattle compared to calf-fed cattle, have heavier placement weights, increased intake, faster rates of gain, poorer feed conversion, less days on feed and larger live carcass weights.

Surprisingly, the research indicates that average quality grade and yield grade are not substantially different, assuming the cattle are harvested at a constant back fat thickness. Therefore, according to this research, the choice of production system primarily influences live carcass weight. Thus, carcass weight parameters defined in the targeted marketing program and the type of cattle (large versus medium frame) should be considered in this decision. Many other factors will be involved in this decision as well, such as market conditions and available ranch resources.

Days on feed is highly and positively correlated with live body weight, body fat (Figure 5), carcass weight, yield grade and to a lesser extent, percent grading choice or higher. Therefore, producers can use days on feed as a powerful tool to manipulate back fat thickness and yield grade. Previous history of the ranch's cattle is necessary to use as a benchmark and to determine if days on feed should be increased or decreased.

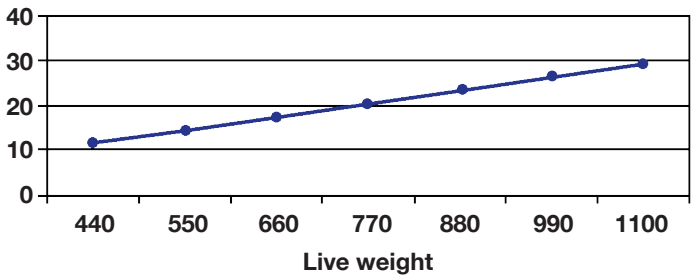


Figure 5. Influences of weight (time on feed) on body fat composition.

It is well documented that sickness reduces feed yard performance, carcass weight and percentage of cattle grading choice and higher (Lalman and Smith, 2000). Therefore, any management steps taken to minimize the risk of sickness and the severity of sickness will ensure optimum feed yard and carcass performance.

Cows and Bulls

Improving characteristics of nonfed beef carcasses is primarily an issue of market timing and culling management. Research (Apple, 1999) concluded that cows in a BCS 6 at harvest optimized returns to producers and processors, based on quality grade and lean meat yield. Therefore, cattle with physical disorders, such as arthritis and stifle joint infections should be marketed before they become excessively thin (less than BCS 4).

Each year, producers should examine the teeth or mouth of cows eight years of age and older. Any cow developing a broken mouth or having lost several teeth should be either marketed before she loses substantial weight and condition or put on a culling list to be identified and culled at the earliest opportunity.

Managing cows to gain weight before marketing may be a profitable alternative if the animals are healthy and if high quality forages or moderate to low-cost concentrate feeds are available. Healthy, thin cows can gain one full body condition score in about 30 days when they are not lactating and are grazing high-quality forage, such as spring and early summer grass or wheat pasture. High concentrate feeding programs also can be used to rapidly improve body condition of thin, healthy cows. However, producers should recognize that feed conversion in mature cows is not very efficient compared to growing cattle. In fact, most studies suggest that feed conversion in thin cows receiving a high concentrate ration (85 percent to 95 percent concentrate) is in the neighborhood of 9 to 10 pounds of feed per pound of weight gain. This compares to a conversion of between 5.5 to 7 pounds of feed per pound of weight gain in calves and yearlings. Cows that do not raise a calf should be marketed before they become excessively fat.

Disabled or downer cattle are no longer allowed in the food chain and should be humanely euthanized on the farm under the direction of a veterinarian.

Minimizing Dark Cutters

Dark cutters result from preharvest stress, which depletes muscle glycogen stores. Without sufficient glycogen in the carcass, lactic acid cannot be produced to reduce the pH of the meat. The result is dark, firm and dry lean. Inclement weather, growth promotants, genetics, disposition and handling practices before harvest all play a role in causing dark cutters. Using low stress animal handling techniques and good management practices greatly reduces incidences of dark cutters.

Disabled or downer cattle are no longer allowed in the food chain and should be humanely euthanized on the farm under the direction of a veterinarian.

Minimizing Carcass Bruising

More than 38 percent of fed-beef and 64 percent of market cow and 42 percent of bull carcasses exhibited bruising (Figure 6). Producers can have a tremendous impact on reducing the incidence of this value-degrading defect. Shipping fever and excess shrink caused by stress from mishandling also lead to severe economic loss in the industry. An understanding of cattle behavior will facilitate handling, reduce stress, reduce bruise defects and improve both handler safety and animal welfare.

Any protruding objects, such as broken boards, nails or exposed bolts should be removed from working facilities. This also includes horns, which should be removed by breeding selections or manually if need be. Tipping of horns does not

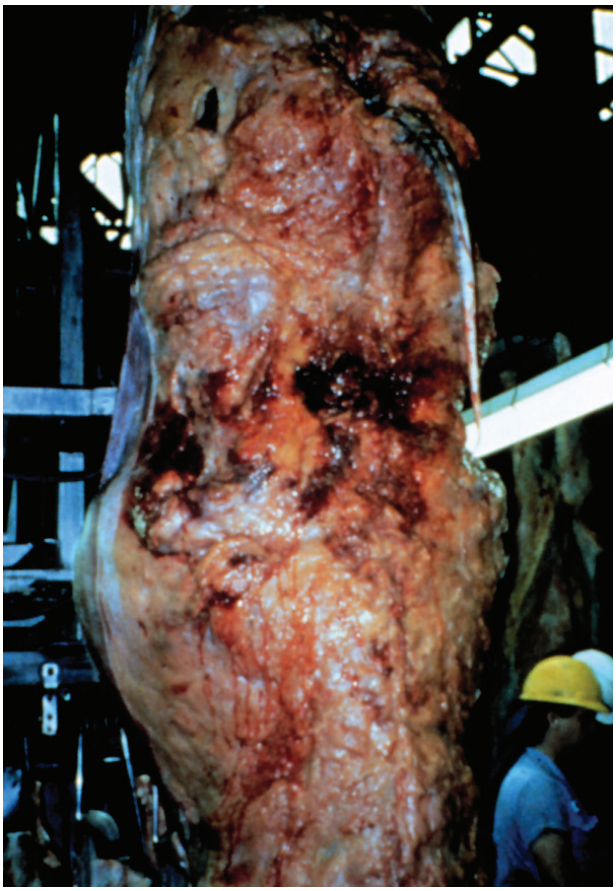


Figure 6. Bruises cost the cattle industry $22 million annually.

reduce bruising because most of the horn is still present. Protruding objects at times may be easily identified. They will typically be shiny or rubbed and often have tufts of hair. Corners and sharp objects that cannot be removed may need to be padded. Rubber tires or pieces of hose work well to soften the impact on cattle.

Gates and flooring can also cause buising. Make sure not to throw a gate into the side of an animal the animal by become wedged between the gate and the fence. Concrete flooring will also require scoring with a 8-inch diamond pattern with 1-inch deep groves so cattle can gain traction when handled.

Processing, Treatment and Use of Animal Health Products

A series of audits designed specifically to monitor the incidence of injection-site lesions in top sirloin butts of fed-beef began in November 1995 and continued in March, July and November of each year following. As an example of how improvement can be made with improved awareness resulting in an industry-wide management change, injection-site blemishes declined from a high of 11.4 percent in 1995 to a low of 2.06 percent in July of 2000 (Figure 7). Much of this dramatic improvement can be attributed to beef producers in each segment moving injection sites from the hip to the neck region.

However, the results of the first Market Cow and Bull Quality Audit in 1994 showed that the percent of injection-site lesions in nonfed cattle was found to be 28.9 percent. In the 1999 audit, which included cull dairy cows, this number increased to 40.9 percent; however, in the most recent audit, this number decreased significantly (Table5). Contrary to popular belief, not all beef from market cows is marketed as ground beef. For example, ribeye rolls and rounds from market cows and bulls are used in products such as Philly Steak and roast beef sandwiches.

Moving the injection-site area to the neck stops damage to expensive steak cuts and allows easier identification of these lesions in the plant.

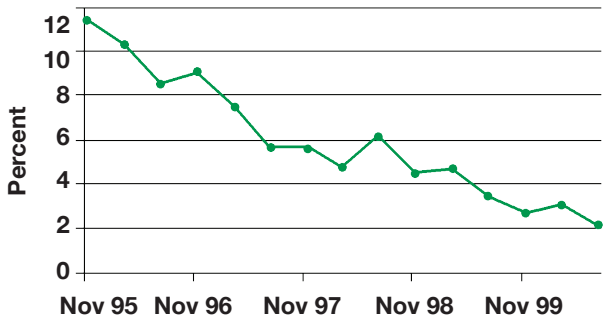


Figure 7. Incidence of injection-site lesions in fed-beef sirloin top butts.

There is a negative relationship between meat tenderness and injection sites, including injection sites with no visible lesion. All intramuscular (IM) injections, including sterile water, create permanent damage regardless of the age of the animal at the time the product was administered. At the very least, tenderness is reduced in a three-inch area surrounding the injection site (Figure 8).

Correct administration of any injection is a critical control point in beef production and animal health. Producers can help to avoid product discounts as a result of abscesses and lesions, and maximize the effectiveness of the animal health product being used by following these simple procedures:

- Use well-designed cattle restraining facilities to make the job of giving injections in the proper location safer and easier. Improper animal restraint is the cause of most bent needle problems. By providing proper restraint, the appearance of broken needles in beef products can be avoided. In the event a needle is broken off in the neck muscle, a veterinarian should be immediately contacted and the broken needle surgically removed. A broken needle is an emergency and time will be of the essence. Broken needles migrate in tissue and if not immediately handled will be impossible to find, requiring the animal to be destroyed. Under no circumstances should animals with broken needles be sold or sent to a packer.
- Use the needle size proper for the situation (Table 7).
- Purchase high quality needles, change needles often—every 10 head to 15 head, and discard damaged or needles contaminated by feces or irritating chemical. Use only a sterile needle to pull vaccine or medicine from a bottle. This keeps the contents in the bottle sterile.
- Properly dispose of used or damaged needles. Place the needles in a hard plastic or rigid

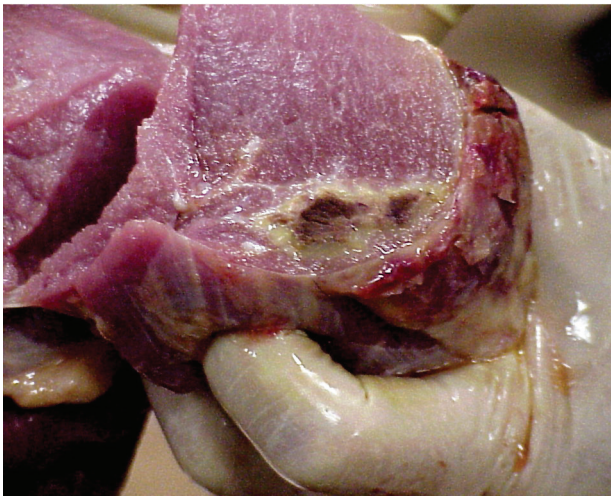


Figure 8. Fluid-filled injection-site lesion. Source: Boyles.

Table 7. Guidelines for needle selection for cattle.

	Route of Administration								
	SQ (1/2 to 3/4 inch needle)			IV (1 1/2 inch needle)			IM (1 to 1 1/2 inch needle)		
Injectable	Cattle Weight			Cattle Weight			Cattle Weight		
Viscosity	<300	300-700	>700	<300	300-700	>700	<300	300-700	>700
Thin example: virus vaccine	18 gauge	18-16 gauge	16 gauge	18-16 gauge	16 gauge	16-14 gauge	20-18 gauge	18-16 gauge	18-16 gauge
Thick example: oxytetracycline	18-16 gauge	18-16 gauge	16 gauge	16 gauge	16-14 gauge	16-14 gauge	18 gauge	16 gauge	16 gauge

Select the needle to fit the cattle size (the smallest practical size without bending).

Always use SQ or IV routes of administration when permitted by the product's label.

cardboard container with a secure lid. Label the container Sharp Objects for Disposal.

- Give injections according to label instructions. Route descriptions: Subcutaneous (SQ) means under the skin, intramuscular (IM) means in the muscle, intravenous (IV) means into the blood, orally (PO and/or O) means in the mouth or in water, and (MF) indicates medicated feeds.
- Check product labels closely and administer the product as specified on the label. Select products that have subcutaneous (SQ) as an approved route of administration. Remember to tent the skin for SQ injections unless advised otherwise by the manufacturer.
- All injections must be administered in front of the point of the shoulder, approximately 4 cm or more only, no exceptions. (Figure 9).
- Administer less than 10 cc per IM injection site unless a larger volume is recommended on an approved label.
- During bad weather, take extra care that the injection site is free of manure and dirt, and syringes and needles are clean and disinfected. Injecting cattle during wet weather increases the potential for carrying a contaminant into the injection site.
- Overall sanitation of equipment and the working area, as well as the cleanliness of employees and coworkers will reduce injection-site defects. A sound educational effort directed toward the people handling the cattle offers great potential for helping eliminate or minimize these problems.

Figure 9. Correct injection site. Source: Boyles.

Injections should be administered in front of the point of the shoulder.

Use of Dart Guns to Deliver Medications

The use of pneumatic dart guns has rapidly increased for remote delivery of medication to cattle in situations where pens and restraining facilities are not readily available. Remote delivery of medications by devices such as dart guns should comply with BQA guidelines, just as conventional administration methods. Keep in mind the importance of injection site selection, route of administration, needle selection, medication selection and volume. Medication use records must be kept, and the producer must have a plan of action if a broken needle leaves metal in the animal.

Use of dart guns requires training and practice. Vendors offer online tutorials and training to familiarize producers with their specific products.

Responsible Drug/Vaccine Use

The United States Food and Drug Administration (FDA) is responsible for determining the market status of animal drugs, based in part upon whether or not it is possible to prepare adequate directions for use under which a layperson can use the drugs safely and effectively. The two basic classes of drugs available to livestock producers are over-the-counter (OTC) and prescription (Rx) drugs.

A drug with significant potential for toxicity in humans or animals (or other harmful effects) may have a unique method of use or requires other special considerations for its use is usually labeled as a prescription drug. Such products can be used or dispensed only by or on the order of a licensed veterinarian, and the label must bear the legend: Caution: Federal law restricts this drug for use by or on the order of a licensed veterinarian.

Withdrawal Times

A withdrawal time may be indicated on the label of certain medications. This is the period of time that must pass between the last treatment and the time the animal will be slaughtered or milk used for human consumption. For example, if a medication with a 14-day withdrawal period was last given on August 1, the withdrawal would be completed on August 15 and would be the earliest the animal could be harvested for human consumption. All federally approved drugs will include the required withdrawal time for that drug on the product label or package insert. These withdrawal times can range from zero to as many as 60 days or more. It is the producer's responsibility to be aware of withdrawal times of any drugs used in their operation.

Unacceptable levels of drug residues detected in edible tissues collected at harvest may result in trace-back, quarantine, and potential fines or jail time. Substantial economic losses may result for the individual producer as well as negative publicity for the entire beef industry. Producers are responsible for residue problems and should follow these three rules:

1. Do not market animals for food until the withdrawal time listed on the label or as prescribed by the veterinarian has elapsed.
2. Use only medications approved for cattle and exactly as the label directs or as prescribed by your veterinarian.
3. If ever in doubt, rely on the veterinarian-client-patient relationship you have established with your veterinarian. Consult your veterinarian with all questions and concerns.

Extra-label use of drugs may only take place within the scope of a valid veterinarian-client-patient relationship.

Extra-label Drug Use

Over-the-counter (OTC) drugs can be purchased from multiple sources and must be used as directed on the label. For example, most procaine penicillin G products are labeled for use at 1 cc/cwt and are given intramuscularly (IM). Therefore, a 600-pound calf would get 6 cc IM. Producers are not allowed to change the dose or give it by any other route, such as subcutaneously (SQ). OTC products must be used exactly as labeled.

Extra-label use is defined as the actual or intended use of a drug in a manner not in accordance with the label. Under the provisions of the Animal Medicinal Drug Use Clarification Act of 1994, the FDA recognized the professional judgment of veterinarians, and allows the extra-label use of drugs (either OTC or Rx) by veterinarians under certain conditions. Extra-label use is limited to situations when the health of an animal is threatened or suffering with death as a possible result from failure to treat, and only by or under the supervision of a veterinarian. Veterinarians may only consider using drugs (OTC or Rx) in an extra-label manner when there is no approved drug labeled for such use. The veterinarian will establish an extended withdraw period and record patients ID as well document when withdraw periods are met. The product will also have additional labeling for producer reference (Figure 10).

It is important to establish a veterinarian-client-patient-relationship (VCPR) and extra-label drug use may only be used within the scope of the VCPR. For a VCPR to exist, the veterinarian has assumed the responsibility for making clinical judgments

Veterinarian _____
Phone _____
Address _____ *Date* _____
Expires _____
Owner/Farm _____ *Animal ID* _____
Species _____
Active Ingredients/Concentration _____

Quantity _____ *Drug Trade Name* _____

Indications _____

Directions - Give _____ *cc/bolus/oz* _____ *times each day for* _____ *days*

Drug Withdrawal Time for Slaughter _____ *days*

Test for Residues - Urine _____ *Blood* _____

Figure 10. Example of a label that your veterinarian may give you for extra-label drug use.

Extra-label drug use is not permitted in animal feeds.

regarding the health of the animal(s) and the need for medical treatment, and the client has agreed to follow the veterinarian's instructions. Also, the veterinarian must have sufficient knowledge of the animal(s) to initiate at least a general or preliminary diagnosis of the medical condition of the animal(s). This means that the veterinarian has recently seen and is personally acquainted with the keeping and care of the animal(s) by virtue of an examination of the animal(s), or by medically appropriate and timely visits to the premises where the animal(s) are kept.

The privilege of extra-label use of drugs is not permitted in animal feeds. A veterinarian cannot use or prescribe drugs for use in feed in any manner except for the approved use and at the approved dosage. Extra-label use of drugs in treating food-producing animals for improving rate of weight gain, feed efficiency or other production purposes is also prohibited. Some specific drugs are completely prohibited for extra-label use in food-producing animals including chloramphenicol, clenbuterol, diethylstilbestrol, dimetridazole, ipronidazole, other nitroimidazoles, furazolidone, nitrofurazone, fluoroquinolones and glycopeptides.

Drug Storage

Drugs, vaccines, implants and other animal health products usually have specific storage requirements. Some, but not all, require refrigeration, and all should be stored in a clean place where they cannot become dirty or contaminated. Observe and obey the manufacturer's recommended storage instructions for each product you use. Where refrigeration is needed, be sure the refrigerator is kept clean and is located in a safe, clean place that is not likely to be overheated or contaminated by dirt or manure and the temperature should be monitored with a thermometer. Animal health products should be stored away from the feed ingredient or mixing area unless they are regularly mixed feed additives. Storage of bottles of partially used medication or vaccine is discouraged because they may have become contaminated and could cause infections or tissue reactions if reused. Purchase of animal health supplies in containers holding the number of doses typically used in a day of processing animals is encouraged.

Syringe Care

Inadequate vaccine syringe cleaning is frequently responsible for localized infections associated with vaccination. If the infection is severe, it may become generalized and the animal may die.

Injection-site swelling is common, especially when vaccines such as clostridial bacterins are given SQ. If the swelling is hard, it could be due to getting the subcutaneous injection too deep and penetrating part of the first layer of muscles. If this is the cause, consider using a "B-Bevel" 5/8-inch needle or a short (1/2-inch or 3/4- inch) regular bevel needle. The injection point on the B-Bevel needle is shorter than a regular injection needle.

Sterile disposable syringes will virtually eliminate injection-site infections. If you require multiple dose syringes, several brands of disposable sterile automatic vaccine syringes are available.

Syringe Cleaning Steps

1. Clean only the external syringe surface with soap, water and a brush.
2. Rinse the inside components of the vaccine syringe, including tubes and connectors with distilled or deionized water near the boiling point (greater than 180 F).
   - This is accomplished by drawing water that is greater than 180 F into the syringe and squirting it out. Three to five rinses should be adequate.
   - Remove as much water from the inside of the syringe as can be squirted out and let the syringe cool before using. Heat kills modified live vaccine (MLV) products.
   - DO NOT use soap or disinfectant on internal components as residues may kill MLV vaccines.
3. Store the vaccine syringe in a dust free, dry (low humidity) environment.
   - It is best if the newly cleaned vaccine syringe is stored in a new plastic zip bag and placed in the freezer.

Vaccine Handling Precautions

Attention to details while storing, handling and administering vaccines can determine the outcome of the herd health program. The following practices will enhance the effectiveness of the program.

- READ THE LABEL.
- Purchase fresh vaccines and store them in a refrigerator.
- Purchase vaccines in containers holding the number of doses appropriate for the task at hand. Storing partially used containers may lead to infections at injection sites, resulting in ineffectiveness of the vaccine.
- Never use an outdated drug or vaccine.
- Use transfer needles to reconstitute vaccines. In general, place one end of the needle into the sterile liquid, and the other in the bottle containing the freeze-dried cake of vaccine. There should be a vacuum that immediately pulls the liquid down. If not, discard the vaccine, as it may not be effective. There are some products requiring special transferring

Clean only the* external *syringe surface with soap, water, and a brush.

DO NOT use soap or disinfectant on internal components as residues may kill MLV vaccines.

techniques. Special instructions will be included on the label.

- Modified live vaccine begins to degrade, or lose effectiveness, after about an hour. Do not mix too much vaccine at one time. Direct sunlight also degrades the products, so keep vaccines and syringes in a cooler while working cattle. When using a large bottle of vaccine, mix thoroughly at first and gently shake the bottle often.
- Do not use the same syringes to inject modified live and killed products. A trace of killed product can harm the effectiveness of the modified live product.
- Clean the top of the vaccine bottle before inserting needles. To avoid contaminating the vaccine, do not put the needle you are using to inject animals back into the vaccine bottle. Change needles every 10 to 15 uses. Discard any bent needles.
- Never mix vaccines or other animal health products. Mixing unlike products can destroy their effectiveness. Use only approved combinations.
- A dangerous practice is to store veterinary drugs in the feed room. This is especially true for pesticides, which could be accidentally mixed into a feed ration.

Care and Husbandry Practices

Sound animal husbandry practices – based on research and decades of practical experience – are known to impact the well-being of cattle, individual animal health, herd productivity and carcass quality. Because cattle are produced using a variety of management systems, in very diverse environmental and geographical locations in the U.S., there is not one specific set of production practices that can be recommended for all cattle producers to implement. Personal experience, training and professional judgment are key factors in providing proper animal care. Below are areas to consider as when putting a Beef Quality Assurance system into place within a beef production enterprise.

Biosecurity

Biosecurity is a practice designed to prevent the spread of disease by minimizing the movement of biologic organisms (viruses, bacteria, rodents, etc.) onto and within your operation. Preventing or at least minimizing cross contamination must be a primary focus of all activities on a livestock operation.

Biosecurity can be very difficult to maintain because of the very complex interrelationships between management, biologic organisms and biosecurity. Biocontainment may be the only practical control for many diseases. While developing and maintaining biosecurity is difficult, it is the least expensive and most effective means of disease control available. Disease prevention program will not work without it.

Assessment of Biosecurity – Resist – Isolate – Traffic – Sanitation (RITS)

Resist, isolate, traffic and sanitation (RITS) are multiple disease protection hurdles. Of all the possible breakdowns in biosecurity, the introduction of new cattle and traffic (onto and within) pose the greatest risk to cattle health. Properly managing these two factors should be a top priority on your operation. Biosecurity plans should be developed to meet the specific needs of each operation.

An important first step is to develop a biosecurity resource group/team. The group should include people important to the success of the operation such as operation supervisors, a veterinarian, a nutritionist, Extension specialists, suppliers and others that may have special knowledge in control of biologic organisms.

Take a close look at what can go wrong. Assess the risk – the relative significance and potential for causing a biosecurity issue – of each potential biosecurity problem.

Biosecurity and Infectious Diseases

The principal threats that could be present in beef herds include: BVD-PI, Johne's Disease, bovine leucosis, anaplasmosis, salmonellosis, leptospirosis, calf scour pathogens, tuberculosis, bangs, mastitis, trichomoniasis, vibriosis, cryptosporidiosis, neospora, noxious weeds and bioterrorism issues. The spread of infectious disease can occur via:

- The introduction of diseased cattle or healthy cattle incubating disease.

Maintain a closed herd if possible.

- Introduction of healthy cattle who have recovered from disease, but are now carriers.
- Vehicles, equipment, clothing and shoes of visitors or employees who move between herds.
- Contact with inanimate objects contaminated with disease organisms.
- Carcasses of dead livestock not disposed of properly.
- Feedstuffs, especially high risk feedstuffs, that could be contaminated with feces.
- Contaminated water (surface drainage water, etc.).
- Manure handling and aerosolized manure and dust.
- Nonlivestock (horses, dogs, cats, coyotes, raccoons, other wildlife, rodents, birds and insects).

Test new animals for diseases.

Implementing a Biosecurity Program

1. **Controlling disease within the herd.**
   - Vaccinate the herd against all endemic diseases (BVD, clostridial disease, etc.).
   - Use low stress management for movement and processing. Provide ample feed, water and shade.

Purchase animals from reputable seedstock producers.

   - Isolate all sick animals.
   - Maintain a closed herd, if possible.
   - Purchase feed from reputable sources.
   - Minimize fence line contact with neighboring animals.
   - Do not place cattle of different ages in the same pen.
   - Keep records of all disease occurrences.

2. **Purchasing replacement animals.**
   - Quarantine all new animals for 30 to 60 days.
   - Test new animals for disease (BVD, Johne's Disease, salmonella, etc.).
   - Purchase animals from healthy and reputable herds.

3. **Environmental and pest control.**
   - Provide human foot baths at entrances and exits of confinement facilities.
   - Provide timely manure and dead animal removal.
   - Keep grounds and feed bunks as dry as possible.
   - Have an insect control program in practice (insects can be vectors for diseases such as anaplasmosis and bluetongue).
   - Have a rodent control program in practice.

Do not allow foreign visitors on the farm until they have been in the country for five days.

4. **Disinfection.**
   - Clean and remove as much organic material as possible before disinfecting.
   - Choose a disinfectant that will work against the pathogen you want to control.
   - Be aware of any toxic, harmful or corrosive effects of the disinfectant.
   - Follow the label on the disinfectant package.

5. **Visitors.**
   - Minimize the number of visitors to the facility and their contact with animals.
   - Be sure all visitors have clean clothing/coveralls, boots and hands.
   - Be sure all vehicles or equipment brought onto the farm are disinfected.
   - Do not allow foreign visitors on the farm until they have been in the country for five days. Do not allow foreign visitors to bring clothing, foods or accessories they have had in another country onto the farm.

6. **Employees.**
   - Be sure all employees understand and follow the biosecurity protocol.
   - Realize that employee-owned animals (horses, dogs, etc.) can be a possible source of contamination to the facility.

Livestock Facilities

Facilities (fences, chutes, shelters, etc.) should be maintained in good working condition and cleaned periodically to provide efficient movement and reduce stress when working cattle. Corrals, pens and chutes should be the proper size for the number of animals and the type of processing being done, this will also allow for proper ventilation and reduce stress on animals while in confinement. Good drainage of water is essential to reducing stress and increasing health of animals in confinement. Sharp objects and protrusions can result in bruising and should be avoided whenever possible. Equipment to restrain cattle should allow for quick and secure restraint in order to minimize stress or injury to the animal or the operator. Experienced and trained personnel should operate restraining equipment.

Beef cattle are produced in a variety of production settings, from pasture and range, to dry lot and confinement facilities. When behavioral and physiological characteristics of cattle are matched to local conditions, beef cattle thrive in virtually any environment without artificial shelter. However,

during extreme weather conditions, cattle should have access to well-drained resting areas and/or to natural or constructed shelter.

Cattle Handling

Cattle handling is of utmost importance to reduce the risk of injury and/or carcass defects in cattle. The following areas should be considered relative to animal handling:

Animal Handling - Processing should never be treated as a race. Working cattle too quickly can lead to bruises, injection-site damage, vaccine and drug failure, human injuries and incorrect records. Stress induced by improper, rough handling also lowers conception rates and reduces both immune and rumen functions.

Cattle Vision - Cattle have a wide-angle vision field in excess of 300 degrees. Loading ramps and handling chutes should have solid walls to prevent animals from seeing distractions outside the working area. Seeing moving objects and people through the sides of a chute can cause cattle to balk or become frightened. Solid walls are especially important if animals are not completely tame or are unaccustomed to the facility. Handling facilities should also be designed to eliminate shadows that may prevent cattle from entering the chutes or working alleys. Cattle have a tendency to move from dark areas to lighter areas, provided the light is not glaring. A spotlight directed onto a ramp or other apparatus will often facilitate entry. Handling facilities should be painted a uniform color because cattle are more likely to balk at a sudden change in color.

Flight Zone - An important concept of livestock handling is the animal's flight zone or personal space. When a person enters the flight zone, the animal moves away. Understanding the flight zone can reduce stress and help prevent accidents. The size of the flight zone varies, depending on how accustomed the cattle are to their current surroundings, people, etc. The edge of the flight zone can be determined by slowly walking up to the animals. If the handler penetrates the flight zone too deeply, the animal will either bolt and run away or turn back and run past the person. The animal will most likely stop moving when the handler retreats from the flight zone. The best place for the person to work is on the edge of the flight zone (Figure 12).

Hearing - Loud noises should be avoided when cattle are being handled and particularly, recurring loud noises should be avoided in working facilities. However, small amounts of noise can be used to assist in moving livestock. Placing rubber stops on gates and squeeze chutes and positioning the hydraulic pump and motor away from the squeeze chute will help reduce noise. It is also beneficial to pipe exhausts from pneumatic powered equipment away from the handling area.

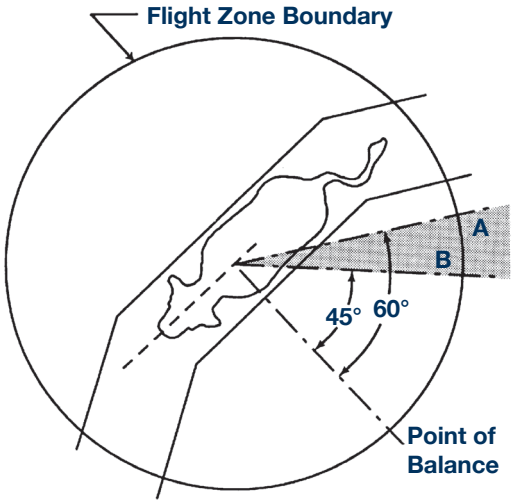


Figure 12. Cattle flight zone. Note: Animal movement stops if handler is in position A. Handler moves to position B to start movement.

Curved Chutes and Solid Fences - Curved single file chutes or working alleys are especially recommended for moving cattle into a truck or squeeze chute. A curved working system is more efficient for two reasons. First, it prevents the animal from seeing to the end of the chute until it is almost there. Second, it takes advantage of the natural tendency to circle around a handler moving along the inner radius. A curved chute provides the greatest benefit when animals have to wait in line for vaccination or other procedures. A curved chute with an inside radius of 13 feet to 16 feet will work well for handling cattle. Livestock will often balk when they have to move from an outdoor pen into a building. To combat this problem, animals should be lined up in a single file chute/working alley outside. Again, solid sides are recommended on both the handling facilities and the crowding pen that leads to a squeeze chute or loading ramp.

Handling Sick, Disabled, or Deceased Livestock - It is the responsibility of cattlemen to humanely care for their animals and make every effort to obtain veterinary care for sick or injured animals. Livestock that are sick or injured and nonresponsive to medical treatment for a reasonable period of convalescence should be humanely

Livestock that are sick or injured and nonresponsive to medical treatment for a reasonable period should be humanely euthanized on the farm or ranch under the direction of a veterinarian.

euthanized on the farm or ranch. Moreover, cattle exhibiting symptoms of advanced disease or cattle that are nonambulatory (downers) should not be transported to market facilities.

Euthanasia is defined as humane death occurring without pain and suffering. Techniques for euthanasia should follow guidelines established by the American Veterinary Medical Association and the American Association of Bovine Practitioners. Producers should use proper methods of disposing of deceased livestock in accordance with federal, state and local regulations. If utilizing a rendering service, keep deceased livestock in a screened area away from public view.

Transportation

During the movement of cattle to and from farms, ranches, feedlots and marketing facilities, proper handling and transportation are important for the safety and welfare of the animals. When loading and unloading cattle, personnel should move cattle as quietly and patiently as possible to prevent stress or injury. Cattle should be separated by size or gender prior to shipping, and if possible, different groups loaded into separate compartments of the truck or trailer (Figure 13). To prevent livestock from falling while in transit, drivers should avoid sudden starts/stops and sharp turns. Moreover, the floors of trucks and trailers should be clean and slip resistant. While in transit, occasional stops should be made to ensure that cattle are well dispersed and still standing. Severe weather conditions must be considered when transporting livestock. As appropriate, adequate ventilation and protection should be provided during transit.

Cattle should be separated by size or gender prior to shipping and loaded into separate compartments of the trailer.

Figure 13. Overcrowding during transport should be avoided.

Oklahoma Mesonet's Cattle Comfort Index

Cattle experience heat and cold stress to a high degree because of their constant exposure to the elements. The Ok-lahoma Mesonet has developed an advisory tool called the Cattle Comfort Index that allows livestock producers the ability to plan for adverse weather effects. The Cattle Comfort Index model considers temperature, relative humidity, solar radiation (sunlight intensity) and windspeed to develop a single number that relates to cattle's response to weather con-ditions. These weather data parameters are collected at the Mesonet's 120 automated weather stations every 5 minutes.

Heat stress is increased by higher relative humidity and solar radiation. Higher wind speeds help mitigate high air temperatures. In cold stress conditions, higher relative humidity and higher wind speeds add to cold stress while solar radiation helps mitigate low air temperatures.

The Cattle Comfort Index can be accessed free of charge by visiting the website: Mesonet.org and then clicking on the Agriculture tab. The tool can show current and forecast conditions for up to 84 hours in either a table or map format. It also can look at historical data for a particular Mesonet site.

Producers can readily monitor forecast and current weather conditions to incorporate into management decisions using Oklahoma Mesonet resources. The Oklahoma Cattle Comfort Index allows for a simple, visible tool for producers to stay on top of how weather conditions will affect their livestock.

Stewardship

Grazing management is critical to the sustainability of livestock enterprises in Oklahoma. The majority of the state's land is managed by ranchers for the primary purpose of providing grazing for beef cattle. These grazinglands are a vital part of the natural and economic resources of the state, and provide many diverse benefits to landowners and society. In a sense, grazing management affects all citizens of Oklahoma. Grazing management is truly a meld of art and science. The best graziers (grazing managers) combine understanding of the biological and physical processes at work in these systems with economic, logistic and social considerations to achieve sustained success. Sustainability and success

can be difficult to define, but achieving a long-term balance among production, profitability, ecosystem health, simplicity and personal satisfaction is the ultimate goal for many.

Several key concepts are important to inform further discussions of grazing management.

- Grazing enterprises are complex systems. Considering all the aspects and potential ramifications of decisions is important. Management practices can often have unintended consequences and can cause one kind of result in the short term and the opposite result in the long term.
- Grazinglands have multiple uses and provide a range of benefits to both the owner and the public at large. Grazinglands provide income from livestock, hay and potentially recreational or energy leases. They also play a key role in protecting soil, water and wildlife resources for the public. Mismanagement of grazinglands can be detrimental to all stakeholders.
- In general, maximizing the percentage of the livestock's diet that is grazed is beneficial to profitability, simplicity and sustainability. Grazed forage, assuming it is well managed, generally is cheaper than harvesting and feeding hay or supplemental feed.
- Stocking rate (the number of animals on a land area over time) is the most important variable for a manager to consider.

Nutrition and Feedstuffs

Nutrition

Cattle should have access to an adequate quantity and quality of nutrients for body maintenance and growth (Figure 14). For grazing cattle, the primary nutrient source is forage. There are times, however, when supplementation or complete feeding is required, such as during winter when adequate forage is not available or when forage quality is low. In these cases, producers are challenged with designing a feeding or a supplementation program designed to match the forage supply. This can be difficult as nutrient requirements of cattle vary according to age, sex, weight, body condition, stage of production and environmental temperature. Specific guidance for formulating effective supplementation programs and rations for cattle are provided through local Oklahoma Cooperative Extension Service offices and at the Beef Extension Web site: www.beefextension.com. Tabular values of nutrient requirements for various classes of cattle are available and tables showing typical nutrient values of common feeds are provided. Additionally, easy-to-use computer software is available for producers to download and use.

Figure 14. Providing a balanced diet is a critical component of BQA.

Cattle should have access to an adequate supply of clean water at all times. Although water requirements vary greatly, as a rule-of-thumb, water consumption will range from 1 gallon per 100 lbs. of body weight during cold weather, to nearly 2 gallons per 100 pounds of body weight during hot weather.

An excellent tool to evaluate the effectiveness of an animal's current nutritional status is the body condition scoring (BCS) system (Figures 15 and 16). Scores range from 1 (very emaciated) to 9 (obese or excessively fat). The optimum range for cows at calving time is BCS 5. Cows calving below BCS 5

Figure 15. Cow with BCS of 4.

Figure 16. Cow with BCS of 7.

Figure 17. Quality control of the feed supply is a critical control point of BQA.

produce less colostrum, lower quality colostrum, and have decreased milk production. Nutritional stress can impact the animal's health and immune system, thereby emphasizing the need for the proper balance of protein and energy to the nutritional needs of cattle.

Feedstuffs

Since most beef cattle operations purchase feeds from outside sources, quality control of the supply is a critical control point in beef quality assurance (Figure 17). Maintaining feed records and closely adhering to feed additive label directions and withdrawal times should also be considered critical control points. Feeding byproduct ingredients should be supported with sound science. Ruminant-derived animal protein feeds are not allowed to be used under current federal law. High risk byproduct ingredients include fats, rendered byproducts, and other plant-based byproducts such as glycerol from corn-based ethanol production. These may be single loads or batches that will be fed to cattle for a prolonged period of time. If purchasing fats and oils, monitor for potential contaminants. Letters of guarantee from companies supplying these materials may be requested that state these materials have been tested.

Contamination from Pesticides

Pesticides are an important tool in livestock production to control insects and weeds. However, inappropriate use of these products can lead to chemical residues in beef, unsafe human exposure to chemicals and groundwater contamination. Consequently, only agricultural chemicals approved for application to land grazed by livestock or on land where feedstuffs are removed for animal

Follow pesticide label directions and observe grazing restrictions on pastures, rangeland and crops.

Figure 18. Check the product label for grazing restrictions following application of pesticides on grazing lands.

consumption at a later time should be used. Be sure to follow label directions and observe grazing restrictions on pastures, rangeland and crops treated with pesticides. Store all chemicals (pesticides, lubricants and solvents) away from feed supplies (Figure 18). The final step in ensuring the safe use of pesticides is to document usage and observe appropriate withdrawal times before marketing cattle. Pesticide use records should be maintained for a minimum of three years.

Oklahoma Pesticide Law requires the registration of all pesticides distributed, sold or offered for sale within the state. Each pesticide product must be registered annually with the Plant Industry and Consumer Services, Division of the Oklahoma Department of Agriculture, Food, and Forestry. This law also provides for the sampling and chemical analysis of pesticides distributed, sold or offered for sale in the state. Under the Pesticide Law, it is unlawful to distribute, sell or use any registered pesticide in a manner inconsistent with its labeling.

The Environmental Protection Agency is directed by federal law to classify all pesticides for either general use or restricted use. Pesticides classified for general use may be purchased by the general public and applied according to the label directions. Pesticides classified for restricted use may be purchased and applied only by certified applicators or individuals working under the direct supervision of a certified applicator.

A certified applicator is any individual who is certified to use or supervise the use of any pesticide which is classified for restricted use. Applicator certification is available in several classes, including: Private Applicator, Commercial Applicator, Noncommercial Applicator, and Service Technicians. Information on the appropriate certification class and certification procedures can be obtained through the local Cooperative Extension Office or through the Oklahoma Department of Food and Forestry's Consumer Protection Services Division (405-521-3864 or http://www.oda.state.ok.us/cps-overviewhome.htm).

Federal regulations prohibit the feeding of ruminant derived protein.

Mycotoxins

Mycotoxins are naturally occurring chemicals produced by fungi. They can be found in grains and forages, and if present in sufficient concentrations, can cause reduced feed consumption, weight loss, abortions and residues in meat and milk products. Mycotoxins can be produced in feedstuffs prior to harvesting or during storage. Mycotoxins may include: vomitoxin, aflatoxin, fumonisin and zearalenone. The following guidelines were established by the Food and Drug Administration and the Oklahoma Animal Disease Diagnostic Laboratory for allowable concentration of aflatoxin (one of the most common mycotoxins in Oklahoma) contamination in feedstuffs for cattle:

Lactating dairy cattle	20 ppb[1]
Immature livestock	20 ppb
Breeding cattle	100 ppb
Finishing cattle	300 ppb

[1] Parts per billion.

Mycotoxin production in the field is very difficult to control (Figure 19). Drought conditions and hail frequently predispose grain to infection by toxic fungi. Consequently, incoming feed ingredients, including freshly harvested feed grains and forage, should be monitored for possible mycotoxin contamination. Storing feed and grain at low moisture content and temperatures will help prevent fungus growth. Apply chemical preservatives according to label directions to ensure complete coverage of the feed or grain. Monitor and aerate treated feed or grain as you would dry grain.

Figure 19. Mycotoxin contaminated corn prior to harvest.

Cleanliness in feed storage facilities, transportation equipment and feeding areas should be promoted as a method to reduce possible mycotoxin contamination of feeds. Remove caked and molded grain from transport trucks, storage bins, conveyors and feeding troughs. If the presence of mycotoxins is questionable, a feed sample should be submitted to a qualified laboratory for quantitative analysis.

No Ruminant Derived Protein

No ruminant-derived protein sources can be fed. As of 1998, federal regulations prohibit the feeding of certain mammalian protein sources. The regulations primarily impact the feeding of meat meal and bone meal derived from ruminants. This restriction is a key critical control point to prevent the establishment or amplification of BSE in the U.S. through the consumption of specified risk material. Tallow, blood byproducts, gelatin products and milk products are excluded by the regulation and are acceptable for use in ration formulations.

Feed Additives and Medications

The use of medicated feeds for livestock is regulated by the FDA. Feed mills that mix certain premixes are required to register with the FDA and are subject to routine inspections. Other feed-mixing facilities including on-farm mixing facilities are not required to register with the FDA, but are required to follow Current Good Manufacturing Practices (CGMPs). CGMPs include the following:

1. Facilities and equipment should be constructed and maintained to minimize vermin and pest infestation; allow proper maintenance and cleaning; accurately produce feed of intended use; and prevent accidental contamination from fertilizer, pesticides or other contaminants.
2. Quality assurance of feed products through identification, storage, inventory control, documented corrective actions and adherence to label instructions.
3. Proper equipment cleanout procedures to prevent carryover.
4. Proper labeling and complete records of feed formulations.

A more complete document outlining CGMPs for nonregistered feed mills is available from the FDA at: https://www.fda.gov/downloads/animalveterinary/guidancecomplianceenforcement/guidanceforindustry/ucm052386.pdf.

Only FDA approved medicated feed additives should be used in rations. Extra-label use of feed additives is illegal and strictly prohibited. To avoid violative residues, withdrawal times must be strictly followed. Complete records must be kept when formulating or feeding medicated feed rations. Records are to be kept a minimum of three years.

All cattle medications and vaccines should be recorded on the Veterinary Drug Order and should be updated at the same time the Treatment Protocol Plan is updated.

Veterinary Feed Directive

Effective January 1, 2017, veterinary oversight is required for the inclusion of medically important antibiotics in animal feeds or water. The federal act, known as the Veterinary Feed Directive (VFD), requires a VFD from a licensed veteri-narian for medically important antibiotics in or on feeds. This necessitates a Veterinary Client Patient Relationship (VCPR) be established in advance to obtain the medicated feed for treatment. The VFD act eliminates the use of medically important antibiotics for growth promotion and feed efficiency purposes and brings the remaining uses under the super-vision of a licensed veterinarian. Authorized use will be for prevention, treatment and/or control of disease. Veterinary Feed Directive rules do not apply to medicated feeds that do not contain medically important antibiotics. Examples of medicated feeds that are not affected by the VFD would be those feeds containing products for controlling bloat, parasites, reproduction, etc.

When using a VFD feed, the producer is required to maintain a copy of the signed VFD from the veterinarian for two years. Cattle owners do not have flexibility in how the medicated VFD feed is used; it can only be used as labeled and prescribed in the VFD. The VFD should specify an "Expiration Date." This is the last day a VFD feed can be fed, not the date the drug becomes ineffective. For those drugs without a specified date, the veterinarian will assign a date not to exceed six months. If a producer cannot complete the therapy before the "expiration date" the producer should contact their veterinarian to obtain a new VFD.

Records

Importance of Records

Record keeping, either computer or by hand, is a critical management tool. Inventory and usage records can point out inefficiencies, theft and negligence. With today's narrow profit margins, correct inventory management is essential.

To ensure consumer confidence and maintain market share, producers must be able to document the use and safety of beef products. The industry must be able to prove it has tight control of risk factors with a residue potential through effective documentation. As a result, consumer confidence will be strengthened and regulatory pressures will be reduced.

Animal health products are costly items. Accurate records can highlight inefficiencies on an animal-by-animal basis and prevent ineffective administration of treatments. Furthermore, this information documents the treatments administered by the veterinarian for validation of treatment recommendations. It allows veterinarians to adjust treatment regimens as animals and environmental conditions change. Records are very important to business success. Regulatory inspections by FDA, USDA, EPA or OSHA will prove the necessity of good records. Effective documentation showing appropriate compliance with training, inventory control, use orders, animal identification, withdrawal and disposal will help avoid liability from a residue contamination. Should a feedyard be cited for a residue violation and that feedyard believes a mistake in identity has been made, good records may be the only proof of compliance. Records will also indicate the complete listing of pharmaceutical products used at the feedyard. Accusations that certain drugs have been used can be avoided when the feedyard can prove it does not use that specific compound.

Computer record systems make extensive evaluation easy and efficient; however, hand-kept record systems are still very effective. Each system has its own merits, so select the best system for your beef production unit.

Veterinary Drug Order

A Veterinary Drug Order (VDO) is a veterinarian approved list of medications used in your operation that fit BQA guidelines (Figure 20).

The VDO should include all products that have a withdrawal time, including vaccines, antiparasitic drugs and all injectables (including vitamins). When all medications, vaccines, etc. are managed as if they are prescription items, an additional measure of quality assurance and safety is obtained.

All cattle medications and vaccines should be included on the VDO and should be updated at the same time the Treatment Protocol Plan is updated.

Treatment Protocol Plan

Ask your veterinarian to develop a Treatment Protocol Plan specific to your operation (Figure 21). Keep the Treatment Protocol Plan on file at the treatment facility.

This concept of a treatment protocol plan may be more familiar to feedyards and larger stocker operations. However, it is a valuable management practice for cow-calf producers as well. It is simply writing down a plan for what treatment(s) are to be used when cattle get sick for various reasons.

Also, write down your plan for follow up and/or alternative treatments if the initial treatment does not produce the desired result.

The plan should be reviewed regularly and updated at least every 90 days or as often as is appropriate. As you update the protocol plan, previous versions should also be kept on file for a year or more to refer back to for treatments that have worked in previous situations. When the plan is updated, it must have your veterinarian's signature and date recorded.

Accurate records also allow you to know exactly what is going into each animal (Figure 22) or group of animals (Figure 23). This information prevents the re-administration of treatments that have previously failed to work. Furthermore, the information tells the consultant/veterinarian what treatments you are applying to see what treatment recommendations are being followed and judge whether treatment regimens need to be adjusted.

Refer to Figures 22 and 23 for examples of handwritten treatment records you can use. Figure 22 focuses individual treatment records and are useful for specific treatment of disease or injury to one specific animal. Group treatment records (Figure 23) are used when vaccinations or mass medication treatments are administered to the herd. Both record types are similar, but it is important to maintain them separately for quick reference. This will make it easier for cattle to be checked and cleared to assure all withdrawal times have been met. A copy of all treatment records should also be transferred with the cattle at the point of sale, and buyers must be informed if cattle have not met withdrawal times.

Conclusion

Producers can have a positive impact on the quality and consistency of beef products by implementing BQA guidelines. The goal of the BQA program is to assure the consumer that all cattle shipped from a beef operation are healthy, wholesome and safe, and their management has met all government and industry standards.

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Veterinary Drug Inventory

The following products are to be used at_____.

Brand Name & Company	Lot Numbers	Number of Doses	Date Purchased	Dates Used	Withdrawal Time	Expiration Date

Figure 20. Example of a veterinary drug order. This form can be copied.

Health Treatment Record for Cattle

ID/Group Description	Date of Treatment	Comments/Symptoms/ Temperature	Product Used	Serial/ Lot Numbers	Route[1] and Location[2] of Administration & Dosage	Withdrawal Date	Person Giving Treatment

[1] SQ (Subcutaneous); IM (Intramuscular); O (Oral).
[2] RN (Right Neck); RE (Right Ear); LN (Left Neck); LE (Left Ear).

Keep This Record for 3 Years

Figure 22 – Example of a treatment record for cattle. This form can be copied.

Treatment Protocol Plan

Disorder: _____

Indications for Treatment (symptoms of affected animals): _____

_____

_____

_____

Primary Treatment

Product/Active Ingredient: _____

Dose: _____

Route of Administration: _____

Duration/Frequency of Treatment: _____

Withdrawal Period: _____

Other Comments: _____

_____

_____

Secondary Treatment

Product/Active Ingredient: _____

Dose: _____

Route of Administration: _____

Duration/Frequency of Treatment: _____

Withdrawal Period: _____

Other Comments: _____

_____

_____

Prevention

Product: _____

Dose: _____

Route of Administration: _____

Withdrawal: _____

Special Instructions: _____

_____

_____

_____

_____

_____

Figure 21. Example of a treatment protocol plan. Can be copied.

Contact Information for the Beef Quality Assurance Team

	Name	Phone
Name of Operation:		
Owner/Manager:		
Feed Employee or Company:		
Cattle Employee:		
Maintenance Employee:		
Office Employee:		
Veterinarian:		
Extension Educator:		
Nutritional Advisor:		
University Specialist:		
Local NRCS:		

Notes:

Notes:


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