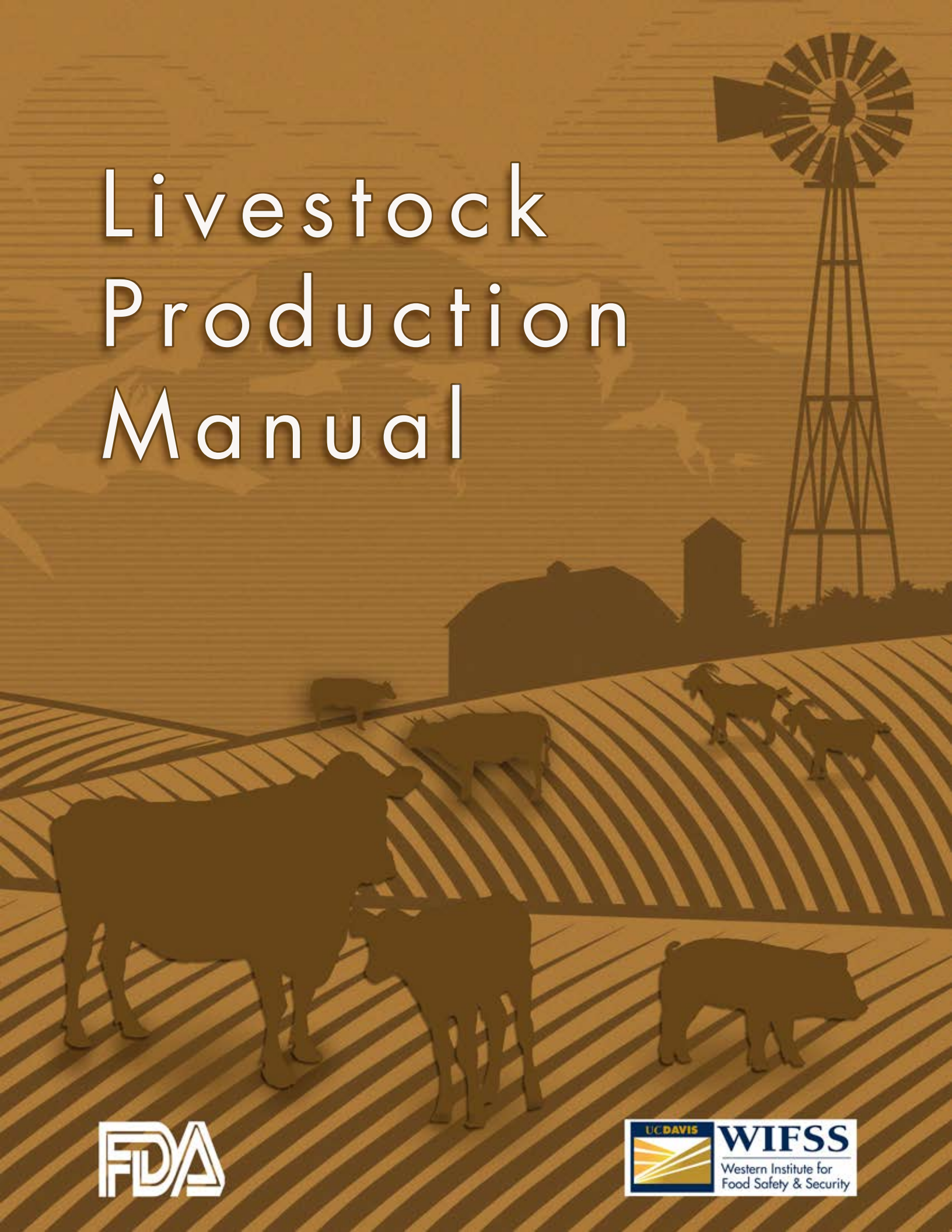
Livestock Production Manual



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This manual was produced as a collaborative project between the Western Institute for Food Safety and Security at the University of California – Davis and the Food and Drug Administration under the "Model Training Programs for Specialty Produce Crops, Dairy and Lab Procedures" Cooperative Agreement (1U54FD004327).

Dairy Cattle and Veal Production

Introduction

The dairy industry in the United States has changed dramatically over the past 75 years. Since the 1940s the number of dairy farms in the country has dropped from over 4 million facilities to about 65 thousand farms. The total number of dairy cows in the U.S. has also dropped by 75%, from approximately 25 million cows to approximately 9 million cows.

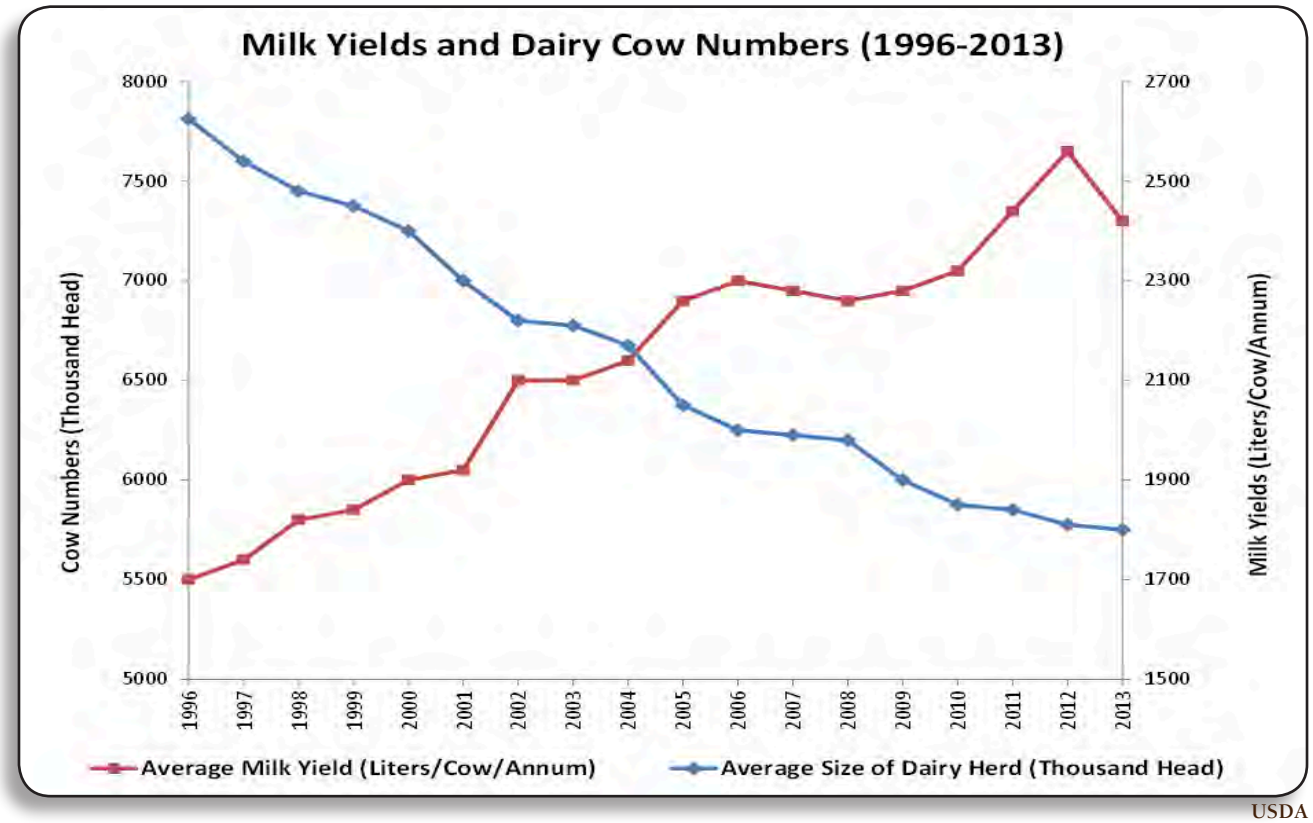
Also since the 1940s, the total number of herds in the United States has grown smaller, but the number of cows in each herd has grown larger. It is estimated that the average U.S. dairy houses about 150 cows. However, there is a wide range among individual dairies with Midwestern dairies tending to be smaller averaging about 90 cows per herd and large dairy herds out west averaging about 1,000 cows per herd. If calves are raised on site as replacements, then a good proportion of the animals on the dairy will be replacement heifers of varying ages. For such dairies, the total number of cattle on the dairy can be roughly estimated by multiplying the number of cows being milked by two.

Torrey Johnson

While both the number of dairy farms and the number of dairy cows in the U.S. has dropped dramatically, the total amount of milk produced in the U.S. has climbed from 54 billion kilograms to 84 billion kilograms (Figure 1). This increase in milk production is due to a 5-fold increase in the amount of milk produced per cow. There can be great variability in milk production from herd to herd with herd averages ranging from less than 14,000 pounds of milk per cow, per year, to more than 23,000 pounds of milk per cow per year. The average U.S. dairy cow makes about 20,000 pounds of milk every 12 months, about 2,300 gallons, or 14 times her body weight.

The dairy and veal industries are intricately linked. The following information about dairy and veal production are general practices that apply to most operations. The relationship between these two industries will be described in the section on life cycles. Among individual dairies there is some variability and sometimes there are extreme differences in practices from one dairy to another.

Figure 1: Milk Yields and Dairy Cow Numbers



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Dairy Terminology

When communicating with dairy and veal producers, it is important to have a functional understanding of common terminology used in these industries.

Artificial Insemination (AI) The introduction of semen passed through a straw and pipette into the cow's reproductive tract for the purpose of achieving pregnancy. The use of AI provides dairy farmers with the ability to breed cows for specific traits in future animals. This is achieved by inseminating cows with semen from bulls that have been selected for specific desirable traits.

Bulk Tank A large tank used for cooling and storing milk at a cold temperature until it can be picked up by a milk hauler for transport to a creamery. Bulk tanks are usually made of stainless steel and must be cleaned after each milk collection.

Bulls Male cattle that have not been castrated and are fertile. Bulls can be extremely dangerous and can cause serious injury or death to personnel when appropriate safety precautions are not taken when working around these animals

Calf A young bovine, either male or female, up to one year of age.

Clean-up Bull A breeding bull that is used to naturally inseminate heifers and cows that do not become pregnant by means of artificial insemination.

Colostrum The first milk produced by a cow following calving. Colostrum has higher concentrations of proteins, fats, vitamins and antibodies (immunoglobulins) compared to milk that is used for human consumption.

Jeff Hall, UC Davis WIFSS

Cull Cows Cows that are removed from the herd for health or production reasons.

Dairy Calves Female or male dairy cattle being fed a ration that includes milk or liquid milk replacer and which are not intended for veal production; one of the 3 classes of 'non-lactating dairy cattle' defined under current federal guidelines.

Dairy Cow Female dairy cattle that are intended for production of milk for human consumption.

Dry Cow Therapy or Treatment An intramammary antibiotic that is administered into each teat at the beginning of the dry period to prevent udder infections that could develop during the dry period and/or treat active infections that are present at the time of drying-off.

Dry Dairy Cows Female dairy cattle that had previously lactated, but which are not currently producing milk (i.e., cows that are between lactations; the period of time between two lactations is also referred to as the 'dry period' (see below).

Dry Period Approximately two months before she is due to calve again, a lactating dairy cow stops getting milked and is allowed ~60 days to gain back weight that may have been lost during lactation; the udder is also able to repair and regenerate secretory mammary gland tissue during this time before the next calving and resumption of routine daily milking.

Extralabel Use of a prescription medication or supplement that is not in accordance with the directions on the manufacturer's label. Extralabel use can only be done by a producer under the direction of a licensed veterinarian with whom there is an established Veterinarian-Client-Patient relationship.

First-Calf Heifer After giving birth to its first calf, a replacement dairy heifer is commonly referred to by producers as a first-calf heifer.

Formula-Fed Calf A calf raised to about 16 to 18 weeks of age on an all liquid diet. The majority of veal marketed in the U.S. is formula-fed. Also called milk-fed or special-fed veal.

Fresh Cows Dairy cows that have recently calved.

Lactating Dairy Cows Female dairy cattle that are producing milk.

Lactating Cow Treatment/Therapy An intramammary antibiotic that is designed for use during the normal lactation period.

Milk Fed Veal Calf A bull calf that is raised on milk replacer for about 16 weeks before slaughter.

Dry Cow Treatment

Jeff Hall, UC Davis WIFSS

Dairy Calves

Jeff Hall, UC Davis WIFSS

Lactating Dairy Cow

Keith Weller, USDA ARS

Non-Formula Fed Veal A calf that has been weaned from milk-replacer at about two months of age and has transitioned to a solid food diet of hay and/or grain. Non-formula fed veal will be marketed at up to 700 pounds. This class represents a very small fraction of the total veal marketed in the U.S.

Pre-Ruminant An animal with a rumen that is not yet anatomically or functionally mature.

Replacement Dairy Bulls Intact male dairy cattle intended for reproductive purposes such as natural breeding or for collection of semen for use in artificial insemination (AI)); one of the three classes of 'non-lactating dairy cattle' defined under current federal guidelines.

Replacement Dairy Heifers Female dairy cattle from the time of weaning until the time of first calving; one of the 3 classes of 'non-lactating dairy cattle' defined under current federal guidelines.

Rumen The largest compartment of the forestomach in a mature ruminant animal and the site of microbial fermentation that is required to produce useable nutrients from consumed feed materials that would otherwise be indigestible. The rumen is anatomically joined to the reticulum to form a 'reticulorumen' that precedes the next two compartments (omasum and abomasum (the true stomach of a ruminant)). The abomasum corresponds to the stomach of a human being.

Teat Sealant A paste that is infused into the end of each teat following dry cow treatment. Such products are used to seal the end of the teat to prevent introduction of infectious agents into the udder during the dry period.

Teat Sealant Being Applied To Dairy Cow

Heather Johnson, UC Davis WIFSS

Veal Calves Immature beef and dairy breed cattle that lack a functional rumen and that are intended for meat production. Veal calves are considered as a distinct regulatory class from suckling calves because of their handling, housing, and proximity to slaughter.

Voluntary Waiting Period A two to three month period of time following calving before which a cow is not rebred by AI or allowed to have exposure to a bull. During this time, the cow's reproductive system is allowed to recover before being rebred. Also during this time, lactation begins and milk production will reach its peak. After the voluntary waiting period is over, the cow will be bred back again. A cow will be milked during most of the pregnancy.

Weaning The process of transitioning a calf away from a diet containing milk or milk replacer, to an all solid feed diet or ration.

Withdrawal Interval Describes a withdrawal period for a drug that has been used in an extralabel manner.

Withdrawal Period The period of time that is required to elapse following the administration of an approved animal drug before which milk can be sold for human consumption, and/or the animal can be slaughtered for human consumption. The withdrawal period is necessary to ensure that tissue and/or milk residues of a drug have fallen below a federally approved concentration limit, such that the animal and/or its milk are safe for human consumption. The withdrawal period is sometimes referred to withdrawal time.

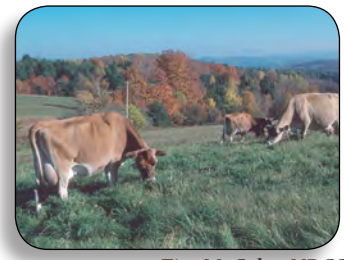
Breeds

Holstein

Jeff Vanuga, NRCS

One similarity between dairy herds all across the U.S. is the preponderance of a single dairy breed: the Holstein. Favored for high milk production, Holsteins represent the vast majority of all dairy cows in the country.

Jersey



Tim McCabe, NRCS

The second most common breed is the smaller Jersey, which is favored by some producers for it's higher milk fat and protein content; these differences make Jersey milk highly valued for cheese production.

Other Breeds

Wikimedia

All of the other breeds, such as the Brown Swiss (pictured left), Ayrshire and Guernsey each make up a very small fraction of the total number of cows in the U.S. dairy population.

Feeding and Operations

Dairies are classified by the way cattle in a particular herd are fed and housed. Most of the dairy operations in the U.S. are classified as conventional and tend to be large-herd operations. In conventional operations, feed grown on the farm or purchased elsewhere is brought to the cows. Typical examples of cow feed include hay (which is grown, cut, dried, harvested and baled in the field for later feeding to cows), and corn silage (which is made from chopped and fermented corn that is stored in silos or plastic bags before being fed to cows).

Feed Truck Bringing Feed to Cows

Jeff Vanuga, NRCS

Less common than conventional operations are grazing or pasture operations. On these farms, rather than bringing the feed to the cow, the cows are brought to the feed in the pasture. Because there are relatively few places in the country where true grazing is available year-round, grazing operations comprise only a very small fraction of the dairy farms in the U.S.

Many operations take advantage of intermittent pasture by allowing grazing when it is available and then feeding cows indoors during seasonal, inclement weather. About a third of U.S. dairy operations utilize this management style. These tend to be small farms that house very few of the total number of dairy cows in the U.S.

Cows in Pasture Operation

Jeff Vanuga, NRCS

Housing

Dairy cattle require proper housing throughout their lifetime in order to maintain safety and health. Dairy farmers typically use different types of housing depending on the age and the stage of the animals' life cycle and region in which they live.

Calves

Jeff Hall, UC Davis WIFSS

The majority of dairy operations in the U.S. house calves in individual pens or hutches typically made of plastic or wood. Raising calves in individual hutches has some health benefits including individual feeding and less opportunity for transfer of diseases between calves. Calves can also be raised in groups, although this is less common than the use of individual calf hutches or pens.

Adults

For adult lactating cows, there are three major types of primary housing:

Tie Stalls/Stanchion

Damien Hardy

Approximately half of dairy farms in the eastern U.S. maintain lactating cows in a "Tie Stall" or "Stanchion" type of housing system. This housing type combines housing and milking at one location; such stalls are the most common type of housing in the eastern U.S. In a tie stall/stanchion operation, cows are restrained in a bedded stall, with an area for eating and drinking in front of them and a manure collection channel behind. The milking system used in this system can be fixed or portable but in either case the cows are milked while standing in the Tie Stall.

Free Stall

NRCS

In this type of housing there are individual stalls with metal pipe partitions between stalls, and cattle are not confined to one particular stall. Cows can move around freely and have access to feeding areas and water troughs. Nearly three-fourths of U.S. dairy operations with 500 or more cattle are free stall operations.

Dry Lot

Torrey Johnson

A dry lot is an outdoor pen typically augmented with shade structures. About one-third of dairies in the western U.S. (California, Idaho, New Mexico, Texas, and Washington) are dry lot operations.

Milking

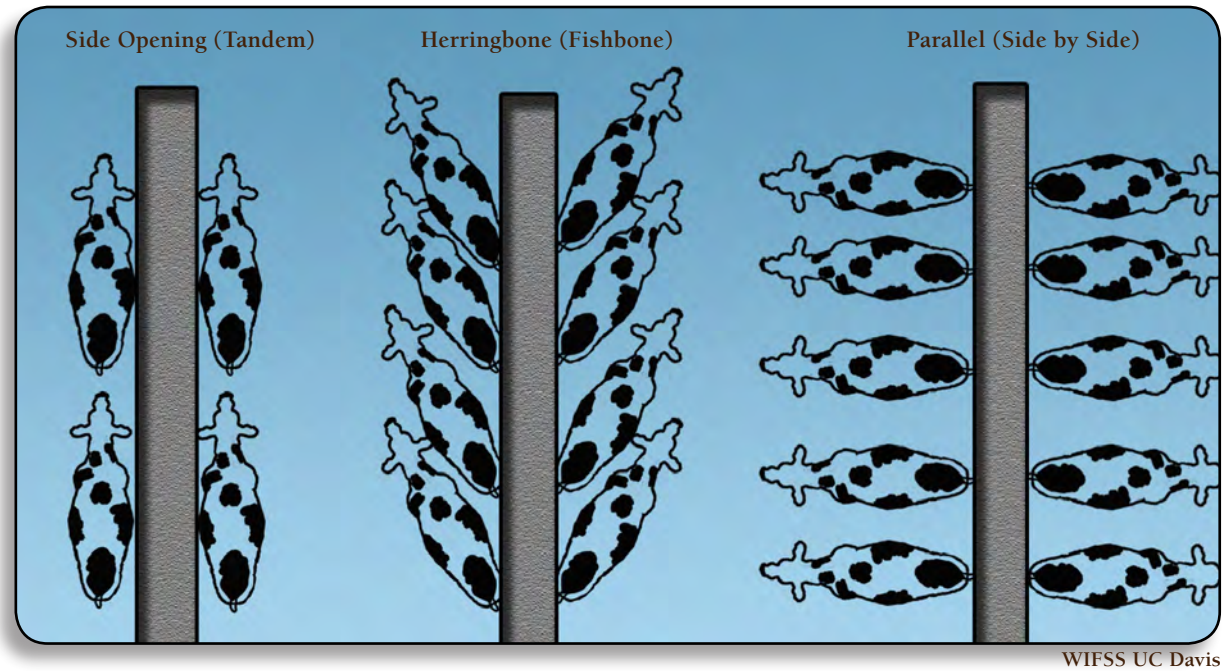
Directly related to how cows are housed is how they are milked. There are two general types of milking facilities: tie stall/stanchion and parlor. In tie stall/tanchion operations, cows are typically milked while standing in their individual stall. In parlor milking systems, cows are walked multiple times per day to a dedicated milking area (parlor). While approximately 60% of dairy operations use tie stall/stanchion milking systems, over three-fourths of cows in the U.S. are milked in parlors. Many factors go into the choice of parlor used, including frequency of milking, available labor, need to treat cattle individually while in the milk parlor, and cow numbers. There are several common styles of milking parlor used by dairy operations in the United States today.

Side Opening (Tandem) Parlor - Less than 10% of operations and less than 5% of dairy cows in the U.S. are milked in a side opening (tandem) type of parlor. These are more suited to operations with up to about 400 cows where there is a high level of management and more individualized care for cows while in the parlor. Cows are milked from the side in this system.

Herringbone (Fishbone) Parlor - Approximately 50% of operations and 50% of cows in the U.S. are milked in a herringbone (fishbone) parlor. In this system cows are milked while standing on an elevated platform in about a 45-degree angle facing away from the milker. In this system cows are milked from the side.

Parallel (Side by Side) Parlor – In this system cows stand on an elevated platform at a 90-degree angle facing away from the milker who must milk the cows from between the rear legs of the cow. The advantage to this system is that the distance between animals is shorter and reduces walking distance for the milkers.

Common Styles of Milking Parlors



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Rotary (Carousel; Turnstile) Parlor– In this type of parlor, cows move onto a rotating platform, facing either inward or outward depending on the system. While this system is typically more costly to construct, the actual day to day milking procedures are more automated and more efficient. As such, this system is best suited to large herds (>1000 cows). This system does not easily allow for individualized cow treatment.

Dairy Cows being milked in a Rotary parlor

Gunnar Richter

Identification

Keeping track of which dairy cows are healthy and profitable requires animal identification and accurate record keeping. The majority of U.S. dairy farms identify individual cattle with ear tags. Other, less commonly used identification methods include neck chains or collars, leg bands, photographs or sketches, branding, tattoos, and electronic systems such as bar coding, radio frequency identification (RFID), and pedometers. Some dairies use more than one identification method. A very small number of small dairy operations with relatively small herds in which the farmer can identify each animal individually do not use any form of recorded animal identification.

Dairy Cow with Ear Tag and Neck Chain

Jeff Hall, UC Davis WIFSS

There are several other identification types that may be present on dairy cattle in addition to individual identifications. These include, but are not limited to, brucellosis tags or tattoos that are applied following vaccination; back tags applied at sale barns or slaughter facilities; brands; and temporary identification systems commonly used to mark cows that have been treated with drugs, or for other identification purposes.

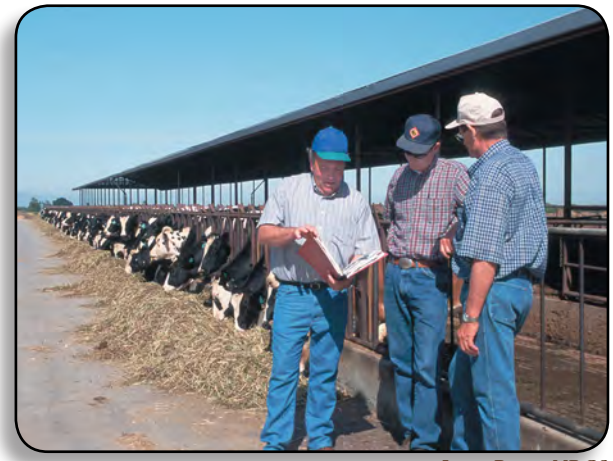
Temporary marking systems may include leg bands typically applied to rear limbs so that milkers can easily identify treated cattle or livestock marking sticks/chalk commonly applied to the hip area or tail head. It is extremely important that any temporary marking systems used to identify animals treated with drugs be clearly visible to milkers who can be alerted to the presence of a treated cow in the milking parlor since milk from cattle that have been treated with antibiotics will have to be kept separate from milk of non-treated cows until appropriate withdrawal times have been observed.

Dairy Cow with Temporary Markings and Leg Band

Jeff Hall, UC Davis WIFSS

Record Keeping

It is critically important for farmers to have established control systems in order to avoid drug residues in milk. The Food and Drug Administration, Center for Veterinary Medicine's Compliance Policy Guide, "CPG Sec. 615.200 Proper Drug Use and Residue Avoidance by Non-Veterinarians", provides guidance concerning proper animal identification and record keeping to avoid drug residues in animals used in food production. Recommendations include identifying and tracking animals to which drugs were administered in order to preclude the sale of edible animal tissue, milk, or eggs containing illegal residues. Identification may be by specific animal identification, pen or lot, quarantine or segregation, or other means. Additionally, FDA recommends maintaining a system of medication or treatment records that, at a minimum, identifies the animal(s) treated (individual animals, pens, lots, etc.), the date(s) of treatment, the drug(s) administered, who administered the drug(s), the amount administered, and the withdrawal time prior to slaughter (and when milk, eggs, etc. can be used, if appropriate).



Lynn Betts, NRCS

Proper identification of individual animals also allows the dairy farmer to more accurately keep track of health and production records for each individual cow. There are a number of systems that are commonly used. These include hand-written records, on-farm computer records and subscription to the National Dairy Herd Improvement Association (or DHIA). The DHIA is a national database that keeps track of milk production by testing cows on the farm every month. Nearly half of U.S. dairy farms are currently subscribed to the DHIA tracking system. However, DHIA participation is not required by FDA and the records solely produced by this system may not be sufficient to address medication or treatment record recommendations in CPG 615.200. Most methods of recordkeeping can be very effective if managed carefully. Many U.S. dairy farms use handwritten records. Larger dairies may be more likely to use on-farm, electronic recordkeeping systems.

The format of identification and record keeping is not important as long as an established control system is in place to allow farmers to track treatment of animals to avoid the risk of violative drug residues appearing in the human food supply.

Life Cycle of Dairy Cattle

Dairy Calves Depending on the management system of the dairy, a calf will be allowed to nurse colostrum directly from its mother, fed by hand from a bottle, or fed by a tube passed through the esophagus directly into the stomach to ensure the calf receives the full amount of colostrum necessary for optimum health. After it nurses or is hand-fed colostrum, a calf is typically separated from its dam (mother) within 12 hours following birth and is placed into a small calf pen or enclosure allowing for individual feeding of milk or milk replacer, and administration of medical care if needed. The fate of the calf will then depend on whether it is a heifer or a bull calf.

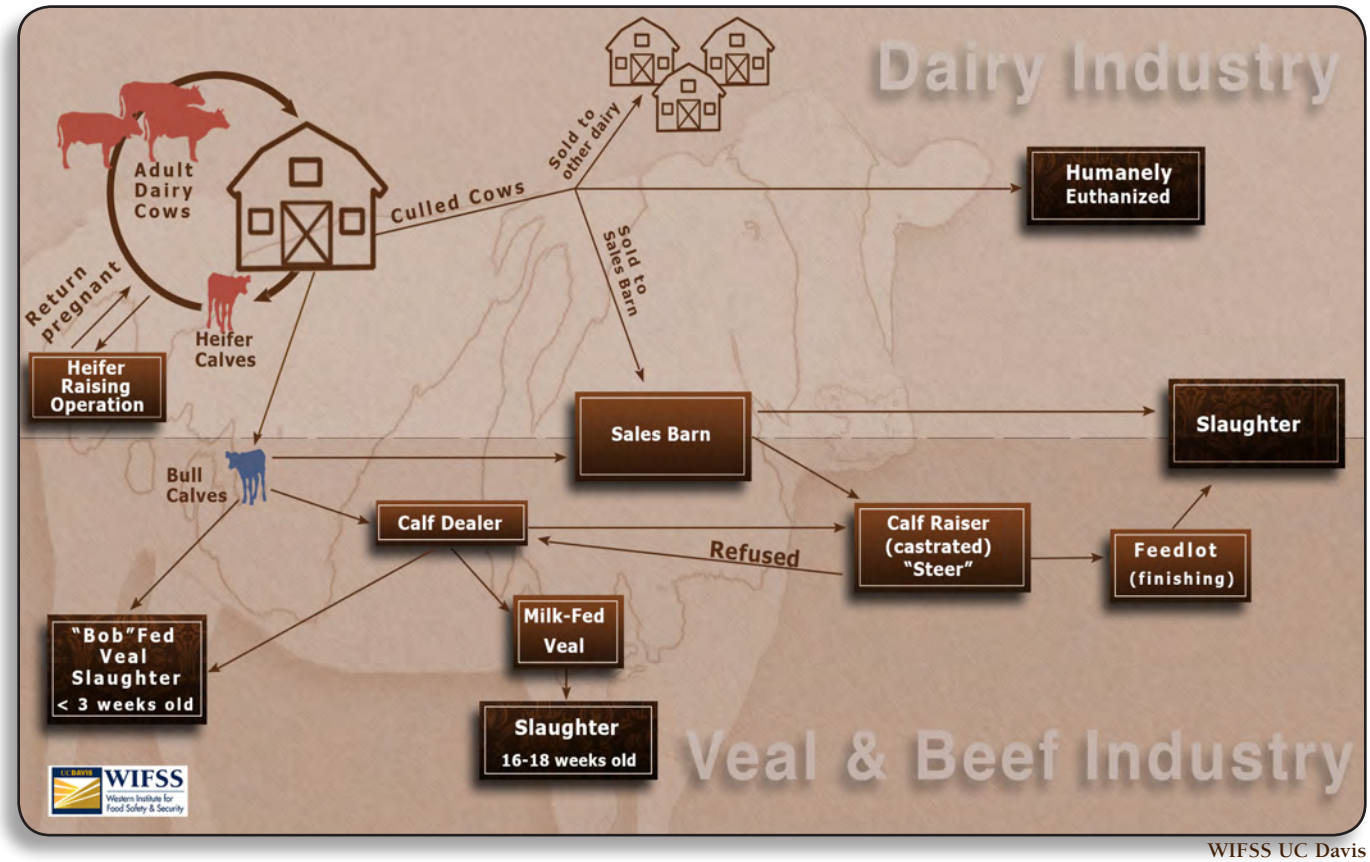
Scott Bauer, NRCS

Females: Heifer calves and adult dairy cows As future milk cows, female calves are considered to be replacement animals for older cows that leave the dairy for a variety of reasons including illness, injury, and/or productivity. On many smaller farms, these replacement heifers will be raised on the dairy farm where they were born. Alternatively, some larger farms will send its heifers to an off-site facility known as a heifer ranch where they will be raised. Once they have become older, heifers will be returned to the farm of origin. The ages at which heifers are returned vary, but often this happens when they have reached puberty or have become pregnant (Figure 2).

Either on the dairy farm or at a heifer ranch, heifers will be fed milk replacer for approximately 2 months before being weaned and transitioned to an all solid feed diet. Weaning ages differ from dairy to dairy, but typically weaning occurs at around 8 weeks of age or older.

A heifer will reach sexual maturity between fourteen and eighteen months of age, depending on the breed. At this time, the heifer will be bred by either artificial insemination (AI) or by exposure to a breeding bull. Some U.S. dairies use only AI, and many use a combination of AI and a clean-up bull. The average gestation period for dairy cows is 9 months.

Figure 2 - Movement of Cattle in the Dairy and Beef Industry



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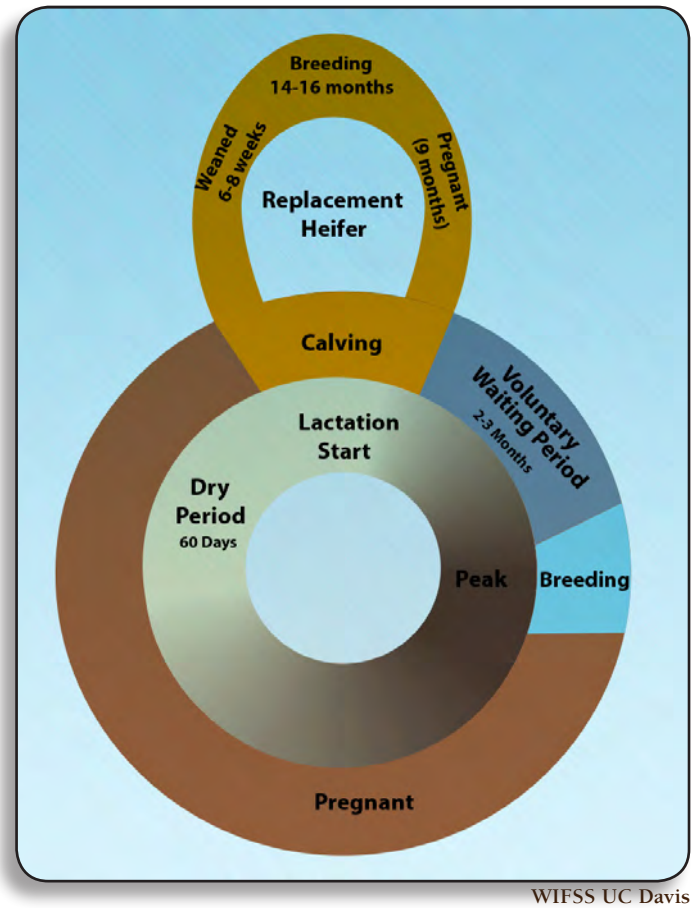
Lactation

Lactation begins immediately following calving. The first milk that is expressed from the udder after calving and during the first several days of lactation is called colostrum and has higher concentrations of protein, fat, vitamins and antibodies (immunoglobulins) compared to regular milk. The antibodies in colostrum come from the mother's body. On many dairies, unused colostrum is saved for feeding to other calves or stored frozen for future use. Colostrum is vitally important to the health of a calf because the high levels of immunoglobulins in colostrum help provide the calf with the ability to resist infections. When fed to calves during the first 24 hours of life, the antibodies in colostrum are absorbed from the calf's gut into its bloodstream. Without the important immune support function provided by immunoglobulins in colostrum, calves become much more susceptible to developing a variety of diseases, and if they do get sick, such calves are usually much more likely to be given drugs to treat such diseases. Colostrum is not sold for human consumption and most dairy cows produce far more colostrum than is needed by one calf.

Figure 3 - Breeding and Lactation Cycle



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Milk from recently fresh cows is withheld from the bulk tank for approximately four days following calving to ensure that colostrum is not accidentally collected into the bulk tank and sold for human consumption. Often, milk from cows during the first three to four days following calving is commingled and fed to calves.

After the voluntary waiting period is over, the cow will be bred again usually by AI.

Fresh cows (those that have just calved) may be segregated from the rest of the herd for a period of days to make sure that they are not experiencing any complications following calving. After this designated fresh period is over, a cow will be introduced into the main milking herd to enter the normal milking cycle on the dairy. On many dairies, cows are often grouped based on age and/or milk production and fed specific rations to meet the metabolic needs necessary to support the level of milk production in a particular group.

A dairy cow will be milked during most of her pregnancy and will typically produce milk for about ten months. On most dairies cows are milked between two and three times per day. In a typical lactation, milk production increases very rapidly, peaks around two months following calving, and then slowly decreases. A dairy cow will stop being milked about two months before she is due to give birth.

This two month period, after milking has stopped and before the next calf is born, is known as the dry period. During this time, the cow is able to gain back weight that may have been lost and the udder is able to repair and regenerate secretory tissue (Figure 3).

At the beginning of the dry period, the farmer may administer antibiotics that are infused into each teat. This practice is known as dry cow treatment and is done to assist in clearing any udder infections that might have developed during lactation and to prevent new udder infections that develop during the dry period.

The entire cycle of breeding, calving and milking is repeated throughout a dairy cow's life. The average U.S. dairy cow has a calf approximately every 13 months and will complete three to five of these cycles during her lifetime prior to leaving the herd (Figure 3).

A dairy cow will leave the herd for a number of reasons (Figure 2). There is a relatively low on-farm mortality rate for dairy heifers and cows, but it is possible for an animal to become sick or injured and die or need to be humanely euthanized. Most dairy cows are removed from the herd (culled) and sold for slaughter or to another farm. The reasons for culling vary, but the most common reasons are reproductive problems, mastitis or other udder health problems, poor production or lameness. The cull rate is between 25% and 33% of the cows on an average dairy. Culled cows are then replaced by replacement heifers.

Jeff Hall, UC Davis WIFSS

Males: Bull Calves Steers and Bulls (Figure 2) The majority of male calves, or bull calves, born on a dairy will ultimately be sold for slaughter. Depending on when it is sent to slaughter, a bull calf's life span is between 3 weeks and 18 months. If it is slaughtered within 3 weeks of birth, it is called bob veal. Bull calves may be sold and raised on milk replacer for about 16 weeks and marketed as milk fed veal. Frequently male dairy calves are castrated and sent to a calf raising operation. Once castrated these calves are called steers and will eventually be sent to a feedlot for 'finishing' where they are raised until about 18 months of age on a diet of mostly grain. The grain diet increases the fat content of the meat to produce the tender, marbled beef desired by consumers. Rarely, bull calves will be retained on the dairy as replacement breeding bulls.

Life Cycle of Veal Calf

The veal industry is very closely tied to the dairy industry. Veal calves are defined differently by the United States Department of Agriculture, with a focus on meat production, and the Food and Drug Administration, with a focus on drug metabolism. For production purposes, the USDA –Food Safety and Inspection Service defines different classes of veal calves by using age and weight at slaughter. In general, the USDA defines a calf as being no more than 750 pounds live weight. Bob veal calves are those calves slaughtered at three weeks of age or younger. Formula-fed, milk-fed, or special-fed veal are calves raised to about 16 to 18 weeks of age on an all liquid diet. The majority of veal marketed in the U.S. is formula-fed. Non-formula fed veal are calves that have been weaned from milk-replacer at about two months of age and have transitioned to a solid food diet of hay and/or grain. Non-formula fed veal will be marketed at up to 700 pounds. This class represents a very small fraction of the total veal marketed in the U.S.

Jeff Hall, UC Davis WIFSS

The FDA defines veal calves as immature cattle (either dairy or beef) intended for meat production that lack a functional rumen; such animals are considered to be pre-ruminating. The anatomical differences between mature cattle and pre-ruminant calves results in large differences in the way that drugs are metabolized and excreted. The growth and maturation of the rumen is a process that occurs as a calf begins to consume solid feed (typically alfalfa hay and a grain mix commonly called calf 'starter'). A calf will have developed a fully functioning rumen by the time its diet is completely solid feed. Thus, when a calf is allowed to develop naturally through weaning and the introduction of solid feed is started at a young age, the rumen will develop normally, and the calf's ability to metabolize and excrete drugs will change to that of a ruminating animal. In contrast, bob veal and formula-fed veal calves that are fed an all-liquid diet without the addition of any solid feed, do not develop a rumen and essentially remain as pre-ruminants. Suckling calves, which will be slaughtered later as mature animals, are a different class of calves than veal calves because their diet will eventually be transitioned to solid food and the rumen will develop normally as this transition occurs.

Most drugs have neither been tested nor approved for use in young calves, or calves that have not developed a mature, functional rumen. A particular veterinary drug label may emphasize this with warning text such as "A withdrawal period has not been established for this product in pre-ruminating calves. Do not use in calves to be processed for veal." An example where immature animals excrete drugs more slowly than more mature animals is when phenylbutazone, an analgesic approved for use in horses, is administered in an extralabel manner. It can take a one-day-old calf four times longer to clear this drug from its system compared to a six month old calf.

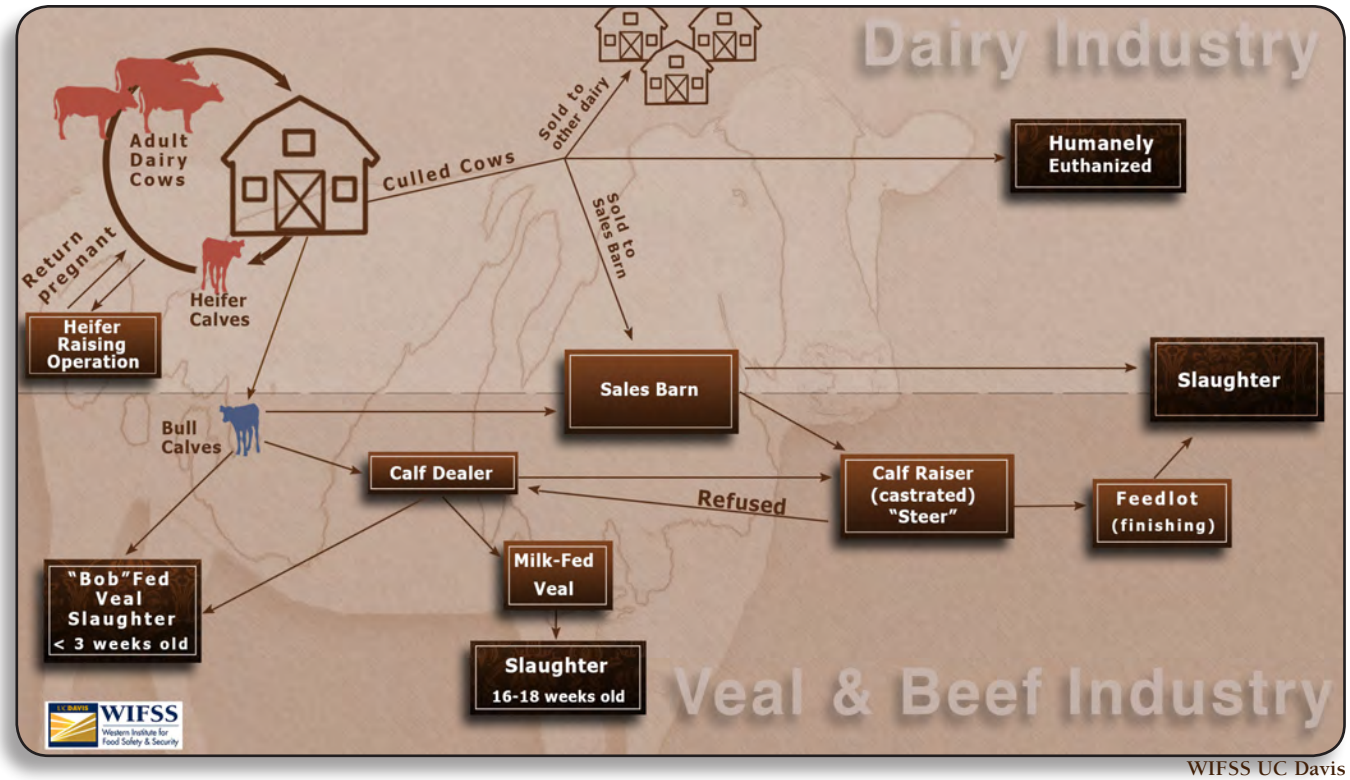
Veal Operations

The majority of veal operations currently use individual veal crates to minimize calf-to-calf contact and disease. Because of lack of public acceptance of this practice, the industry is being driven to adopt the use of group housing for veal production. The industry goal is to have all U.S. veal operations transition to group housing by 2018. Currently, about one third of veal operations in the U.S. house calves in groups. Most veal raising operations are located in the upper Midwestern parts of the U.S. in communities with a strong dairy industry. These operations are generally small family farms that house, on average, between 200 and 225 animals.

Movement of Calves Through Veal Industry

Although the majority of veal calves originate from dairy farms, marketing channels for these animals can be complex and varied (figure 2). A bull calf leaving a dairy can be sent directly to slaughter (as bob veal) or to an auction yard. From the auction yard this animal will be purchased by another operation in the veal or beef production chain. A bull calf is frequently purchased from the dairy by a middleman calf dealer. The calf dealer may resell the calf as either bob veal or formula-fed veal. Alternatively, the dealer may sell larger, healthier looking calves to a calf raising operation where the calves will be castrated and raised as steers for a number of months before being shipped to a feedlot for finishing on a predominantly grain diet. Feedlot steers are typically slaughtered between eighteen and twenty months of age, at between 1,200 and 1,400 pounds. With the variability and frequent changes in ownership, tracing historical animal ownership through records can be extremely challenging.

Figure 2 - Movement of Cattle in the Dairy and Beef Industry



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Acknowledgments

Authors and Contributors:

Mike Payne, DVM, PhD
John Angelos, MS, DVM, PhD, DACVIM

Editors:

Amanda Arens, DVM, MPVM, PhD
Juanita Humphrey
Heather Johnson, MS

Publication Design

Amanda Arens, DVM, MPVM, PhD
Jeff Hall

Graphic Design

Jeff Hall

References:

Code of Federal Regulations (CFR) Title 21 Part 530: Extralabel drug use in animals.

Compliance Policy Guide (CPG) Sec. 615.200. Proper Drug Use and Residue Avoidance by Non-Veterinarians.

Dairy Cattle Identification Practices in the United States, 2007. Info Sheet. United States Department of Agriculture; Animal and Plant Health Inspection Service; Centers for Epidemiology and Animal Health; Veterinary Services. November 2007.

Facility Characteristics and Cow Comfort on U.S. Dairy Operations, 2007; United States Department of Agriculture; Animal and Plant Health Inspection Service; Veterinary Services; National Animal Health Monitoring System; December 2010

Food Animal Residue Avoidance Databank: http://www.farad.org/regulatory/useclass_cattle.asp

A guide to colostrum and colostrum management for dairy calves.
http://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/bamn/BAMN01_Colostrum.pdf

Guidance for Industry #191. Changes to Approved NADAs — New NADAs vs. Category II Supplemental NADAs. U.S. Department of Health and Human Services. Food and Drug Administration. Center for Veterinary Medicine. November 19, 2009.

Reinemann, DJ. Milking Parlor Types. University of Wisconsin-Madison Milking Research and Instruction Lab. December 2003.

Beef Cattle Production

Introduction

Modern domestic cattle evolved from a single early ancestor, the aurochs, and remains of domesticated cattle dating to 6,500 B.C. have been found in Turkey and other sites in the Near East. Domestication of cattle followed sheep, goats, pigs, and dogs. Early cattle were multi-purpose, providing meat, milk, and labor to their owners. Currently in the U.S., cattle are selected more for the single purpose of meat production, or in some cases, production of milk as well.

The Beef Cattle Industry is not a single entity. In contrast to other intensive animal agriculture systems, very little vertical integration exists in the beef cattle industry. As a result, each phase of production is operated by different individuals. Throughout the country, beef cattle are raised under a tremendous variety of different management inputs, environmental settings, and production intensities.

Bruce Hoar, UC Davis WIFSS

Cattle Terminology

A variety of terms are commonly used in the beef industry. Having a functional knowledge of these terms is important when communicating with beef cattle producers.

Backgrounder Operation (also referred to as a 'stocker' or 'grower'operation) A type of beef cattle rearing operation in which weaned younger/lighter weight steer calves and weaned heifer calves that are not being kept as future breeding cows are raised to about 12 to 16 months of age while grazing on inexpensive feed sources such as grass or other forages. Animals develop lean muscle mass and increased body frame/size prior to entering a feedlot while on these operations.

Bull An intact, sexually mature male bovine that is intended for breeding purposes.

Beef cattle Cattle that are intended for meat production.

Calf A young bovine, either male or female, up to one year of age.

Cattle Fed in Confinement for Slaughter One of the use classes for beef cattle defined by the FDA; it refers to beef and dairy breed cattle that are confined in group pens and fed a high-energy diet until the time of slaughter.

Cow-calf Operation A type of beef cattle operation with the purpose to produce calves that will become either future breeding cows or breeding bulls, or calves that will be raised for meat production. The goal of a cow-calf operation is to have each cow produce and raise one calf per year.

Culling Removal of an animal from a herd usually for health or production reasons.

Cattle Grazing in Backgrounder Operation

Jeff Vanuga, NRCS

Cow Calf Operation

Jeff Vanuga, NRCS

Fed Cattle Steers and heifers that have been fed concentrates while on a feedlot.

Feeders Weaned calves grazing pasture that have reached sufficient weight and maturity to go to a feedlot to be placed on a high energy ration for finishing; they are generally older, weigh more, and carry more condition (finish) than stocker cattle ('stockers'). Feeders are categorized within the FDA beef cattle use class definition of 'Growing Cattle on Pasture or in Dry Lot'.

Feedlot (or Finishing) Operation A confinement production operation in which beef cattle (or dairy cattle that are being raised for beef production) are raised to market (slaughter) weight while being fed high concentrate diets on a feedlot (or 'feedyard'). Feedlots range in size from less than 100-head capacity to many thousands. While at a feedlot, cattle are grouped into pens where they can socialize and exercise. The period of time that cattle are on a feedlot is referred to as the "finishing phase." The diets fed to cattle on feedlots are usually a cereal grain, commonly corn, wheat, or barley, and cereal grain by-products such as distillers' grains. Cattle (heifers or steers in feedlots) typically remain on a feedlot from 90 to 180 days before being sent to a processing facility at 18 to 22 months of age. At which point the cattle will have reached 'market weight' and weigh approximately 1200 to 1400 lbs (545 to 637 kg).

Feedlot or Finishing Operation

Jeff Vanuga, NRCS

Finishing Period The final feeding stage of cattle on a feedlot prior to animals reaching market weight.

First-calf Heifer After giving birth to its first calf, a replacement beef heifer may be referred to as a first-calf heifer.

Grass-Fed/Grass-Fnished Beef Beef that comes from cattle that have been raised primarily on pasture forages; also refers to cattle that are fed pasture forage as opposed to cattle that are raised on a feedlot being fed high concentrate diets.

Grass Finished Beef

Kate Jewell, Creative Commons

Grower Operation (also referred to as a 'stocker' or 'backgrounder'operation) A type of beef cattle rearing operation in which weaned younger/ lighter weight steer calves and weaned heifer calves that are not being kept as future breeding cows are raised to about 12 to 16 months of age while grazing on inexpensive feed sources such as grass or other forages. During this time animals develop lean muscle mass and increased body frame/size prior to entering a feedlot.

Growing Cattle on Pasture or in Dry Lot (includes 'stockers' and 'feeders') – An FDA beef cattle use-class definition that refers to weaned beef or dairy breed cattle that are maintained on pasture or in a dry lot, receiving the majority of their diet from forage.

Heifer A female bovine from the time of weaning until the time of first calving.

Lactating Beef Cows An FDA beef cattle use-class definition that refers to lactating beef breed female cattle that are nursing calves intended for meat production. Milk from lactating beef cows is NOT intended for human consumption.

Market Weight The weight at which an animal is harvested for meat production. For beef cattle raised on a feedlot operation, market weight is typically reached at 18-22 months of age at 1200 to 1400 lb (545 to 637 kg).

Non-Lactating Beef Cows An FDA beef cattle use-class definition for female beef cattle that had previously nursed calves, but which are NOT currently producing milk.

Pre-Ruminant An animal with a rumen that is not yet anatomically or functionally mature.

Purebred Cattle Cattle whose ancestors over many generations are derived from a recognized breed.

Lactating Beef Cow and Calf

Lynn Betts, NRCS

Purebred Charolais Bull

Robert Scarth

Replacement Beef Bulls An FDA beef cattle use class definition that refers to intact male beef breed cattle intended for reproductive purposes.

Replacement Beef Heifer An FDA beef cattle use class definition that refers to female cattle that are intended for reproduction to produce calves intended for meat production. The term 'heifer' specifically refers to a female bovine from the time of weaning until the time of first calving.

Rumen The largest compartment of the forestomach in a mature ruminant animal and the site of microbial fermentation that is required to produce useable nutrients from consumed feed materials that would otherwise be indigestible. The rumen is anatomically joined to the reticulum to form a 'reticulorumen' that precedes the next two compartments (omasum and abomasum (the true stomach of a ruminant)). The abomasum corresponds to the stomach of a human being.

Seedstock Operation A type of beef cattle operation whose goal is to produce purebred cattle for the purpose of genetically improving a particular breed. Such herds are usually small, and produce bulls and replacement females for sale to cow-calf producers.

Slaughter Cattle An FDA beef cattle use class definition that refers to cattle grazing on pasture and suitable for slaughter.

Steer A castrated bovine male.

Stockers Weaned cattle of either beef or dairy breeds that are maintained on pasture or a dry lot and receive the majority of their diet from forage prior to entering a feedlot. Stockers are usually younger, weigh less, and are of lower condition (finish) than 'feeders'. Stockers are typically sent to a feedlot at 12 to 16 months of age. Stockers are categorized within the FDA beef cattle use class definition of 'Growing Cattle on Pasture or in Dry Lot'.

Slaughter Cattle

Bob Nichols, NRCS

Stocker Operation (also referred to as a 'backgrounder' or 'grower'operation) - A type of beef cattle rearing operation in which weaned younger/lighter weight steer (castrated male) calves and weaned heifer calves that are not being kept as future breeding cows are raised to about 12 to 16 months of age while grazing on inexpensive feed sources such as grass or other forages. During this time animals develop lean muscle mass and increased body frame/size prior to entering a feedlot.

Suckling Calves An FDA beef cattle use class definition that refers to immature, pre-ruminant cattle (including dairy breeds intended for meat production), maintained with and dependent upon their dam for nourishment. Veal calves are NOT considered suckling calves.

Veal Calves An FDA beef cattle use class definition that refers to immature cattle, including beef and dairy breeds, that lack a functional rumen and that are intended for meat production. Veal calves are recognized as a distinct regulatory class from suckling calves because of their handling, housing, and proximity to slaughter.

Weaned Cattle An FDA beef cattle use class definition that refers to beef or dairy breed cattle that are maintained on pasture and receive the majority of their diet from grazing on pasture.

Weaning The process of transitioning a calf away from a diet containing milk or milk replacer to an all solid feed diet or ration. Most beef calves are weaned from their dams at 6 to 10 months of age weighing 450 to 700 pounds.

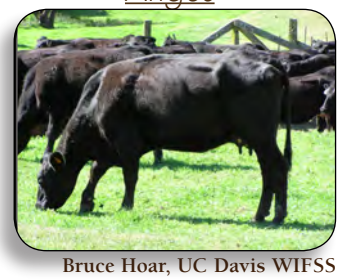
Beef Calf

Gary Kramer, NRCS

Beef Cattle Breeds

At least 250 breeds of beef cattle are recognized worldwide. Despite this high number of breeds, beef cattle are broadly classified as to whether they are descendants of two early lineages: European cattle (the so-called "Taurine" cattle derived from Eurasian subspecies) or zebu cattle (characterized by a humped back and prominent dewlap (fold of skin at the lower neck and between the front legs)) derived from Indian subspecies that are known for having heat tolerance. Cross breeding of cattle is used extensively to provide hybrid vigor in the offspring and to improve growth rate, reproductive efficiency, and certain carcass/meat characteristics. Over 60 beef cattle breeds can be found in the United States; six common breeds are described below:

Angus



Bruce Hoar, UC Davis WIFSS

The most predominant breed in the United States and first imported to the U.S. from Scotland around 1878. This breed is very popular, as it is adaptable to a variety of conditions, and is born without horns (also known as "polled"). Both Black and Red Angus are common.

Brahman

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A breed of zebu cattle, imported from India, and noted for their extreme tolerance to heat and resistance to insects.

Charolais

Adrian Michaels, Wikimedia

This breed is typically white and was introduced to the U.S. from France in the 1940's.

Hereford

Sarah Smith, Creative Commons

Classically appear as red-coated with a white face. Both horned and polled varieties are found in the U.S. This breed originated from southern England.

Limousin

Kate Jewel, Creative Commons

Another French breed of beef cattle, and noted for having lean, tender meat.

Santa Gertrudis

C. Goodwin, Wikimedia

This breed was developed on the King Ranch in southern Texas and is a result of breeding Brahman bulls with Beef Shorthorn cows. They are very adaptable to harsh climates.

Production System and Life Cycle

The beef production systems can be divided into 4 types of operations: cow-calf, backgrounder (also called 'stocker' or 'grower'), feedlot, and seedstock.

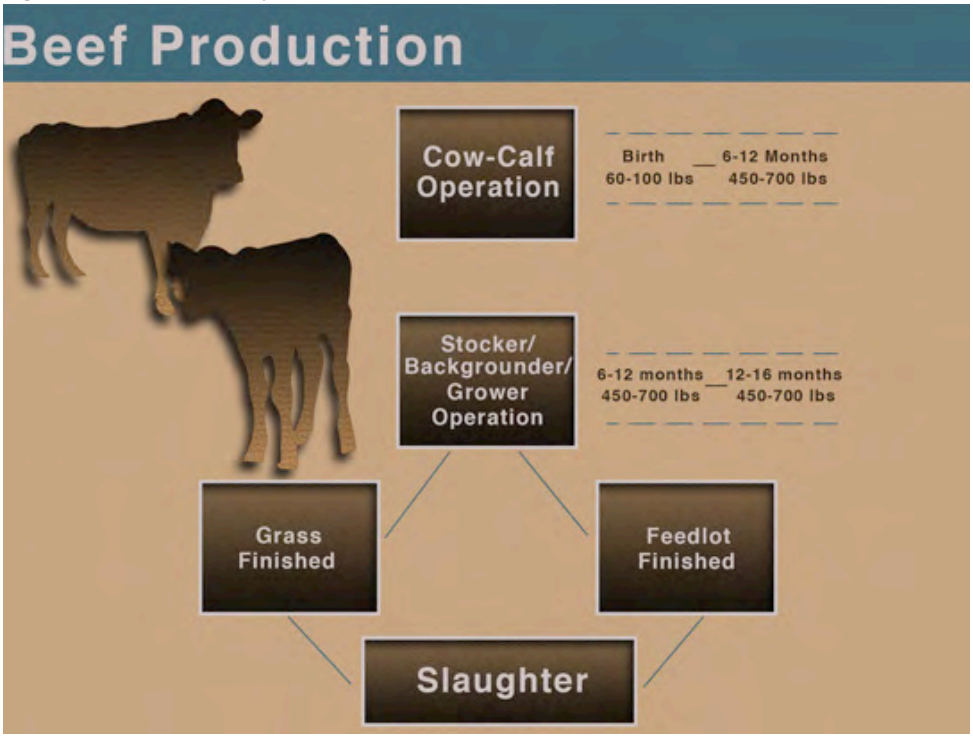
The life cycle starts on a cow-calf operation with the purpose to produce calves that will become either future breeding cows or breeding bulls, or calves that will be raised for meat production (Figure 1). The goal of a cow-calf operation is for each cow to produce and raise one calf per year. Most beef cattle herds rely on natural breeding, therefore a set of bulls are maintained for breeding purposes. The cows are bred during the breeding season and calves are born after about a nine month gestation period. Birth weight of calves are typically 60 to 100 pounds. The cow-calf phase runs from birth to weaning which usually occurs when the calf is approximately 6 to 10 months of age and weighs 450 to 700 pounds.

Cow Calf Operation

Gary Kramer, NRCS

At weaning, some female calves will remain in the herd as replacement heifers and will be bred at approximately 15 months of age to deliver their first calf at two years of age.

Figure 1. Beef Production Cycle



WIFSS UC Davis

Steer calves and most heifer calves not being kept as future breeding cows will leave the herd of origin between six and twelve months of age. Those calves that are younger/lighter weight are typically raised as 'stockers' and will enter stocker operations where they are raised to twelve to sixteen months of age. During this time, cattle are grazed on inexpensive feed sources such as grass or other forages and develop lean muscle mass while increasing body frame and size prior to entering a feedlot. Stocker operations exist on many different forage types in geographically diverse areas of the U.S. and include wheat fields of Oklahoma, grasses in the Flint Hills of Kansas, lush pastures of southern Florida, and corn stalks in Iowa. Changing weather patterns and market conditions (e.g., high corn prices) have major impacts on stocker operations.

Stockers

Scott Bauer NRCS

The final phase in beef production is the feedlot where cattle have a three to six month 'finishing period'. Feedlots can range in size from small farmer-feeders with 20 or fewer animals to large scale feedlots with a capacity of 100,000 or more animals. The purpose of a feedlot is to increase the animal's body weight and add fat (referred to as marbling) to edible tissues to provide consumers with a taste and texture they desire from beef. This is accomplished by feeding cattle high energy concentrated diets. Diets are typically based on a cereal grain, usually corn, wheat, or barley, and cereal grain by-products such as distillers' grains. Feeder cattle (heifers or steers in feedlots) will remain in feedlots anywhere from 90 to 180 days before being sent to a processing facility at 18 to 22 months of age. At this time cattle have reached 'market weight' weighing approximately 1,200 to 1,400 pounds.

Finishing on a feedlot

Jeff Vanuga NRCS

Of increasing popularity amongst U.S. consumers is beef that has been 'grass-finished' or 'grass-fed'. Producers of grass-fed beef raise their cattle on grass pasture until they reach market weight instead of sending cattle to a feedlot for final finishing. Because the energy densities of grasses are lower than cereal grains, it takes longer for grass-fed beef to reach market weight compared to cattle raised on a feedlot.

'Seedstock' operations represent a relatively small subset of the beef industry. These operations function to produce purebred cattle for the purpose of genetically improving a particular breed. Such herds are usually small, and produce bulls and replacement females for sale to cow-calf producers.

Feeding

Beef cattle, like other ruminants, possess a multi-compartment forestomach that allows otherwise indigestible fibrous plant material such as dry hay and corn stalks to be digested by bacteria and protozoa living in the forestomachs in such a way that such feeds are converted into useable nutrients for the animal. On cow-calf and stocker operations, profitability is dependent on availability of inexpensive feed sources, primarily pasture or other grazing land. Cattle can utilize feed of lower quality that would not be appropriate for consumption by non-ruminant animals such as pigs or chickens. Mineral and protein supplements are also provided to ensure that all the nutritional requirements of the cattle are met. During periods of the year when plant growth is not sufficient, additional feeds, such as grass or alfalfa hay, is provided.

Cattle Feeding

Jeff Vanuga, NRCS

On feedlot or finishing operations, cattle are housed in pens of usually between 100 to 125 other animals. High energy cereal grain-based diets are incorporated into the diet or 'ration' to allow for high growth rates of between 2.5 to 4 pounds per day. Such high growth rates are achieved by feeding diets that are 70 to 90% grain; these diets allow cattle to gain ~1 pound for each 6 pounds of feed that is consumed. Cattle are usually fed twice per day into feed bunks that allow sufficient space for all cattle to eat simultaneously. Constant access to water is provided usually via water troughs or through automatic watering bowls.

The FDA defines specific use classes for beef cattle as it does for dairy cattle. These use classes are defined based on the type of diet that the animal is consuming, as well as the intended function of the animal. 'Suckling calves' are immature, pre-ruminant cattle (including dairy breeds intended for meat production) that are maintained with and dependent upon their dam for nourishment. 'Veal calves' are recognized as a separate use class defined as immature beef and dairy breed cattle that lack a functional rumen and that are intended for meat production. Veal calves are recognized as a distinct regulatory class from suckling calves because of their handling, housing, and proximity to slaughter. 'Weaned cattle' are beef or dairy breed cattle that are maintained on pasture and receive the majority of their diet from grazing on pasture. 'Stockers' refers to weaned calves that are grazing pasture to enhance growth prior to finishing and slaughter; they are usually younger, weigh less, and are of lower condition (finish) than 'feeders.' The term 'feeders' refers to weaned calves grazing on pasture that have reached a sufficient weight and maturity such that they can be placed on high-energy rations for finishing. Feeder cattle are usually older, weigh more, and have more condition (or 'finish') compared to stockers. 'Slaughter cattle' refers to cattle that are grazing on pasture and that are suitable for slaughter. 'Replacement beef heifers' are female cattle that are intended for reproduction to produce calves intended for meat production.

Housing

The majority of cattle on cow-calf and stocker operations are raised outdoors. In inclement weather, some form of shelter such as barns, sheds, or windbreaks, and some form of bedding, will be provided for the cows and calves. Access to shade is necessary in climates with very high ambient temperature/ humidity. In arid climates sprinkler systems may be used in hot weather for cooling and dust control.

Large feedlots will confine cattle in pens to maximize feed intake and growth rates. Most pens will be outdoors, and therefore will have dirt floors, and bedding will be provided. Understandably, pen conditions can deteriorate significantly during times of inclement weather. The lots are usually paved if located in wet climates to minimize mud problems. Some feedlots will be located indoors, and will have slatted floors so that feces and urine can fall through and washed away.

Feedlot

Dr. Bruce Hoar, UC Davis WIFSS

Identification

Animal identification is an extremely important aspect of animal traceability when it comes to disease control or outbreak investigations. According to the January 2013 'Final Rule on Traceability for Livestock Moved Interstate' published by the USDA, cattle that are required to be officially identified for interstate movement must be identified by means of either: an official eartag; a brand registered with a recognized brand inspection authority and accompanied by an official brand inspection certificate, when agreed to by the shipping and receiving State or Tribal animal health authorities; tattoos and other identification methods acceptable to a breed association for registration purposes, accompanied by a breed registration certificate, when agreed to by the shipping and receiving

Ear Tag

Dr. Bruce Hoar, UC Davis WIFSS

State or/Tribal animal health authorities; or a group/lot identification when a group/lot identification number (GIN) may be used. A GIN is the identification number used to uniquely identify a "unit of animals" of the same species that is managed together as one group throughout the preharvest production chain. When a GIN is used, it is to be recorded on documents that accompany the animals moving interstate, however, it is not necessary to have the GIN attached to each animal.

Keeping track of which cows are healthy and profitable requires records and animal identification. Nearly two-thirds of beef cattle operations use some form of individual animal identification (ID) on at least some cows, and almost 80% percent of cows have some form of individual ID. Plastic ear tags are the most common single type of individual cow ID for operations and individual cows. Other forms of ID include Brucellosis tag, hot-iron brand, ear tattoo, ear notch, freeze brand, and electronic ID or microchips.

Culling (removal from a herd)

Cattle may be removed from a herd for a variety of reasons including health or production problems, infertility, and economic reasons (drought, herd reduction, market condtions).

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Authors and Contributors:

Bruce Hoar, DVM, MPVM, PhD
John Angelos, DVM

Editors:

Amanda Arens, DVM, MPVM, PhD
Juanita Humphrey

Publication Design

Amanda Arens, DVM, MPVM, PhD
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Graphic Design

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References:

Beef 2007-2008; Part I: Reference of beef cow-calf management practices in the United States, 2007-08. United States Department of Agriculture; Animal and Plant Health Inspection Service; Veterinary Services; National Animal Health Monitoring System

FACT SHEET: Feedlot Finishing Cattle. Accessed July 22, 2014. http://www.beefusa.org/uDocs/Feedlot%20finishing%20fact%20sheet%20FINAL_4%2026%2006.pdf.

Greiner, SP. Beef Cattle Breeds and Biological Types. Virginia Cooperative Extension. Publication

Final Rule: Traceability for Livestock Moved Interstate; Accessed July 22, 2014. http://www.aphis.usda.gov/newsroom/2012/12/pdf/traceability_final_rule.pdf

Food Animal Residue Avoidance Databank. Accessed July 22, 2014. http://www.farad.org/regulatory/useclass_cattle.asp

Modern Beef Production Fact Sheet. Cattlemen's Beef Board and National Cattlemen's Beef Association. Updated 9/2009. Accessed July 21, 2014. http://www.explorebeef.org/

Cattle Diseases, Treatments & Tissue Residues

Introduction

Whether young or adult, cattle can be adversely affected by disease leading to decreased production. The diseases of young cattle (dairy or beef) primarily include calf diarrhea and respiratory disease whereas adult dairy cows and beef cattle mostly have problems associated with milk production, reproductive disorders, or lameness.

Calves and Young Cattle

Scours (Calves) Calf diarrhea, or scours, is a very common problem in young cattle. Diarrhea is defined as excessive and frequent passage of watery feces. In severe cases, diarrhea can result in animal debilitation from dehydration and electrolyte losses and may result in death if it is not recognized quickly and treated appropriately. In calves this disease is commonly associated with infection of the gastrointestinal (GI) tract by bacterial, viral, or protozoal agents; however, dietary (nutritional) changes can also result in diarrhea caused by inappropriate feed or feed mixtures for the age of the calf, or even sudden changes in the type of feed. Nearly 25 percent of calves on a given farm may be affected each year, and in severe cases where the disease is not recognized and treated in time, a significant number of deaths may occur.

Calf with Diarrhea

Dr. John Angelos, UC Davis WIFSS

Multiple factors can contribute to a calf developing scours and in many cases more than one of these factors will play a role in the development of the condition. One common factor is inadequate feeding of colostrum following birth. Colostrum is an important source of immunoglobulins (antibodies) that not only act locally in the gut to bind ingested pathogens but also are absorbed into the calf's bloodstream to provide the calf with a ready source of antibodies that are needed to combat infections. Colostrum must be received by the newborn within 24 hours of birth in order to be absorbed systemically. Without this important immune support, calves are much more susceptible to disease, more likely to develop disease, and as a result, much more likely to receive drugs as a form of treatment for disease. Exposure to high concentrations of GI pathogens in the calf's environment is another contributing factor to the development

Feeding Colostrum to a Calf

Dr. Munashe Chigerwe, UC Davis School of Veterinary Medicine

of diarrhea. Virtually every calf is exposed to one or more disease causing agents at some point during early life and mixed infections are common. Diarrheal pathogens can rapidly spread between calves and result in outbreaks of diarrhea.

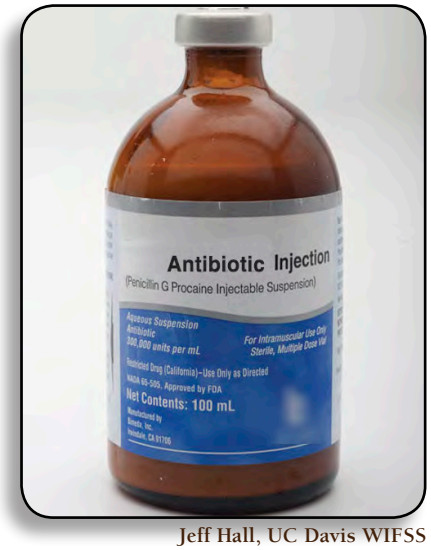
Bull calves tend to be at greater risk for developing scours than heifer calves because they generally have a lower economic value and may not receive an adequate amount of colostrum immediately following birth. Because most bull calves do not remain in a herd, they are also more likely to be sold multiple times over a short period of time during early life. Such frequent changes of ownership and location, as well as commingling of animals, can put these young, and potentially immunocompromised, calves at a higher risk of exposure to a wide range of infectious agents.

Dr. John Angelos, UC Davis WIFSS

Scours is the most important condition affecting young calves in the dairy industry. Producers are motivated to prevent and treat scours, especially in their valuable heifer calves, as these animals represent the future milk cows that will remain in the herd. Producers count on a supply of healthy heifers every year to replace the dairy cows that will be culled from the herd. According to the National Animal Health Monitoring System, it is common for a significant number of all unweaned heifer calves to be diagnosed with scours, and most of these will be treated with an antibiotic.

Treatment of Scours

When producers treat calf scours, their focus is on replacing the fluids and electrolytes that were lost from the calf's body. Replacement fluids can be delivered by a number of routes, including oral, intravenous, and subcutaneous. Some producers may also administer anti-inflammatory and antipyretic (to treat fever) drugs in addition to fluids. The thought is that reducing fever and inflammation can assist in the healing process.



Jeff Hall, UC Davis WIFSS

Although some of the causative diarrheal agents are not susceptible to antibiotics, most calves with diarrhea will be treated with antibiotics to prevent secondary complications such as septicemia (bacterial infection in the blood) as well as to treat a primary GI infection in the event that the diarrhea is bacterial and is susceptible to an antibiotic. Producers use a variety of antibiotics, delivered by a variety of methods when treating scours. Common antibiotics used for treatment of scours include oxytetracycline, chlortetracycline,

neomycin, and sulfamethazine. Antibiotics can be given either parenterally (by injection), orally (via bolus in the mouth), via medicated milk replacer or by adding it to the water, as long as the manufacturer's instructions printed on the label are followed. Extralabel drug use in feed, including milk and milk replacers, is strictly prohibited.

It is important to know that some infectious causes of diarrhea in calves are zoonotic diseases and can infect people. Whenever working around calves, sick or healthy, it is always a good idea to wear disposable gloves to reduce exposure to possible zoonotic pathogens.

Respiratory Disease

Pneumonia, an inflammation of the lungs can occur in cattle of any age, but the disease is particularly prevalent in housed calves, weaned calves and feedlot cattle. In broad terms, the pneumonias in these groups of animals are classified as 'bronchopneumonias' because the infectious agents that typically cause lung diseases in these age groups gain entry to the body through the airway. In housed dairy calves bronchopneumonia is often referred to as 'enzootic' pneumonia and in feedlot cattle it is called 'shipping fever' because the disease is often associated with recent shipment to a feedlot. These diseases are often also referred to as 'BRD' (bovine respiratory disease) and drug manufacturers will commonly refer to BRD on a list of indications for use of a drug on a manufacturer's drug label.

Yearling Beef Cattle in Sale Yard

Wikimedia Commons

Bacterial and viral agents are both important causes of bronchopneumonias in cattle. In many cases a primary viral infection that involves the airway can also then lead to a secondary bacterial infection of the airway. Common bacterial causes of pneumonia in cattle include *Mannheimia haemolytica (M. haemolytica), Pasteurella multocida (P. multocida), Histophilus somni (H. somni), and Mycoplasma bovis (M. bovis)*. Recently weaned calves or cattle sent to a feedlot are at greater risk for developing pneumonia as a result of multiple factors that include dietary changes, transport to a different location, commingling of new animals, and exposure to new pathogens. Such changes can result in stress in an animal that may also lead to immunocompromise and an increased susceptibility to bacterial/viral infections that cause pneumonia. In severe cases of pneumonia the lungs can become congested and consolidated making breathing and air exchange very difficult for the calf. Some of the early clinical signs of pneumonia in cattle include lack of appetite, depression, a stiff gait and a rough, ungroomed hair coat. Body temperatures can also become elevated. Later in the course of disease an increased respiratory rate with nose or eye discharge and cough are commonly observed.

Regardless of the agent causing the disease, most cattle that develop pneumonia are treated with antibiotics. Common choices for antibiotic treatment of BRD include but are not limited to florfenicol, enrofloxacin, ceftiofur, oxytetracycline, tilmicosin and tulathromycin. These are examples of products labeled for treatment of BRD associated with *Mannheimia haemolytica, Pasteurella multocida*, and/or *Histophilus somni*, and when used appropriately, are quite effective. If the pneumonia is caused by a bacterial infection, antibiotics will help to clear the infection in the lungs. If the pneumonia is viral in nature, antibiotics may help to protect the animal from other secondary bacterial infections that may develop during recovery. Often a nonsteroidal anti-inflammatory drug such as flunixin meglumine is also administered because it can act as an antipyretic (fever reducer). Also, providing a warm, dry environment, making sure that nutritional needs are met, and preventing other illnesses from developing will help support healing and recovery.

Jeff Hall, UC Davis WIFSS

Despite treatment, there are instances when the producer will decide that selling the animal is the best economical option. For instance, a calf with severely affected lungs may never recover completely, and her growth and potential for milk production may be reduced. In these cases, the calf may be sent to slaughter early. If producers do not administer drugs according to manufacturer label directions and then do not keep accurate treatment records to ensure that appropriate drug withdrawal periods are observed prior to sending an animal to slaughter, illegal tissue residues may be detected at slaughter.


Dairy Management Inc.

Adult Cattle

Mastitis

Mastitis is inflammation of one or more quarters of a cow's mammary gland. Mastitis most commonly occurs as a result of bacterial infection of the udder that is caused when bacteria gain entry to the mammary gland through the end of the cow's teat. Although all types of cattle are at risk of developing mastitis, the disease is mainly a concern for the dairy industry because of the direct impact on the quality and safety of milk products sold for human consumption. Treatment for mastitis most commonly involves the use of antibiotics because such treatment can reduce the duration, severity and reoccurrence of the illness. While different antibiotics are administered by different routes such as intravenously, subcutaneously, or intramuscularly, the most frequently used route of antibiotic administration for mastitis is infusion into the gland through the teat end. This method of treatment is called intra-mammary infusion. Antibiotic treatments by any route of administration can result in residues in meat or milk if drugs are not used in accordance with approved label directions or extralabel use requirements under 21 CFR 530.

Inflammed Udder in a Cow with Mastitis

Dr. John Angelos, UC Davis WIFSS

Antibiotics administered through the udder can become absorbed into the bloodstream and circulate throughout the cow's body. Different drugs are metabolized differently and may be stored in different organs or tissues before being completely eliminated from the body. If a cow is slaughtered before the drug residues have been metabolized and excreted, drug residues may be present in tissues. Thus, intra-mammary infusion of antibiotics may lead to drug residues not only in milk, but also other edible tissues. For this reason, approved mastitis antibiotic preparations will have both a milk discard time as well as a slaughter or meat withholding time (withdrawal period) listed on the manufacturer label.

Intra-Mammary Infusion

Jeff Hall, UC Davis WIFSS

While dairy farmers and employees usually remember to hold out the milk of treated cows from the bulk tank, they may forget that a cow treated for mastitis can have a longer slaughter withdrawal period that may be much longer than just the milk discard time. Cows that are sold and slaughtered prior to completion of that withdrawal period are at risk of having detectable tissue residues of antibiotics or other drugs.

Some dairy cows are given an intramammary infusion of antibiotics during the dry period between lactations as a way to help treat stubborn or sub-clinical infections. Antibiotics that are labelled for use during this dry period are called dry cow therapy or dry cow treatment and a cow is said to have been 'dry treated' if she received such treatment at the start of her dry period. Dry cow treatments may have higher antibiotic concentrations in contrast to lactating cow intra-mammary treatments that are designed to be given while the cow is still being milked during her lactation. Dry cow treatments are often also formulated with slow release vehicles such as peanut oil. Another big difference between lactating and dry cow therapies is that dry cow treatments typically have much longer withdrawal periods compared to lactating treatments. If a cow is culled during a dry period, there may be a risk for violative drug residues if that cow had been dry treated.

"Extralabel Drug Use" or ELDU is only permitted under the direction and supervision of a licensed veterinarian within the context of a valid veterinarian-client-patient relationship, who will provide a scientifically based extended withdrawal period. Treating mastitis in an extralabel manner can dramatically increase the risk of violative tissue residues. For instance, infusing a cow's udder with gentamicin, a drug approved for horses, can result in kidney residues for many months!

As is the case for treatment of diseases in all food producing species, if a cow treated for mastitis does not have adequate identification (such as ear tags, leg bands, or neck chains) and the producer does not have complete treatment records, the likelihood of violative tissue residues being detected at slaughter is dramatically increased.

Metritis

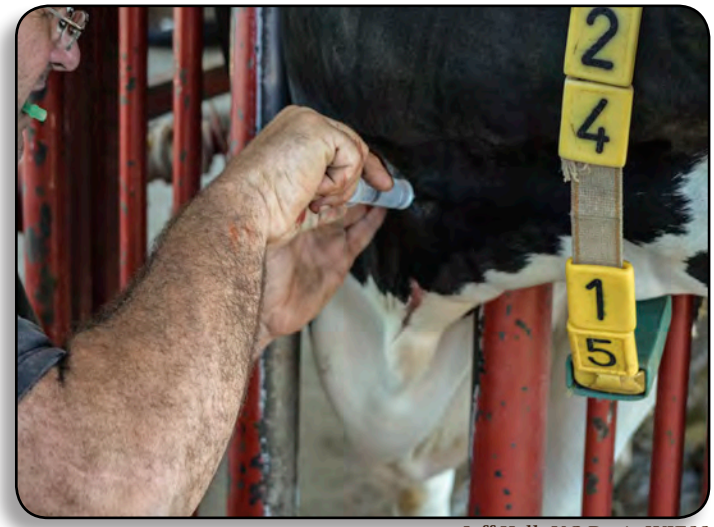
In general terms, metritis is an infection and inflammation of the uterus. While there are more specific definitions for the terms 'endometritis' versus 'metritis' depending of the layers of the uterine wall that are involved in the inflammatory process, the term 'metritis' is commonly used to represent both conditions. In cattle, metritis is often characterized by the presence of a foul-smelling, watery vaginal discharge plus a fever. The vaginal discharge originates from the infected uterus and is frequently associated with situations such as unsanitary calving facilities, difficult calvings that required producer or veterinary assistance to resolve, and retained placentas. 'Retained' placenta means the presence of placental tissue attached to the inside wall of the uterus for more than 12 hours after calving.

Cow with Metritis

Dr. John Angelos, UC Davis WIFSS

Although there are FDA approved parenterally (i.e., subcutaneous, intravenous, or intramuscular) administered antibiotics that are specifically labelled for treating metritis, producers will sometimes choose to administer an antibiotic that is approved for treatment of metritis by a parenteral route of administration directly into the uterus. An example is the administration of oxytetracycline (an antibiotic) placed or infused into the uterus. These are examples of extralabel drug use. Performing such extralabel treatment should only ever be done according to policies established by 21 CFR 530 in consultation with the attending herd veterinarian who can assist the producer in determining appropriate milk and meat withdrawal intervals.

Intravenous Drug Administration



Jeff Hall, UC Davis WIFSS

Antibiotics administered directly into the uterus can enter the bloodstream and circulate throughout the cow's body. Some of these drugs can be concentrated in the kidney, an organ that is commonly tested at the time of slaughter for the presence of drug residues. Proper animal identification and treatment records are necessary so that a producer does not forget that a cow has received intrauterine antibiotics and inadvertently send the animal to slaughter prior to the necessary slaughter withdrawal time.

Lameness

Lameness is a very common problem in dairy cows and ranks second only to mastitis in cow health problems.

Footrot One of the most common causes of lameness in both dairy and beef cattle is foot rot. Other names for foot rot are bovine interdigital phlegmon, acute interdigital necrobacillosis, and infectious pododermatitis.

Footrot is caused by a bacterial infection between the digits/claws and is extremely painful. When it is not recognized and treated appropriately, the infection can become deep-seated involving vital structures such as the joints of the digit. Treatment is aimed at controlling the infection and reducing inflammation/ pain with antibiotics and anti-inflammatory drugs.

A variety of different prescriptions as well as over-the-counter antibiotics can be effective against foot rot and include, but are not limited to, penicillin, oxytetracycline, florfenicol, and tulathromycin. Three prescription anti-inflammatory drugs are approved for use in cattle in the U.S.A.: dexamethasone, isoflupredone acetate, and flunixin meglumine (flunixin). Aspirin can also be used for inflammation and does not require a veterinarian's prescription. Flunixin belongs to the class of drugs known as non-steroidal anti-inflammatory drugs and is only approved for intravenous use. To help control foot rot on a dairy, foot baths containing disinfectants are routinely used in alleys that cows must walk through as they exit the milk parlor.

Lame Cow with Sore Right Front Leg

Dr. John Angelos,UC Davis WIFSS

Foot Rot Between Toes on Cow's Foot

Dr. John Angelos, UC Davis WIFSS

Hairy Foot Warts Hairy foot warts are another extremely painful condition that cause lameness in dairy cows. The lesion usually has wart-like hairy growths that arise from the skin surface or may be less wart-like and appear more red and raw. Thus, other names include hairy heel warts, strawberry heel warts, digital dermatitis, and papillomatous digital dermatitis. Cows with these growth can be extremely lame, however the skin growths may not look that severe.

It is believed that hairy foot warts are caused by a type of bacterium that thrives in wet conditions commonly found on dairies. Fortunately, the disease can be controlled through the application of topical antibiotics. Since hairy foot warts are easily transmitted between animals through use of common hoof trimming equipment the disease can be prevented by disinfecting hoof trimming equipment used on cases of suspected hairy heel warts and between dairies.

Hairy Foot Wart on Heel of Cow's Foot

Dr. Dusty Nagy, University of Missouri,

Subacute/Chronic Laminitis One of the most important causes of lameness in dairy cows is laminitis - inflammation of the laminae (the living part of the hoof wall that is responsible for growth of the hoof wall). The underlying cause of laminitis in dairy cattle is brought about by the dietary changes created during the transition from the pre-calving diet (the dry cow diet) to the post-calving diet that is more carbohydrate-rich.

The list of potential hoof problems that result from laminitis do not usually develop suddenly and so these problems are said to come about because of 'subacute' or 'chronic' laminitis. Some hoof problems that can result from laminitis in dairy cows include: sole hemorrhages, slipper feet, widened and flattened hooves with horizontal ridges that form fissures and full thickness wall breaks, softer-than-normal 'powdery' sole horn that is easily traumatized, sole abscesses, shallow heels, sole ulcers, white line 'disease', white line abscesses, and heel erosions. While some of these individual diseases are treated with antibiotics and anti-inflammatory drugs and managed with hoof trimming and supportive measures, the best prevention for laminitis is proper management of the cow's diet.

Sole Bruising and Abscess from Subclinical/Chronic Laminitis:

Dr. John Angelos, UC Davis WIFSS

Tissue Residues and Cattle

In all species and all classes of food animals, the principal cause of all violative residues is a failure to allow adequate time for livestock drugs to be metabolized and excreted. Common circumstances which can lead to an inadequate "withdrawal period" can be grouped into three general categories:

Inadequate animal identification and/or amimal treatment records It is important for farmers to have established control systems in order to avoid drug residues in meat and/or milk. Inadequate animal ID can lead to the wrong animal being marketed. Inadequate records can result in inadvertently sending treated animals to market earlier than the established withdrawal period or adding milk from a treated cow into the bulk tank.

Lynn Betts, NRCS

Failure to follow the label directions A rigorous drug approval process is a major safeguard that protects consumers of livestock products from drug residues. Part of that approval process includes an FDA-approved label. Drug labels include specific directions on how the drug should be used, the conditions for use, the route of administration, the slaughter withdrawal period and a milk discard time if appropriate.


Jeff Hall, UC Davis WIFSS

FDA definitions for veal calves and non-lactating cows become very important when following label directions. For example, if pre-ruminating veal calves are given colostrum or milk from a cow who was treated with drugs prior to calving, the calf may receive residues of drugs prescribed for ruminating cattle. This can lead to residues in the bob veal calf if sent to slaughter within three weeks of birth. This is an especially important consideration if colostrum/milk from treated cows is comingled and fed to all calves. Another example is that replacement heifers are considered to be "non-lactating dairy cattle" because they have not yet had a lactation, while adult dairy cows that have already had one lactation cycle, but that are in the dry period of their cycle, are classified as dry dairy cows and not as non-lactating dairy cattle. The withdrawal period may be different between these two cow classifications.

An important difference between dry and lactating therapy is the duration of time following drug administration that a dairy producer must wait before the milk from that cow is allowed to be sold for human consumption. This period of time is very prolonged for dry cow therapies and typically extends past the initial milkings of colostrum following calving. Failure to follow the directions for dry and lactating therapy witholding times could lead to residues in the milk.

Failure to follow requirements for extralabel use When drug use deviates from explicit label directions, the time that the drug persists in the tissues and milk can also change. There are legitimate reasons for deviations from label directions by a veterinarian. This practice is called "Extralabel Drug Use" or ELDU. Because of the risk for violative drug residues, on-label treatment should always be the producer's first choice. Extralabel treatment should be a treatment of last resort and only done under the supervision of a veterinarian in accordance with 21 CFR 530. Under 21 CFR 530 ELDU requires there to be a valid Veterinarian-Client-Patient Relationship and extended veterinarian-provided withdrawal periods based on scientific evidence. According to 21 CFR 530.12, the veterinarian must provide an ELDU label for the drug being used that includes the class/species identification of the animal(s) being treated; dosage; frequency; route of administration; duration of therapy; the extended meat withdrawal period and the extended milk discard time based on scientific evidence. When the ELDU directions provided by a veterinarian are not followed, a violative residue may occur in milk or meat.

In cases where drugs are being used in an extralabel manner, veterinarians are also required to keep specific records in accordance with 21 CFR 530.5. The records must include:

1. The established name of the drug and its active ingredient, or if formulated from more than one ingredient, the established name of each ingredient;
2. The condition treated;
3. The species of the treated animal(s);
4. The dosage administered;
5. The duration of treatment;
6. The numbers of animals treated; and
7. The specified withdrawal, withholding, or discard time(s), if applicable, for meat, milk, eggs, or any food which might be derived from any food animals treated.

A veterinarian must keep all required records for two years or as otherwise required by Federal or State law, whichever is greater. Also, any person who is in charge, control, or custody of such records shall, upon request of a person designated by FDA, permit such person designated by FDA to, at all reasonable times, have access to, permit copying, and verify such records.

Acknowledgements

Authors and Contributors:

Bruce Hoar, DVM, MPVM, PhD
John Angelos, MS, DVM, PhD, DACVIM

Editors:

Amanda Arens, DVM, MPVM, PhD
Juanita Humphrey

Publication Design

Amanda Arens, DVM, MPVM, PhD
Jeff Hall

Graphic Design

Jeff Hall

References:

Beef 2007-2008; Part I: Reference of beef cow-calf management practices in the United States, 2007-08. United States Department of Agriculture; Animal and Plant Health Inspection Service; Veterinary Services; National Animal Health Monitoring System

Goats: Penn State Extension. Accessed May 18, 2014.
http://extension.psu.edu/animals/goats

FACT SHEET: Feedlot Finishing Cattle. Accessed July 22, 2014.
http://www.beefusa.org/uDocs/Feedlot%20finishing%20fact%20sheet%20FINAL_4%2026%2006.pdf.

Oklahoma State University Breeds of Livestock: Goats. Accessed May 20, 2014
http://www.ansi.okstate.edu/breeds/goats/

Greiner, SP. Beef Cattle Breeds and Biological Types. Virginia Cooperative Extension. Publication

Final Rule: Traceability for Livestock Moved Interstate; Accessed July 22, 2014.
http://www.aphis.usda.gov/newsroom/2012/12/pdf/traceability_final_rule.pdf

Food Animal Residue Avoidance Databank. Accessed July 22, 2014.
http://www.farad.org/regulatory/useclass_cattle.asp

Modern Beef Production Fact Sheet. Cattlemen's Beef Board and National Cattlemen's Beef Association. Updated 9/2009. Accessed July 21, 2014.
http://www.explorebeef.org/

Dairy 2007. Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007. USDA. APHIS. Veterinary Services. National Animal Health Monitoring System. October 2007. http://www.aphis.usda.gov/animal_health/nahms/dairy/downloads/dairy07/Dairy07_dr_PartI.pdf

Swine Production

Introduction

Pork is the most widely consumed meat in the world. In the United States, approximately 50 pounds of pork are consumed per person per year. Pork production is an important component of American agriculture, with production concentrated in Corn Belt states (such as Nebraska, Iowa, Minnesota, Missouri, Indiana and Illinois) and North Carolina. Modern pork production is mostly done in enclosed buildings to protect animals from the weather, from predators, and from the spread of diseases. Over the past 50 years low prices have resulted in larger, more efficient operations with many smaller farms finding it hard to produce pigs profitably.

Amanda Slater

Wild boars domesticated in Northern Europe around 1500 B.C. mixed with smaller Asian species domesticated in China around 3000 B.C. are believed to be the ancestors of modern domesticated hogs. Hogs came to the Americas with Columbus on his second voyage in 1493, but may have also been brought to the Hawaiian Islands even earlier by Polynesians.

Swine Terminology

There are a number of terms that are unique to the swine industry and warrant definition here:

Sow with piglets

Wikimedia Commons

Barrow Castrated male pigs intended for slaughter. Usually castrations are performed at a very young age (a few days old).

Boar Intact, sexually mature, male pigs intended for breeding purposes. Boars are generally not intended for slaughter in the U.S.

Farrowing The process of giving birth to a litter of piglets.

Finishing Pigs Barrows and gilts from approximately 120 to 150 lbs (55 to 68 kg) to market weight for slaughter.

Gilts Female pigs intended for slaughter or breeding purposes that have not yet farrowed a litter.

Growing Pigs Barrows and gilts from approximately 50 to 60 lbs (23 to 27 kg) to 120 to 150 lb (55 to 68 kg).

Market Pigs Pigs that are marketed and slaughtered for pork production. Typically these pigs are slaughtered at 5.5 to 6 months of age at 200 to 300 lbs (91 to 135 kg).

Nursing Pigs Pigs from birth until weaning and still nursing.

Piglet A newborn pig until it is weaned from a diet of milk to an all solid-feed ration.

Replacement Gilt Breeding female pigs that have not yet farrowed a litter; usually weigh 220 to 300 lbs (100 to 135 kg).

Roaster Pigs Pigs of both sexes and any age marketed with the carcass unsplit and with the head intact.

Sow A female pig that has had at least one litter of piglets.

Stags Male pigs that are castrated at any age after reaching sexual maturity. Sexual maturity is reached at five to six months of age.

Starter or Nursery Pigs Boars, barrows, and gilts from approximately two to four weeks of age and approximately 50 to 60 lbs (23 to 27 kg)

Swine Breeds

More than 70 recognized or "official" breeds of pigs exist in the world. In the United States, most hogs bred for consumption are the combination of a dark breed boar bred to a white breed sow. Dark breed boars enhance the meat quality of their offspring, while white breed females are used for their ability to produce many piglets and have good maternal instincts. Some of the most common breeds are presented here.

Duroc

Wikimedia Commons

There is considerable color variation within the Duroc breed, ranging from a very light golden, to a very dark red that approaches mahogany. The ears should be droopy. Quick growth and maturity and heavy muscling make this a good breed for meat production.

Hampshire

Evelyn Simak

The Hampshire breed was developed in the United States and is now one of the world's most important breeds. Black with a white belt over the shoulders. Hampshires are a heavily muscled, lean meat breed that are regarded by many as the best terminal sire breed for all purposes.

Landrace

Wikimedia Commons

Landrace pigs are white in color with droopy ears. They are known for having and raising large litters of piglets. Landrace are known for their long body, high percentage of carcass weight in the ham and loin, and ideal amount of fat. Landrace are prolific mothers and are exceptionally heavy milkers.

Yorkshire

Kevin Noone

Yorkshire pigs are also white in color, but have erect ears. They are the most common breed of swine in the United States and Canada. This is a very durable and muscular breed with a high proportion of lean meat and low back fat.

For those interested in learning more about breeds of swine, visit http://www.thepigsite.com/info/swinebreeds/php where there are detailed descriptions of all breeds.

Swine Operations

Before the 1960's, most pork in the U.S. was raised in outside lots or on pasture systems. The development of slotted floors and liquid manure handling equipment, allowed producers to more easily care for large numbers of animals, and protect them from the weather in an enclosed building.

Indoor Confinement Operation

USGS

Almost all large swine operations now are total confinement operations, and these produce the majority of market hogs in the United States. The buildings have a controlled environment provided by fans for ventilation and heaters for warmth. Many of the buildings will have flexible curtains on the side walls that can be opened and closed to allow for natural ventilation. In this type of system, feed intake and animal health is more easily monitored. Also, there is reduced risk of disease since there is less contact with wildlife, and between different age groups of pigs.

Outdoor rearing systems generally require less capital input, however there is lower productivity in terms of product output when compared to a confinement system. Pigs are especially susceptible to heat stress, making it necessary to provide shade structures in warm climates if rearing pigs outdoors. Farrowing huts, bedded with straw, are often used for the gestation and farrowing phases in outdoor swine production systems.

Hoop-type buildings can be used for gestating and finishing pigs. These buildings have wooden or concrete sidewalls 3-4 feet high upon which are mounted hoops that support covers. The ends of the building are left open during warmer weather.

Outdoor Facility

Tim McCabe, USDA NRCS

Fans on Indoor Facility

Bob Nichols, NRCS

Hoop Type Building

Creative Commons

Feeding Swine

Swine are classified as having a monogastric digestive system, characterized by a simple, glandular stomach. Humans and carnivores are also monogastrics.

In swine diets a variety of feedstuffs such as corn, barley, milo, or oats are used to provide energy, while oilseed meals (primarily soybean meal) are the major source of protein. Vitamins and minerals are also added to the feed to optimize health and growth at each stage of life. The ration is normally changed to provide more energy and less protein as the pig grows. Pig rations are usually ground or partially ground prior to mixing.

Hogs Being Fed in Outdoor Pen

Lynn Betts, NRCS

Feed can be delivered to pigs by a variety of methods and the one chosen will depend on the type of housing, availability of labor, management preference, and feedstuffs being used. In automated delivery systems, feed is delivered to pigs via feed lines and drawn from a feed bin using an auger. This system requires a power source to get feed from the bin to the pen. Hand delivery is more labor intensive, and is usually used in outdoor rearing systems and farrowing rooms. With this method, workers monitor feed intake and delivery on an individual basis.

Identification

Ear notching is widely used in the swine industry, and involves removing V-shaped notches from the pig's ear that correspond to a specific litter number and also an individual pig number from that litter. Ear notching is used when the pig needs to be recognized separately from other pigs, such as breeding stock and exhibition animals.

Ear tags are often used in conjunction with ear notches in a breeding herd. These are typically plastic tags with numbers printed on them to identify individuals.

Slap tattoos (a temporary tattoo, usually on the shoulder of the animal) may be used when hogs are sent for slaughter. This allows the transporters and slaughter facilities to readily identify ownership of the shipment.

Ear Notch

Dr. John Angelos, UC Davis WIFSS

Record Keeping

Large confinement swine operations will utilize commercial computer software to keep track of sows and growing pig production. These software programs can generate a variety of reports that allow the manager to track individual, as well as group performance. Culling and feeding decisions are often based on performance records.

Smaller farms and outdoor swine producers will also maintain records. Written paper records are commonly observed in these situations. Breeding records and drug usage records are the information most commonly kept by producers.

Ear Tag for Record Keeping

Wikimedia Commons

Life Cycle of a Pig from Birth to Death

Over 100,000,000 swine are slaughtered annually in the United States, with the vast majority being market hogs. About 3% of the total number of pigs slaughtered consist of other classes, including roaster pigs, boars, and sows.

AIAO Indoor Swine Facility

In large, integrated hog farms, a group of pigs will move together through the system from birth to slaughter. That is, a group of sows will farrow at the same time, the piglets will be weaned at the same time, and those pigs will then move through the nursery and finishing units together. This "all-in, all-out" (AIAO) approach helps maximize production and limits disease transmission. Each room or building is completely emptied and sanitized between groups of pigs, therefore new groups of pigs enter freshly disinfected environments. The facility has a separate room or building for each group of pigs weaned. AIAO animals in each room are of a uniform age and size, and are isolated to the extent possible, to decrease the possibility of diseases spreading from older animal groups to younger ones.

Swine production is generally classified into four production phases (on large farms, each phase occurs in a separate barn, and often a separate physical location):

Breeding/Gestation Historically, sows have been bred by placing a number of sows in a pen with one or more boars. Now, boars are often rotated between sow pens to make sure that all sows are bred while they are in heat. Sows come into estrous three to five days after their piglets are weaned, and are bred at this time. If the sow is not bred, she will return to estrous about 21 days later. After breeding, the sow has a gestation period of about 115 days (three months, three weeks, and three days). The goal of most pork producers is to have, on average, greater than two litters per sow per year

Sow and Her Piglets in a Farrowing Pen

Keith Weller, USDA ARS

Farrowing Just prior to farrowing, pregnant animals are moved to individual pens or stalls in the farrowing barn. Sows typically farrow from eight to twelve piglets, which as a group are called a litter. Most confinement operations place the sow in a farrowing pen or crate which restricts her movement to protect her baby pigs. Farrowing and lactation occur in the same facilities until the baby pigs are weaned. An average sow will raise three to five litters of pigs in her lifetime.

Pigs are born with sharp teeth and curly tails. The tips of the teeth are clipped at birth to prevent injury to the sows udder and other piglets, and the tail is shortened to prevent tail biting. Piglets are weaned anywhere from five days to four weeks, with most operations weaning at two to three weeks.

Nursery Weaned pigs are moved to either a nursery facility or a wean-to-finish building. In either case, both weaned types of facilities may be on a separate site from the farrowing facility. In confinement barns, the floors will be constructed from plastic or plastic covered steel, with slots to allow manure to fall through. The temperature is closely controlled, as pigs can suffer from heat and cold stress. Pigs are normally removed from the nursery at about six to ten weeks of age and placed in the finishing building.

Weaned Pigs in a Nursery

Wikipedia

Grow-Finishing Pigs are fed in the grow-finishing facility until they reach market weight of 250 to 275 pounds. The grower stage takes starter pigs from about 35 to 60 pounds to 120 to 150 pounds body weight while the finishing stage takes pigs from about 120 to 150 pounds up to 230 to 270 pounds body weight. During these stages pigs are fed specialized diets to maximize growth and achieve a target of 230 pounds body weight by 175 days of age. Marketing typically occurs at five to six months of age. At this time, gilts may be selected to become replacement sows and be moved to a breeding/gestation facility. The remainder of the market weight pigs are sent to slaughter.

Pigs in a finishing facility

Wikipedia

Leaving the Herd Market pigs are sent to slaughter at about 6 months of age, weighing 200 to 300 pounds of live weight. This represents the most common reason for leaving the herd. Sows and boars are culled from the herd due to old age, reproductive failure, poor performance (small litter size, high preweaning mortality, low birth weight), illness or injury. About one in five, to one in four, breeding age females are culled or die every year. Those that are culled are usually sold to livestock auctions or sent directly to slaughter

Common Swine Diseases and Treatments

All-in, all-out production in confinement barns has helped many swine farms greatly reduce the incidence of disease in their herds. There continues to be several significant infectious and non-infectious diseases that affect swine production, and a few of the more important ones are presented below.

More information can be found at "The Pig Site"

(http://www.thepigsite.com/diseaseinfo/).

Sick Pig

Dr. John Angelos, UC Davis WIFSS

Respiratory Disease Market hogs are susceptible to a variety of microbial agents that can cause respiratory infections and pneumonia including viruses, bacteria, and some parasites. Often, disease transmission is exacerbated if less than ideal environmental conditions (poor ventilation, high humidity) exist in the swine units. The most common type of treatment for respiratory infections is antibiotic therapy. Drugs used to treat bacterial pneumonias in pigs include oxytetracycline, ceftiofur, florfenicol, sulfamethazine, tulathromycin, lincomycin, and tylosin. Some of these drugs are supplied in the form of medicated feeds, injectable formulations, or both.

Gastrointestinal Problems such as Ileitis, bloody diarrhea, and gastric ulcers are common in market hogs. Antibiotics are used in the U.S. to help treat some of the causes of these conditions. In some cases medications are provided through feed to help control and/or treat these diseases in large groups of pigs. Drugs provided through the feed include chlortetracycline, tiamulin, tylosin, and lincomycin.

In outdoor rearing systems, internal and external parasites are more commonly encountered than in confinement barns. Parasite treatments include ivermectin, hygromycin B, levamisole, and fenbendazole. Roundworms are often seen in sows and boars, especially in those reared outdoors. Fenbendazole is an antiparasitic drug that can be administered in the feed to control infestations with roundworms.

Lameness is a common reason for sows and boars to be culled from a breeding herd. While there are potentially many causes of lameness, producers may not establish a definitive diagnosis, and often will administer antibiotics such as penicillin procaine G, in the hopes that the causative agent is a bacteria that is susceptible to the drug.

Intestinal Roundworm from a Pig

Dr. John Angelos, UC Davis WIFSS

Lame Pig with Sore Left Hind Leg

Dr. John Angelos, UC Davis WIFSS

Porcine Epidemic Diarrhea Virus (PEDV) and Porcine Delta Coronavirus (PDCoV)

Recently, two new viral infections of swine have been identified in the U.S. swine population: porcine epidemic diarrhea virus (PEDV) and porcine delta coronavirus (PDCoV). Together these viruses are responsible for a condition described as novel swine enteric coronavirus disease (SECD). In suckling piglets, PEDV causes a severe disease characterized by acute watery diarrhea, vomiting, loss of appetite, and dehydration; are fatal in 50 to 80% of affected piglets. PDCoV is believed to cause a similar disease in suckling piglets. Both viruses are only known to affect swine and are not threats to public health. Efforts to develop vaccines to protect pigs against these diseases are ongoing.

Scott Bauer, USDA

Tissue Residues and Swine

Tissue residues are possible when drugs are administered in ways that are not specified on the manufacturer's label. For example, procaine penicillin G, an over the counter drug that is readily available at feed stores, is often administered at doses that far exceed those listed on the label. If a producer has not consulted with a veterinarian with whom they have a valid Veterinarian-Client-Patient Relationship, such use would constitute extra-label-drug-use (ELDU) and would be illegal. Such use can result in a producer not observing an appropriate withdrawal period for the drug prior to sending an animal to slaughter, and could result in violative tissue residues of a drug being detected at slaughter. Inadequate record keeping or lack of individual animal identification may lead to an animal being sent to slaughter prior to the end of an adequate withdrawal period.

Inadequate record keeping or lack of individual animal identification may lead to an animal being sent to slaughter prior to the elapse of an adequate withdrawal period.

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Acknowledgements

Authors and Contributors:

Bruce Hoar, DVM, MPVM, PhD
John Angelos, MS, DVM, PhD, DACVIM

Editors:

Amanda Arens, DVM, MPVM, PhD
Juanita Humphrey

Publication Design:

Amanda Arens, DVM, MPVM, PhD
Jeff Hall

Graphic Design:

Jeff Hall

References:

Ag 101 Pork Production, United States Environmental Protection Agency. Accessed May 21, 2014. http://www.epa.gov/oecaagct/ag101/printpork.html

Guidance for Industry #191. Changes to Approved NADAs — New NADAs vs. Category II Supplemental NADAs – Final Guidance. United States Department of Health and Human Services. Food and Drug Administration. Center for Veterinary Medicine. November 19, 2009.

The Pig Site: The Different Breeds of Swine. Accessed May 21, 2014. http://www.thepigsite.com/info/swinebreeds.php

The Pig Site: Quick Disease Guide. Accessed May 22, 2014. http://www.thepigsite.com/diseaseinfo/

Proper way to ear notch pigs, NebGuide. Accessed May 22, 2014. http://ianrpubs.unl.edu/pages/publicationD.jsp?publicationId=1056

Novel Swine Enteric Coronavirus Disease (SECD). USDA. Animal and Plant Health Inspection Service. Veterinary Services. June 5, 2014. Accessed August 6, 2014. http://www.aphis.usda.gov/animal_health/animal_dis_spec/swine/downloads/secd_case_definition.pdf

Goat Production

Introduction

Goats are one of the oldest domesticated livestock animals and are used for production of fiber, milk, or meat. Goat breeds are commonly split into 'meat goats' and 'dairy goats'. Goats are also raised for other uses such as brush or weed control, livestock exhibits, packing, and as companion livestock (pets). In the United States, the majority (over 2/3) of goats are raised for meat. While goat meat is consumed widely throughout the world and especially in developing countries and among certain ethnic groups, it is not commonly sold in traditional grocery marketplaces in the United States.

Trisha M Shears

Goats are efficient converters of low-quality forages into meat, milk, and fiber for specialty markets. As such, in the past decade in the United States there has been an increase in goat production. If resources are limited, a small herd of goats may be enough to provide supplemental income for small, part-time farmers thereby helping to enable self-sufficiency.

Goat Terminology

Terms that are unique to the goat industry:

Don Preisler, School of Veterinary Medicine UC Davis

Billies Breeding male goats are sometimes called billies.

Buck A male goat that has not been castrated and is used for breeding purposes. Bucks are typically associated with a foul odor arising from scent glands (located near the horn base) and urine which a buck will spray on its face, beard, front legs and chest.

Cabrito Roasted meat from goat kids 4 to 8 weeks of age; used as barbecue meat.

Chevon Meat from goat kids 48 – 60 pounds or 6 – 9 months of age.

Doe A female goat that has delivered kids ('kidded'); also referred to as a 'nanny'.

Doeling A doe from the time that it has been weaned (taken away from its mother) until she has delivered a kid.

Goat For USDA Food Safety and Inspection Service, 'Goat' refers to animals of both sexes and any age, however producers use specific terms to describe various life stages/types of goats when discussing and marketing their animals.

Kid A goat that is less than 1 year old.

Kidding The process of giving birth.

Wether A castrated male goat (unable to reproduce); most male goats in production settings are castrated at a young age.

Kid

Don Preisler, SVM UC Davis

Doe

Wikimedia Commons

Buck

Wikimedia Commons

Goat Breeds

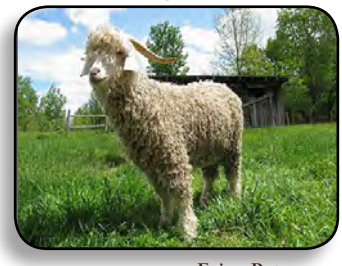
Over 100 different breeds of goats have been developed in modern times. The breed that a producer chooses to raise depends on the product that is desired. For example, Angora goats are used primarily for fiber production, while Boer goats are more suited to meat production. Breeds of goats used for milk production in the United States are Alpine, LaMancha, Nigerian Dwarf, Nubian, Oberhasli, Saanen, Sable (a Saanen with a colored coat), and Toggenburg. Young males of any dairy breed can also be used for meat production; however, meat goat carcasses are generally leaner and more muscular than dairy goat carcasses. Small-frame breeds such as Nigerian Dwarf and Pygmy are commonly kept as companion ('pet') livestock. Almost any breed can be used for brush control. Some of the more commonly kept breeds are listed below:

Alpine

Damien Hardy

Primarily a dairy breed of goats that originated in the Alps, Alpine goats have no distinct color pattern and may range from pure white through shades of fawn, gray, brown, black, or combinations of these colors. These are hardy, adaptable animals that thrive in any climate while maintaining good health and excellent production.

Angora



Erica Peterson

These goats are used to produce mohair. The Angora dates back prior to early biblical times. They originated in central Turkey, a mountainous area with a dry climate and extreme temperatures. The average U.S. Angora goat produces about 5 pounds of mohair per shearing, and is usually sheared twice per year. Both sexes have horns.

Boer

Wikipedia

This breed is originally from South Africa and is used primarily as a meat goat. Unlike dairy goats, which breed only in the fall to winter months, Boer goats (as well as some other meat goat breeds) are polyestrous, meaning they can breed throughout the year. This allows for year-round kidding and continuous goats for meat production.

LaMancha

Wikimedia Commons

A dairy breed that can be recognized by its extremely short ears which may, on quick inspection, appear to be absent. Any color or combination of colors is acceptable with no preferences. The hair is short, fine and glossy.

Nigerian Dwarf

Trisha M. Shears

A miniature goat of West African origin that is similar to that of larger dairy goat breeds. This breed is often raised for show purposes, but will be disqualified from the show ring for being over-sized. Many people raise Nigerian dwarf or Pygmy goats as pet animals or for animal projects for 4-H or FFA (Future Farmers of America) youth development programs.

Nubian

Wikipedia

A multi-purpose goat that is useful for the production of milk, meat, and hides. This breed is named for Nubia, in northeastern Africa where early ancestors of today's Nubian breed originated The breeding season for Nubian does is longer than some other dairy breeds, so it is possible to produce milk year round with these goats. The breed is characterized by its long, pendulous ears and Roman nose.

Saanen

Wikimedia Commons

The Saanen dairy goat originated in the Saanen Valley in Switzerland. Saanen goats are known for high milk production, and medium to large body size with a white or light cream colored coat.

For those interested in learning more about goat breeds, visit http://www.ansi.okstate.edu/breeds/goats/ for additional details on these and other goat breeds.

Goat Operations

In the U.S., goat raising occurs under extremely varied conditions. Access to inexpensive forage/ browse (forbs, woody plants, vines, brush) is critical for economical production. Therefore, open or fenced range with uncultivated acreage is the most common production setting used for goats intended for meat or fiber production. A fenced farm, with cultivated grasses or browse is also frequently encountered, for at least a portion of the year. A dry lot, where feed is delivered to the goats, is typical of dairy goat operations, where ready access to the animals is required for milking. Many producers will use a combination of some or all of these, depending on seasonal feed availability and access.

Goats require tight fencing. Electric netting fencing material can provide a temporary enclosure; however, goats will eat through such a fence if not continuously electrified.

Dairy Goat Dry Lot

Allison Lippert, FDA

Feeding Goats

Goats have a preference for browse. Goats can be grazed with other livestock, and can complement sheep and cattle, thus maximizing the use of marginal pastureland.

Pasture grasses, either native or cultivated, are the primary feed source used by goat operations. A carefully planned rotational grazing program can enhance pasture production and help control internal parasites. Moving goats out of pasture when plant growth is still over three inches tall can help reduce internal parasite infections.

Concentrates (corn, milo, barley, wheat, oats, and rye) may be used as an energy supplement, especially for goats that are in the later stages of pregnancy or during lactation when they are producing milk. Cut hay is also commonly fed, especially when pasture and browse are less readily available.

Grazing Goats

USFS Region Five

Identification

Commonly used types of animal identification (ID) are collars, leg bands, tattoos placed in the ear or tail fold (important for goats with very little ear tissue, such as LaMancha), plastic or metal ear tags, radio frequency identification (RFID) tags and RFID implants (microchips). Animal IDs are used by producers for official registration with breed registries, tracking animal health and production for record keeping purposes, and for meeting state/federal requirements when goats are moved interstate or in commerce/exhibitions. Today, microchips are becoming increasingly more common, especially in very small breeds such as the Nigerian Dwarf and Pygmy goats. Microchips are usually placed in the tail web (the loose, hairless area under the tail) and require special "readers" to obtain the information on the tag.

Ear Tag

Premier 1 Supplies

An example of a federal disease control program that requires goats, as well as sheep, to be officially identified is the National Scrapie Eradication Program (NSEP) which is coordinated by the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS). Scrapie is a transmissible spongiform encephalopathy affecting sheep and goats. It is a uniformly fatal degenerative neurologic disease that is related to bovine spongiform encephalopathy ('mad cow' disease). Under the National Scrapie Eradication Program, all goats, except low-risk commercial goats exempted by the State in which they reside, goats in slaughter channels, and castrated male goats (wethers), must have official identification when moving in interstate commerce or during ownership changes. In addition, some States may require other classes of goats to be identified or may exempt certain animals during intrastate commerce. Current information on each individual State's identification and movement requirements can be found at www.eradicatescrapie.org.

Record Keeping

While some large producers may use computer software programs to keep track of production, many producers use paper/written records as their primary form of record keeping. Breeding records and drug usage records are most commonly kept. Dairy goat producers often track milk production as well.

Don Preisler, School of Veterinary Medicine UC Davis

Life Cycle of a Goat from Birth to Death

Breeding/gestation Goats are classified as being seasonally polyestrous. This means that they have estrous cycles and can be bred for only a part of the year. In the United States, most breeding occurs in late summer through early winter. The gestation period is around 150 days; therefore, kidding typically occurs in late winter to spring. Anywhere from one to three (occasionally four) kids are born from each pregnancy. This varies a lot with breed. Most goats have one pregnancy per year; however some meat breeds may have three pregnancies every two years. Young does can enter the breeding herd and be bred as early as seven months of age. Replacement does should be approximately two-thirds of their mature weight when they are first bred.

Breeding Does

Don Preisler, School of Veterinary Medicine UC Davis

Nursing/Lactating Dairy does will be milked for approximately 10 months following kidding, and then held dry for two months prior to her next kidding. This will allow her to regain weight and prepare for the next lactation. Non-dairy goats will raise their kids to weaning which can occur anywhere from six to 12 weeks of age, depending on the intended use of the kid.

Dairy Milking Barn

Allison Lippert, FDA

Leaving the Herd Unlike cattle or pigs, dedicated facilities for fattening and finishing goats are uncommon. More typically, a goat intended for slaughter may receive some extra feed for a few weeks prior to slaughter.

Young kids are sold for meat at a variety of ages, however, the most common practice is to slaughter when the kid is about four to six months of age or 50 to 80 pounds.

Does and bucks are culled and slaughtered primarily due to old age, poor performance, and economic issues such as drought, herd reduction, or market conditions. Culled animals are usually sold to livestock auction markets or directly to slaughter. In a typical goat herd, about 15 – 20% of does and bucks are culled each year.

Diseases and Treatments

Goats are generally hardy animals and can survive under harsh environmental conditions. However, infectious and non-infectious diseases can and do occur, which can negatively impact health and production. Some of the more commonly encountered disease conditions of goats are presented below.

Caseous Lymphadenitis on the Neck of a Goat

Dr. Joanie Rowe, School of Veterinary Medicine UC Davis,

Abscesses/Boils/Lumps on the head, shoulder, upper rear legs, and internally can be caused by a disease called caseous lymphadenitis (CL). This is an economically important disease in goats caused by the bacterium *Corynebacterium pseudotuberculosis*. This organism also causes a disease in horses called 'pigeon fever'. Different strains of *C. pseudotuberculosis* affect different domestic livestock species. The choice of treatment for CL depends on the location of the abscess as well as prior presence of the disease within the herd. Antibiotics can be used to treat the condition however responses to antibiotic treatment alone can be poor.

Mastitis/Udder Inflammation is a common disease of dairy animals, including dairy goats and cows While bacterial infections account for most cases of mastitis in goats, other agents can cause mastitis including viruses. In severe cases of bacterial mastitis, the udder will be hot and painful, the milk will be abnormal, and milk production will be reduced. The animal may also be systemically sick depending on the severity of the infection and causal organism. Producers usually treat such conditions with antibiotics administered either systemically (intramuscular, subcutaneous, or intravenous) or intra-mammary.

Joint Swelling or Crippled Goats are common reasons for goats to be culled from a breeding herd. Producers may not establish a definitive diagnosis for the cause of disease, and often will administer antibiotics, such as procaine penicillin G, in the hopes that the causative agent is a bacteria that is susceptible to the drug. Because some of the causes of joint swelling can by bacteria or viruses that can be transmitted between animals in a herd through activities such as milking and kidding/nursing, it is generally a wise decision on the part of the producer to consult a veterinarian to determine any underlying causes of joint swelling in crippled animals.

Parasites both internal (such as roundworms, stomach worms, lungworms) and external (such as mites and lice), are often seen in goats. Weight loss, rough hair coat, and diarrhea are common signs of parasitism. Anemia (pale mucous membranes) due to internal parasites can also be an indicator of parasitism. Pasture management is important in control programs for parasites of goats.

Tissue Residues and Goats

Whenever a drug is administered to an animal in which the meat or milk will enter the food supply, there needs to be adequate time between drug administration and slaughter or milking for the drug to be cleared from the animal's system. 'Withdrawal time' is the time required following the administration of an approved animal drug to an animal until the time that tissue and/or milk residues of the drug have fallen below a federally approved concentration limit and the animal and/or its milk are safe to enter the human food chain. 'Withdrawal period' is also often used to describe this period of time. 'Withdrawal interval' is a term used to describe a withdrawal period for a drug that has been used in an 'extra-label' manner, or not in accordance with the directions on the manufacturer's label. Sometimes withdrawal period/time/interval are used interchangeably; however, it is important to understand the distinctions between these terms.

Violative tissue residues are possible in meat or milk when drugs, which include withdrawal time, are used in ways that are not in accordance with the directions on the drug manufacturer's label. For example, procaine penicillin G, an over-the-counter (OTC) drug that is readily available at feed stores, is often administered at doses that far exceed those listed on the label. If a producer has not consulted with a veterinarian, this would be a violation of the Animal Medicinal Drug Use Clarification Act (AMDUCA), and the producer may not realize that an extended withdrawal interval is required. This could result in violative drug residues occurring in the human food chain.

Neck Chain on a Goat for Identification

Wikipedia

Inadequate record keeping or lack of individual animal identification may lead to an animal being sent to slaughter before an established withdrawal time/interval has elapsed.

Since goats are a species of minor economic importance, there is limited economic incentive for manufacturers of animal health products to obtain drug labels that include goats. As a result there are less than a dozen compounds with label approval for goats. In order to treat disease and limit animal suffering, goats are frequently treated with products approved for other species such as cattle. Using medications in an unapproved species, without the guidance of a veterinarian, is a practice which increases the risk of violative tissue residues.

Extra-label use of drugs must always be done in consultation with a veterinarian, who can help establish a recommended withdrawal interval for meat and milk. One commonly used resource for veterinarians to help in establishing such withdrawal intervals is the Food Animal Residue Avoidance Databank (FARAD). FARAD is a congressionally-mandated risk-management program that is supported by the United States Department of Agriculture (USDA). For information about FARAD, visit www.farad.org.

Acknowledgments

Authors and Contributors:

Bruce Hoar, DVM, MPVM, PhD
John Angelos, DVM, PhD, DACVIM

Editors:

Amanda Arens, DVM, MPVM, PhD
Juanita Humphrey

Publication Design:

Amanda Arens, DVM, MPVM, PhD
Jeff Hall

Graphic Design:

Jeff Hall

References:

Animal Care Series: Goat Care Practices. University of California Cooperative Extension (http://afghanag.ucdavis.edu/c_livestock/goats/Man_Goats_Care_Practices_UCD.pdf)

Goats: Penn State Extension. Accessed May 18, 2014.
http://extension.psu.edu/animals/goats

National Scrapie Eradication Program: Animal Identification and Record keeping Guide for Sheep and Goats. United States Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services. 2012

Oklahoma State University Breeds of Livestock: Goats. Accessed May 20, 2014
http://www.ansi.okstate.edu/breeds/goats/

Biosecurity

Introduction

Maintaining the highest possible animal health status is critical to the sustainability and profitability of producers of animal agricultural products. As consumers become more educated and have an ever-increasing demand for high quality, safe, humanely and often sustainably-produced animal products, programs to monitor and certify the health and welfare of production animals are increasingly being implemented in all segments of animal agriculture to assure that these goals are being met. Access to premium markets will increasingly depend on the ability of producers to demonstrate freedom from serious animal diseases and pests. This assurance is made possible through the development of optimum biosecurity programs. Processor requirements, quality assurance programs, and retaining market access and competitiveness will demand that such biosecurity programs be implemented. In addition, on-farm biosecurity can control production limiting diseases that currently cost livestock producers millions of dollars each year.

Farm-Level Biosecurity Measures Due to Disease Outbreak

Kate Jewell

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Most of the reasons for implementing a biosecurity program are self-evident and include maintenance of animal health, welfare, and productivity, as well as the reduction of disease transmission and negative economic impacts caused by disease incursions. Other reasons may not be as apparent, but are nonetheless critical to consider. A strong biosecurity program can protect the health of the people working with and consuming the products of the animals, allow for the continued movement of animals, provide for protection of ancillary agricultural industries (such as feed suppliers, veterinarians, nutritionists, and others), as well as assist in export and domestic marketing. Another reason for implementation of strict biosecurity practices is that such practices can help maintain healthy ecosystems and therefore help support agricultural sustainability.

Biosecurity is a holistic concept of direct relevance to food safety and the protection of the environment. Biosecurity refers to any activity taken to keep disease out of an area – whether that be cleaning your boots before entering a farm, building a new barn, repairing a fence, or developing a vaccination program – the goal always being to maintain the health of animals on a livestock facility.

Components of a Biosecurity Plan

Gary Kramer, NRCS

One way to approach development of a biosecurity plan is to divide the plan into five major components: Assessment, Resistance, Isolation, Traffic control, and Sanitation. When managed properly, these five components will allow the biosecurity objectives of the livestock producer to be met. These components are discussed below:

Assessment The first step is to assess the potential for disease organisms to enter a livestock herd. A list of specific diseases which may affect the herd in question should be constructed. For each specific disease of concern, you should evaluate the likelihood of herd exposure, potential impact on the herd, and understand what options are available for control of the disease if it did occur. The assessment should also include a general evaluation of the potential for contamination of livestock from other/outside livestock, wild animals, contaminated feedstuffs, equipment, and other possible sources.

Resistance Resistance refers to the ability of an animal to respond to exposure to an infectious agent. This includes both specific immune mechanisms as well as general metabolic processes and both components must be properly maintained for an animal's resistance to be optimized. Specific disease conditions may be addressed by proper vaccination programs, however, effective vaccines do not exist for many of the infectious agents that can affect livestock. Therefore, it is critical that general resistance mechanisms are supported by proper nutrition. Stress can also impair such resistance mechanisms, so minimizing stress is also very important. Purchasing animals of known disease and vaccination status, as well as continual on-site testing and surveillance, can help to maximize resistance to infectious disease agents.

Cow Being Vaccinated

Jeff Hall, UC Davis WIFSS

Isolation Isolation refers to the prevention of contact between animals as much as possible. The most important first step in disease control is to minimize commingling and movement of animals. This includes all new purchases as well as commingling between established groups present on the farm. Separating by age and production groups is an important biosecurity measure, even in operations with a high turnover rate. It is important to ensure that facilities, such as fences and isolation areas, are well maintained and cleaned or disinfected appropriately prior to adding new groups of animals.

Traffic Control Traffic Control includes traffic both onto and within the operation. It is important to understand that traffic includes more than vehicles. All animals, including dogs, cats, horses, wildlife, rodents and birds, as well as people must be considered. It also involves traffic within the production unit between different age groups (if present) on the facility. Generally speaking, farm workers who have contact with both younger less mature animals and older more mature animals should plan activities that cause contact with younger animals, before moving to older animals. Planning facilities so that traffic is minimized is an important part of an overall biosecurity plan.

Feeding Truck on Confined Dairy Operation

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Sanitation Sanitation addresses the disinfection and cleanliness of materials, people and equipment entering and while on the production facility. One extremely important overarching goal of disease control is to prevent fecal – oral contamination. Equipment which may contact the oral cavity or animal feed should always receive special attention with regard to disinfection. Removal of organic matter, especially feces, is critical. Blood, saliva, and urine from sick or dead animals should also be targeted. Disinfectants do not work equally well on all types of materials. For example, in the presence of organic matter, some disinfectants are ineffective. This point helps illustrate why things that are hard to clean usually won't get adequately disinfected. All equipment used for manure or dead animal handling must be cleaned thoroughly before being used with feeds, or ideally, completely different equipment should be used. Disinfection protocols should be established, written down, and followed.

Foot Bath at Entrance to Pasture

Colin Smith

Visiting a Livestock Facility

Before visiting a farm, it is essential that you prepare yourself in order to prevent disease transmission. You may consider contacting the producer to discuss specific biosecurity requirements of the farm. Additionally, you may contact the State Veterinarian and/or Regional USDA-APHIS office to determine if special measures are required to control animal diseases. If the facility is known or suspected to be involved in a contagious animal disease outbreak, contact the Center for Veterinary Medicine and/or the Center for Food Safety and Applied Nutrition for additional precautions which may be necessary. APHIS and/or the State Veterinarian may also have special restrictions or precautions for you to follow.

Wikipedia

Before arrival, ensure that your vehicle is clean and has been recently washed. Obtain equipment and supplies, such as laundered or disposable coveralls/smocks, disposable plastic gloves, rubber boots, reusable cloth or plastic laundry basket, soap, water, hand towels, sanitizing solutions and equipment. Make sure any equipment you take has been thoroughly cleaned and sanitized. Clipboards, briefcases, flashlights, coolers, and other objects should be cleaned between uses/farm visits as these can spread diseases between individuals and between farms.

The following procedures are applicable to virtually any farm that you visit. Some farms will have additional biosecurity measures so you should check with the owner or manager prior to your visit.

1. Wear rubber boots or other suitable footwear, which is disinfected upon arrival and again prior to departure. Disposable foot coverings are preferable. Use foot baths if available.

2. Wash your hands with soap and water. Wear disposable gloves as required by the protocol of the facility.

3. Wear disposable or freshly laundered coveralls. Shower-in and shower-out if requested to do so by the facility.

4. Wear appropriate head coverings as necessary.

Handwashing

UC Davis WIFSS,

5. Minimize materials carried with you, such as notebooks, flashlights, etc. to only those items that are necessary to complete your task.

6. If the farm has animals of various ages, try to work from the youngest to the oldest.

7. Avoid direct contact with livestock, wild animals, or pets, bodily fluids or animal by products when visiting facilities. Whenever possible, avoid stepping directly into manure piles.

8. Upon completing your visit, return to your vehicle, remove your personal protective equipment and place them in a disposable bag. Clean and sanitize boots/footwear.

9. Repeat these procedures for each separate location visited or inspected.

Further information on visiting a farm can be found in the FDA Investigations Operations Manual, 2014 (http://www.fda.gov/downloads/ICECI/Inspections/IOM/UCM150576.pdf).

Species Specific Biosecurity Procedures

The steps listed above can be universally applied to any livestock production facility; however, there may be certain unique situations encountered depending on the species of livestock involved. These are described below.

Dairy Operaation

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Dairy Cattle All dairies will have a milking parlor, as this is a requirement in the Pasteurized Milk Ordinance; however much variability will be encountered relative to other aspects of the dairy and its animals such as the amount of grazing, type of housing, and type of milking parlor. Biosecurity on dairies can be difficult to ensure, as there is much traffic on and off the farm, there can be many farm workers and generally few controls. If you visit a dairy, park in an area well away from any animal housing area. It is usually best to park near the house or office to meet with the producer before proceeding to the animal area. Your vehicle may also transport infection if you drive through contaminated areas and may require frequent cleaning between sites. In general, entry to animal housing or feeding areas, corrals, pens or special treatment facilities should be avoided unless there are specific reasons to enter those areas. As much as possible, avoid stepping into fecal material, feed bunks, and feed storage areas. Do not handle any animals (including pets) unless official duties require such contact.

Beef Cow-Calf Operation

Jeff Vanuga, NRCS

Beef Cattle There is tremendous variability in how beef cattle are raised. Cow-calf production is considered as an extensive production system, with some grazing, and feed provided seasonally as required. Similarly, stocker cattle are raised under extensive conditions and are maintained by grazing. In contrast, feedlots are usually an intensive production system, with all feed provided by farm workers to the animals. Most feedlots have dirt-floored pens, but some are in slotted floor barns.

In extensive production systems, such as cow-calf and stocker, biosecurity can be a challenge, given that the animals are on pasture with many miles of fencing, and little direct animal control. Feedlots are somewhat more secure; however, often there is a lot of traffic on and off a facility. Feedlots may have visitor control areas and some form of security. The same precautions to be taken when visiting a dairy farm also apply to beef cattle facilities.

Swine The majority of pigs raised in the United States are raised under intensive production systems such as with finishing hogs on a large production unit. Vertical integration on some facilities has resulted in there being a separation of different phases of production. On such facilities you may find a gestating barn, a farrowing barn, a growing barn, and a finishing barn. These may be on the same or separate physical locations. All feed is provided to the animals, and all-in, all-out production is common. In all-in, all-out production, a group of animals all of a similar age group is moved into an area/pen/unit etc., and then all moved out at the same time prior to the area/pen/unit being disinfected in advance of the arrival of the next group of animals. Some pigs are raised less intensively and sows may be on pasture for a portion of the year, farrow outdoors, and have no farrowing crates. Given the differences in how the pigs are raised, biosecurity will be highly variable as well. In general, there is lots of traffic and movement on and off all farms. On intensive production units, it is common for there to be visitor control, with limited access, and some degree of security. Large farms are likely to have a requirement that all visitors and personnel shower-in and shower-out when entering animal areas.

Finishing Barn in an All-In, All-Out Swine Operation

Jeff Vanuga, USDA NRCS

Goats and Sheep In many ways, small ruminant production mirrors cattle production. Meat goats and sheep are usually extensively reared, utilizing grazing as the primary source of nutrition with seasonal supplementation. Feedlots for finishing kids and lambs are not common. Dairy animals are treated like dairy cattle, with a milking parlor, and variable amounts of grazing. Biosecurity measures also mirror those intended for cattle.

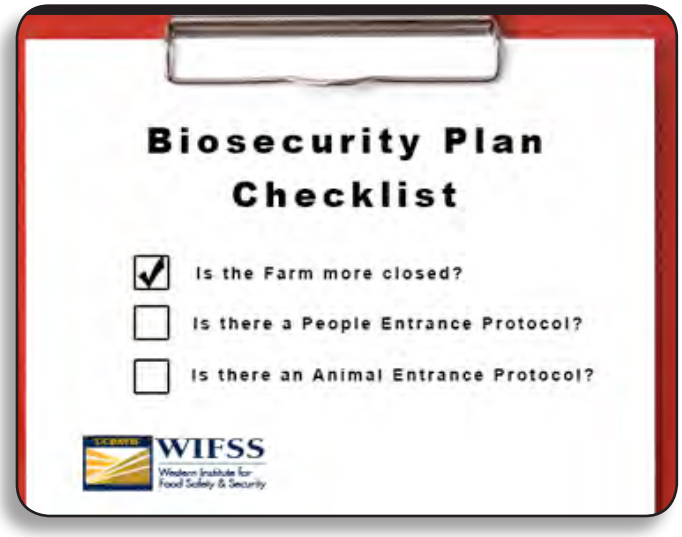
Goat Operation

Jeff Vanuga, USDA NRCS

Developing Biosecurity Plans for Livestock Production

It may be useful to have basic knowledge of specific approaches to a biosecurity plan for livestock production. One useful approach has been to create a 10-step approach that involves creation of tailor-made working instructions for the producer and farm-workers. The main objective is to reduce the effects of risk factors or control these risks so that the probability of disease will be as low as reasonably feasible on that particular production facility.

Step 1. Make the farm more closed, which means making it less likely that animals that have not been raised on-site or that have been purchased from the outside are allowed into the herd as replacements/additions. It is usually difficult to have a completely "closed" herd, but the more closed it is, the better.



Step 2. Design a People Entrance Protocol. There needs to be a written plan that is enforced related to hygiene of workers and visitors entering onto the facility.

Step 3. Similarly, a protocol needs to be established for all animals that enter and exit the premises. This includes the health and vaccination status of the animals, as well as the disinfection/cleaning protocol of all vehicles used for transporting those animals.

Step 4. It is highly recommended that every unit on a farm have a separate set of protocols specific to that unit. For example, the farrowing barn and the gestation barn would each be considered separately. This will assist with employee training and adherence to Hazard Analysis and Critical Control Points (HACCP) documents.

Step 5. Protocols for day-to-day activities need to be formally established. This would include items such as health care, feeding management, hygiene and disinfection.

Step 6. Monitoring protocols are essential. There is a saying that "if you cannot measure it, you cannot manage it". Having results that can be measured are vital if improvement in the process is going to be a tangible goal.

Step 7. The importance of a well-trained staff cannot be over-emphasized. If the workers are assigned responsibilities within the biosecurity plan and are rewarded for achievements, they will embrace the concept thereby greatly increasing the probability of success.

Step 8. Given that we have divided the facility into separate units, it should be apparent that training programs specific for each unit need to be in place and training efforts should be directed to the individuals working in those specific units. It makes no sense to teach the person in charge of a calf unit about mastitis control in the milking string, if they only ever work in the calf unit.

Step 9. Each unit of a farm will have its own separate set of risk factors to consider. Therefore a separate Standard Operating Procedure (SOP) should be established for each unit. While there may be overlap (e.g. the whole farm may have the same water supply), having separate documents will aid in compliance.

Step 10. Another critical factor to realize is that any Biosecurity Plan will not be a static document. Having regular meetings among all those involved, and then adapting the plan to become more functional, will allow it to develop and improve over time. Remember, too, that the workers are the people that will have the most intimate knowledge of conditions in their unit, so their input is essential and should be carefully considered when making improvements to the plan.

Summary

We have discussed the importance of biosecurity for disease control on various livestock operations. It takes a true commitment to a Biosecurity Plan for it to be successful, however, this commitment is worthwhile as it will fundamentally help to improve animal health and well-being, maintain public health, ecosystem health, food safety, food defense and the economic well-being of the production unit. There are many ways by which diseases can be introduced or spread. While disease risk cannot be completely eliminated, risk can be managed. Everyone can play a critical role in minimizing infectious disease introduction and spread.

UC Davis, WIFSS

Acknowledgements

Authors and Contributors:

Bruce Hoar, DVM, MPVM, PhD
John Angelos, MS, DVM, PhD, DACVIM

Editors:

Amanda Arens, DVM, MPVM, PhD
Juanita Humphrey

Publication Design:

Amanda Arens, DVM, MPVM, PhD
Jeff Hall

Graphic Design:

Jeff Hall

References:

National Animal Health Emergency Response Corps Training Site
http://naherc.sws.iastate.edu/

Canadian Food Inspection Agency Animal Biosecurity
http://www.inspection.gc.ca/animals/terrestrial-animals/biosecurity/eng/1299868055616/1320534707863

Biosecurity for Pork Producers
https://webadmin.pork.org/filelibrary/Biosecurity/final%20biosecurity%20book.pdf

Farm and Ranch Biosecurity
http://www.farmandranchbiosecurity.com/