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Dairy Goat Quality Assurance and HACCP

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Abstract
Today's US milk supply is the safest it has been in history, yet consumers have concerns about the quality and safety of the food products they purchase. News of food recalls based on the presence of potentially harmful bacteria or other disease-causing agents and contaminants raise fear in consumers and lower the confidence in our nation's food supply. While food safety may be at an all time high, the perception of many consumers is that there is genuine risk in consuming many of the products marketed at grocery stores. This perception can play a role in consumers' increased consumption of foods labeled as "organic" or "naturally produced," foods purchased directly from the farm, or from farmers markets.

Disciplines
Large or Food Animal and Equine Medicine | Veterinary Medicine | Veterinary Preventive Medicine, Epidemiology, and Public Health

Comments
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Quality Assurance and Food Safety

Today's US milk supply is the safest it has been in history, yet consumers have concerns about the quality and safety of the food products they purchase. News of food recalls based on the presence of potentially harmful bacteria or other disease-causing agents and contaminants raise fear in consumers and lower the confidence in our nation's food supply. While food safety may be at an all time high, the perception of many consumers is that there is genuine risk in consuming many of the products marketed at grocery stores. This perception can play a role in consumers' increased consumption of foods labeled as "organic" or "naturally produced," foods purchased directly from the farm, or from farmers markets.

The USDA Food Safety Inspection Service (FSIS) is the government agency that has as one of its responsibilities the testing of our food supply to ensure its safety. By FSIS definition, food safety refers to the conditions and practices that preserve the quality of food to prevent contamination and food-borne illnesses. Detecting the presence of disease organisms, chemical residues, or foreign material in foods and recalling those foods are examples of some of the work conducted by the FSIS to safeguard the nation's food supply. These quality control measures evaluate the final product prior to sale and prevent potentially harmful food from being distributed or consumed by the public. In contrast, a quality assurance program at the producer level ensures that animals and animal products entering the food chain have been raised and made following a set of management practices designed to produce the best possible product for consumers.

The presence of drug residues in milk can serve to illustrate the difference between quality control and quality assurance. As an example, consider a producer that treats a sick milking doe with oxytetracycline. Assuming that the producer has followed suggested quality assurance procedures, they will have a veterinarian-specified withdrawal time prior to which milk from this animal cannot be added to the bulk tank. Prior to that designated milk withdrawal time, the producer thinks enough time has lapsed and allows milk from the doe into the bulk tank. Chemical tests on the milk detect the presence of unacceptable levels of antibiotic residues. The milk from this farm and all of the other milk in that truckload is condemned and destroyed resulting in a loss of income. The quality control program identified the problem, unacceptable levels of drug residues, but could not pinpoint where in the production process the problem occurred.

The producer, using a quality assurance program, could trace back and find where the problem occurred, in this case a failure of correct record keeping. Quality assurance programs set forth guidelines to prevent failures in quality from occurring and, when problems are detected, provide the framework to identify and correct the production practices that led to compromised product quality. The goal of a quality assurance program is to consistently produce a safe product at the level of quality demanded by the consumer and mandated by law.

Pre-harvest vs. Post-harvest Quality Assurance

The drug residue scenario provided an example of how on-farm dairy management practices impact food wholesomeness and safety. These on-farm practices are termed "pre-harvest" since they focus on management practices performed on a live animal prior to the marketing of the food commodity. In the case of meat from cull dairy goats, the pre-harvest period of management would be from birth of the animal until it was killed at a slaughter facility. The "post-harvest" period includes all of the processing steps and management decisions that the milk processor or slaughter house control with regards to food quality and safety over which the producer has no control. Conversely, the abattoir and milk or meat processors have no control, except that exerted through market channels, on the product they receive for processing. The responsibility of delivering milk or an animal that produces high quality and high value edible product belongs to the producer. The role of a quality assurance program for production is to devise and implement pre-harvest production practices that ensure quality standards for marketed milk or animals.

Increasingly, consumers are becoming concerned not only with the immediate safety of food, but with all aspects of food production and marketing. The public is becoming better educated about the nutritional implications of food consumption on long-term health and disease
incidence. The trend to consume cuts of meat lower in fat and cholesterol to combat potential atherosclerosis and heart disease is a prime example. Consumers are also concerned with the presence of other contaminants or diseases that can arise during the production, or pre-harvest, phase. Further, consumers are becoming increasingly concerned with the living conditions in which food animals are raised and their welfare. These issues have put pressure on the livestock industry to respond and use production practices and quality assurance protocols to satisfy consumer concerns about its product and the conditions under which animals are raised.

**Benefits of a Dairy Goat Quality Assurance Program**

Recent years have shown a significant growth in the goat milk market for production of fresh and aged cheese. At present, there are roughly 360,000 dairy goats in production in the US on roughly 30,000 farms. The goat cheese market is the fastest growing cheese market in the country and shows good promise for continued growth with over 50% of the current product being imported. With this increase in production comes the need for implementation of a standardized, formal framework of practices and procedures to assure the public of the safety and wholesomeness of all goat products produced in the US. These types of frameworks are already used in other livestock industries such as beef - Beef Quality Assurance (BQA), pork - Pork Quality Assurance Plus (PQA Plus®), and sheep - The Sheep Safety and Quality Assurance Program.

The impact of livestock producer quality assurance programs can be exemplified by the improvements in meat quality seen as a result of implementing the BQA program. The National Beef Quality Audit published in 2000 reported significant improvements in beef quality due to producer training conducted through the BQA program. These quality improvements included: reduced injection site lesions (<3% of beef butts contained injection site lesions in 2000 as compared with 22% in the early 1990s), improved carcass quality (as evidenced by a higher percentage of carcasses grading choice and prime versus that reported in the 1995 audit), and reduced carcass bruising. The improvements in beef quality were only possible by producers working together to solve problems and concerns identified by consumers and other segments of the industry.

Livestock quality assurance programs also respond to consumer concerns showing the public that their voice is important to the industry. In 2007, the pork industry expanded the animal welfare component of its popular Pork Quality Assurance Program and created PQA Plus®. This was done partly in response to consumer concerns on the welfare of pigs during production. Animal welfare and concern for the growing conditions of livestock has been increasing in importance in recent years.

The need for a Dairy Goat Quality Assurance (DGQA) program is not only to show the public that the dairy goat producing community is working to produce safe, wholesome products, although that is one objective, it is also needed to assist producers in making production decisions and guiding them through the production process. An industry-wide DGQA program could play a role in the following areas:

**As a production tool**

The dramatic increase in goat cheese production in the US indicates that dairy goat production is rapidly expanding. This expansion has come about through herd growth, a shift in focus from dairy cattle to dairy goat production, and through new producers entering the goat industry.

Some producers new to raising goats have extensive experience with raising other livestock species such as cattle or sheep. Some new producers have little to no livestock experience. Since goats are considered a “minor species,” few drugs are approved for the treatment of diseases and parasites, and education is needed in this area. Many producers have a need for current and correct information on how to raise goats and produce the safe, wholesome products demanded by the public. A DGQA program, with recommended production practices and procedures, can assist both experienced and inexperienced producers in making sound production decisions that result in goat milk that meets or exceeds industry and federal standards for milk quality.

**Long-term industry development**

All dairy goat producers should understand that they are part of a growing industry whose goal is to have goat cheese considered in the marketplace alongside other domestic and imported cheeses. Producing a product that may have drug residues or inferior quality affects the image of the industry as a whole. A standard DGQA program adopted by the main dairy goat associations in the US will unify producers in working toward an industry standard, i.e., wholesome dairy goat products in demand by consumers.

**As a marketing tool**

Almost one-half of the goat cheese sold in the US is imported. With many food safety issues in the minds of the public, many consumers wish to know where and how their cheese or milk was produced. Adoption of an industry-wide DGQA program would be a large step in the promotion of US-produced products to the consuming...
public. A quality assurance statement, coupled with the natural benefits of goat milk compared to other milks in terms of protein and cholesterol content, could be the basis for a very effective marketing campaign.

**An industry safeguard**

As the industry grows and additional producers enter the marketplace a wider variety of production systems, and potential problems, are likely to emerge. Future developments in the livestock industry, such as the nationwide Animal Traceability Program allowing the tracing of diseased animals back to their farm of origin, will affect all animal producers. Having an industry approach to quality assurance can assist producers in complying with federal regulations and avoid problems that could drastically, negatively affect the entire industry.

Adopting a DGQA program demonstrates to the public that producers in the dairy goat industry do all they can to protect the welfare of their stock. While goat producers are very caring toward their animals, misunderstandings can arise with the general public. As fewer and fewer people are involved in direct animal production, there is a growing lack of understanding of animals, production systems, and the management actions involved in producing this nation’s food. In some countries of the world, this has led to establishment of government regulations on animal production, some of which can be quite restrictive. For example, goat animal welfare codes established the United Kingdom state that all disbudding must be carried out by a veterinary surgeon. Adoption of a DGQA program and adherence to its standards are ways that dairy goat producers can show the public how they care for and uphold the welfare of their animals.

**Best Management Practices and HACCP**

An effective dairy goat quality assurance program will focus on not only production and product safety issues, but also on the total production environment. The program should set standards that address issues directly concerned with product safety and quality along with animal welfare and well-being. Practices range from basic herd management to herd health to nutrition and feeding. In the DGQA program these are "Best Management Practices" or BMP. On-farm evaluation and use of BMP are based upon the Hazard Analysis Critical Control Point (HACCP) principles.

HACCP systems are extensively used in the food processing and preparation industry, i.e., post-harvest processes, as a major means of assuring food safety. The key to the HACCP system is the analysis of potential production hazards and the pinpointing of places in production, called critical control points, where preventive measures can be taken. As an example of HACCP’s impact on the food industry, the US Department of Agriculture mandated that meat and poultry processing establishments begin using HACCP by January 1999 to improve product safety and prevent the three main hazards that occur in food processing, biological (microbial contamination), chemical (toxins or drug residues), and physical (foreign material in food, e.g., glass or plastic).

Processing facilities must have HACCP plans in place to deal with hazards that occur during processing and hazards that are present due to on-farm production practices. Thus, it is important for livestock industries to use HACCP-like principles in quality assurance programs to assist milk and meat processors trace detected failures in production and prevent future occurrences.

Quality assurance programs such as those mentioned for the beef, sheep, and pork industries are pre-harvest programs that use HACCP-like procedures to assist in the production of animals giving safe, wholesome products.

There are seven HACCP principles that assist producers to identify, evaluate, control, and, finally, prevent food safety hazards and assure quality.

**HACCP Principles**

1. **Conduct a hazard analysis.** Review your production system for procedures or places that could allow for harm to animals, compromise production, or introduce biological (microbial), chemical (toxins or drug residues), or physical contamination.

2. **Determine critical control points.** Critical control points are those areas in production where problems could happen resulting in lower quality products and where production changes or interventions should occur to prevent problems.

3. **Establish critical limits for control points.** Set desired limits on identified hazards.

4. **Establish monitoring procedures for control points.** Decide how to monitor and determine if critical limits have been met.

5. **Establish corrective actions.** Actions to be taken when monitoring procedures indicate a problem.

6. **Establish record keeping and documentation procedures.** Records should be kept on identified problems, corrective steps taken, effectiveness, and methods to prevent future occurrences.

7. **Establish verification procedures.** These procedures verify that proper corrective measures were taken and have been effective.

These seven principles can be used in virtually all aspects of production. For instance, in the drug residue example the seven HACCP principles would be as follows:

1. **Hazard analysis - potential presence of drug residues**
Dairy Goat Quality Assurance and HACCP

2. **Critical control point** - drug withdrawal time prior to sale
3. **Critical limit** - zero drug residues in milk.
4. **Monitoring procedures** - records kept on all animals treated on-farm, including animal number, drugs used, amount given, treatment dates, and withdrawal periods
5. **Corrective action** - improved record keeping, employee training in drug use and record keeping
6. **Effective record keeping** - checking treatment documents to ensure proper, correct, and current information
7. **Verification procedures** - periodically reviewing all records, no further reports of residues in milk

While it may appear difficult to follow the seven steps of HACCP, in reality most livestock producers are already using HACCP-like procedures to solve and prevent problems. Diagnosing problems and taking corrective action are common occurrences on farms. The advantage of HACCP is that it provides a formal, proven framework of procedures whereby a producer can objectively evaluate current production systems, identify flaws, and put into place evaluation and corrective action plans prior to the occurrence of a problem. Using HACCP-like principles represents a shift from being reactive to events that cause production or quality loss, to being proactive by working to prevent those occurrences from happening. Further, by using HACCP-like procedures, if a problem does occur the necessary planning for corrective actions is already in place saving time and eliminating other potential mistakes. Ultimately, preventing problems and production loss will result in an enhanced production environment with fewer problems that will lead to increased profit. That is the goal of all quality assurance programs.

Exposed nails or sharp wire on farm structures provide an illustrative example of the way producers may already be using HACCP-like principles. These sharp points and edges can cut a goat's skin and lead to increased use of antibiotics and potential income losses from milk that has to be dumped due to antibiotic residues. Thus, exposed nails and wire are a hazard and when noticed these are repaired or removed.

Using HACCP-like principles does not change the basics of what is performed, that is the prevention of cuts. What using HACCP-like principles does, is to assist in structuring a method of checking on the hazard and deciding what to do in the future to prevent another occurrence. To illustrate, the hazard is exposed nails or sharp wires. The control points are those portions of your pens and buildings where nail points could be exposed or where goats can damage facilities resulting in exposure. A desired critical limit is zero nails or wire exposed that could cause harm. Looking at facilities when feeding is one method of monitoring those control points. Corrective actions would be repairing fences or buildings to prevent nails from protruding or perhaps installing a shield in prone areas. Repairs or shield installation should be recorded in your farm records, particularly if any expense was involved. Finally, a regularly scheduled, periodic walkthrough of your facilities to inspect repairs and current condition would be a method of verifying that monitoring and corrective actions have worked.

**Best Management Practices of the DGQA Program**

Best Management Practices (BMP) in a DGQA program represent critical points in dairy goat management where problems or issues may arise that could lead to reduced product quality and safety or compromised welfare of the animal.

Six BMP areas have been targeted by this DGQA program as critical points in the production of quality dairy goat milk and meat 1) Herd Health, 2) Nutrition/Feedstuffs, 3) Maintain Milk Quality and Develop an Effective Mastitis Management Program, 4) Management and Proper Care, 5) Record Keeping, and 6) Biosecurity.

**Best Management Practices in Herd Health**

**Herd Health BMP #1 - Establish and follow a herd health program**

A herd health calendar specific to your production system should be developed upon consultation with a licensed veterinarian. All vaccinations should be given at times appropriate to individual groups of animals. Consideration of natural periods of immunocompromise (periparturient period), disease risk, and duration of immunity should be discussed during development of the protocol. Management practices that can impose stress on an animal, such as castration, should be done in a manner that prevents health complications. In addition, veterinarians and producers should work together to develop appropriate management protocols for painful procedures that address pain mitigation strategies when deemed appropriate. All kids should receive an adequate volume (minimum of 10 to 12% of body weight) of high quality colostrum within 24 hours of birth and should receive preventative care for common diseases. The environment surrounding the animals should be maintained to minimize exposure to pathogens, for example, through regular manure removal, appropriate air quality management, and appropriate stocking densities.
Herd Health BMP #2 - Establish a valid veterinarian-client-patient relationship and use any off-label drugs in accordance with guidelines for their use within such a relationship

Having a good relationship with your veterinarian is absolutely necessary in forming and following a comprehensive herd health program. Under federal law, only a veterinarian can authorize the use of any drugs not specifically labeled (i.e., the bottle does not specifically list goats) for use in goats for a specific disease or dosage. The fact that every truckload of goat milk processed through licensed cheese plants is tested for antimicrobial residues underscores the absolute necessity that labeled or veterinarian-assigned withdrawal times are strictly followed. Failure to do so can result in economic losses associated with condemned milk as well as state regulatory action. If these residues result from extra-label drug use in the absence of a valid veterinarian-client-patient relationship, the producer is fully liable.

There are very few drugs cleared by the Food and Drug Administration for use in goats. Most drugs used to treat diseases in goats are used in an “off-label” manner, meaning that they are administered in a manner not according to their labeled use. This is the case for any drug that does not specifically list goats on the label or for any drug that list goats on the label but which is used in a manner differing from that on the label (for instance the dosage is changed, the route of administration or the indication/disease process is different from the label). This is referred to as extra-label drug use (ELDU) and can only be authorized by a veterinarian in the context of a valid veterinarian-client-patient relationship (VCP). In general, this means that 1) the veterinarian has been to the farm, examined the animal(s) in question and determined that no approved drug exists to treat their condition or that the dosage prescribed for an approved drug is ineffective; 2) the veterinarian instructs the producer on proper use and administration of the drug and determines an appropriate withdrawal period; and 3) the veterinarian is available in the case of adverse reaction to the drug and for follow-up examination and treatment. All three conditions must be met for ELDU. Complete records of animal number, drug given, dosage, route of administration, date, and specified withdrawal period must be maintained for all ELDU.

Some practical implications for how this impacts drug usage on goat dairies are warranted.

1) Over-the-counter purchases and ELDU. Many producers purchase over-the-counter drugs for use in their operation. These are drugs that do not require a veterinary prescription. Examples include procaine penicillin, oxytetracycline, ivermectin, and fenbendazole. In cases where these drugs are used exactly as labeled on the bottle, these products do not require a prescription; however, these products are rarely used according to the label. For example, the labeled dose of penicillin is far below therapeutic levels, therefore to be effective the dosage must be increased and, consequently, this now requires a veterinary prescription for ELDU of this product. In fact, all four products listed above, if used in an efficacious manner, will involve ELDU. Consequently, for a producer to utilize over-the-counter products such as penicillin and ivermectin effectively in dairy goats a prescription is required. A penicillin residue in milk without a valid veterinary-client-patient relationship and an ELDU prescription would be a violation of federal law.

2) Veterinarians in other parts of the country that do not routinely visit your farm and are not available for coming to the farm in the case of an emergency likely do not meet the standards for a valid veterinarian–client-patient relationship. Due to the perception that many veterinarians do not “know anything about goats,” it is common for dairy goat producers to call veterinarians in other parts of the country for advice or information. In such a case, any advice or treatment recommendations legally need to be administered through a local veterinarian with a valid veterinarian-client-patient relationship. A verbal or email conversation between a producer and a veterinarian that has not physically visited the farm and seen the animals or is not available for immediate follow-up in the case of an emergency is not a prescription for ELDU.

3) The milk and meat withdrawal times listed on the bottle do not apply when the product is used in an ELDU manner. The veterinarian will provide new withdrawal times for the product based on dose, route, and principles of pharmacology. This new withdrawal time is legally binding for the producer and must be adhered to. In most cases, the new withdrawal time will be longer than that listed on the bottle in order to assure no residue is present.

4) Perhaps the best means of establishing a valid veterinarian-client-patient relationship with your veterinarian, as well as providing the ability for the farm to treat animals legally without having to call the veterinarian for each individual animal, is the formation of standard operating procedures (SOPs). These SOPs for common treatment or management procedures allow the veterinarian to provide detailed input on how the treatment should occur (i.e., what are the triggers for treatment intervention, what drug should be used and how, what withdrawal times are appropriate, and how follow-up
will be done). This document should be signed by both the veterinarian and the producer and evaluated/renewed on a yearly basis. In essence, these documents serve as contracts to document how ELDU will occur on a farm and provide detailed information on how to do that and maintain excellent quality assurance.

_Herd Health BMP #3- Store and administer drugs according to labeled use or veterinarian authorized off-label use and follow all withdrawal periods_

Drugs should be stored securely away from curious animals and unauthorized persons. In most jurisdictions, drugs for use in lactating animals should be stored physically separate from drugs that are not utilized in lactating animals. Some drugs require refrigeration. When administering drugs, follow recommended dosages and administration guidelines or follow veterinarian instructions regarding ELDU. Protect drugs from sunlight and heat during use to prevent reducing their effectiveness. Do not use drugs past their expiration date. Record the date and amount of drug administered and the date when the prescribed withdrawal period has been fulfilled for each animal when treated.

_Herd Health BMP #4- Use proper injection technique including preferred injection site (in front of the point of the shoulder)_

Use the correct injection method when administering injectables. Subcutaneous (SQ) administration is preferred to intramuscular (IM) injections. When administering drugs SQ, use proper “tenting” technique to avoid entering the muscle. If IM injections must be given, ensure that all injections are given in front of the point of the shoulder. Lesions can form from injection sites and injecting in the neck prevents damaging the more valuable cuts of meat.

When giving IM injections, proper technique calls for pulling back slightly on the plunger after entering the muscle to make sure a vein or artery has not been penetrated. Injections given in muscle allow for slower absorption of the active drug than intravenous (IV) injections. If, in an IM injection, a vein has mistakenly been penetrated, the rate of drug absorption will be dramatically increased. This may cause shock, seizures, or animal death depending on the drug. Intravenous injections should only be given by experienced individuals.

Proper injection technique also includes proper needle selection depending upon the viscosity or thickness of the drug to be administered, injection method, and age of the animal. Generally, 18 to 20 gauge needles are sufficient for most injections. Lengths of 3/4 to 1” should be used for IM or IV injections, while shorter lengths of ½ to 3/4” are suitable for SQ injections. To minimize animal discomfort, avoid using dull needles. It is suggested to change needles after a maximum of every 10 animals. If a blood-borne disease (caprine arthritis encephalitis – CAE or other) is suspected to be present in the herd, needles should be changed after every animal. If a needle becomes bent, replace it immediately. Have an appropriate “sharps” container to dispose of used needles.

_Herd Health BMP #5- Provide training to all persons treating animals on proper drug usage and administration techniques_

All persons who work on the farm should be trained in proper herd health care including drug use and storage, injection techniques, and in completing the record keeping system used. Training should be kept up to date and reviewed when new drugs are introduced. When SOPs are utilized it is a good management practice to have each employee sign that they have been trained on the SOP. The SOPs should also be easily available for reference on treatment specifics.

**Best Management Practices in Nutrition/Feedstuffs**

_Nutrition/Feedstuffs BMP #1- Provide proper nutrition to all animals according to age and stage of production_

Proper nutrition is essential in the well-being and productivity of all farm animals. Properly fed animals are healthier and will exhibit greater production efficiency than underfed or overfed animals. Good nutrition and health begin with ensuring that all kids consume colostrum to receive needed nutrients and antibodies. Body condition scoring provides producers with information on the nutritional status of their herd and the need for feeding adjustments. Using a nutrient calculator, such
as the web-based calculator developed by the American Institute for Goat Research found at http://www2.luresext.edu/goats/research/nutreqgoats.html, can help producers determine the amount of energy and protein-needed for animals at different ages and production stages.

**Nutrition/Feedstuffs BMP #2 - Ensure that feed and water are free of contaminants**

Feed should be stored in areas that are free of the risk of contamination from foreign substances, such as motor oil, chemicals, baling twine, etc. Storage conditions should also ensure that no fermentation or mold growth occurs that could lead to the presence of mycotoxins. Purchased feed should be free of aflatoxins and other harmful substances. Water should not contain high levels of dissolved salts, chemical residues, feces, or urine. Feeders and waterers should be constructed to minimize opportunities for animals to foul feed and water through urine or manure. Control rodents from entering your feed supplies. Purchased feed and hay should be free of chemical, biological, and foreign material hazards.

**Nutrition/Feedstuffs BMP #3 - Comply with FDA regulations on the ban of feeding ruminant-derived protein supplements to other ruminants**

The Food and Drug Administration has published regulations prohibiting the feeding of feedstuffs containing proteins derived from other ruminant species to other ruminant animals. This has been mandated to prevent potential cases of bovine spongiform encephalopathy (BSE, also known as Mad Cow Disease), from occurring in ruminants in the US. Banned feeds include all protein supplements of ruminant origin including ruminant-derived meat meal, meat and bone meal, blood and blood byproducts, glandular meal, etc. Pet food may contain substances banned from ruminants; thus, food for guard dogs should not be readily available for goats to eat. Other prohibited substances include human plate waste processed for livestock feed.

**Nutrition/Feedstuffs BMP #4 - Take proper care in the use of medications and other feed additives**

Few medications and feed additives are approved for use in goats. To find the current status of drugs, additives, and medications approved for goats, consult a veterinarian or the Food and Drug Administration “Green Book” that lists approved drugs for livestock. This searchable on-line database can be found at http://www.fda.gov/AnimalVeterinary/Products/ApprovedAnimalDrugProducts/default.htm. A searchable database can be accessed through Animal Drugs @ FDA http://www.accessdata.fda.gov/scripts/animaldrugsatfda/. As of this writing, April 2016, only 51 drug products have been approved for use in goats. Consult a veterinarian concerning any possible use of medicated feeds in an off-label manner.

**Nutrition/Feedstuffs BMP #5 - Record use of chemicals on pastures to prevent harvest and feeding of feed containing chemical residues**

A major issue in food safety is chemical residue avoidance. Chemical residues (drug residues or chemical toxins) are one of the three contaminants that affect milk safety, the others being biological (microbial) and foreign substances (such as metal, glass, plastic, etc.). Anytime a pesticide or herbicide is applied there is potential for that chemical to enter the food chain. Appropriate sprayer cleaning procedures and proper disposal of used containers is essential. Care should be taken during application to prevent chemical runoff that will contaminate water supplies. Consult product labels for approval for use on forage or feed crops and for grazing and harvest withdrawal times.

**Best Management Practices in Milk Quality and Mastitis Management**

**Milk Quality and Mastitis BMP #1 - Proper sanitation and waste management to allow for good udder hygiene**

Surface contamination of the udder with feces, urine, or soil can pose a significant risk to milk quality and hygiene. If this contamination is not completely removed from the udder and teat prior to milking, this contamination will be dislodged by the milking machine inflation and may be carried directly into the milk. For this reason proper waste management, bedding management, and sanitation are all critical to milk quality. Animals should be housed in a clean, dry environment. Manure should not be allowed to accumulate to excessive levels and the udder/teat should remain visibly clean between milkings. Tailhead, udder, and thigh hygiene scoring systems have been developed for dairy cattle but are difficult to apply in dairy goats due to the formed, dry nature of the feces. In general, no fecal contamination of the udder should be observed and the udder should not be damp or wet when the animals enter the parlor. Excessive moisture in bedded packs may be evidenced by wet udders and teats during milking and should be corrected immediately.

**Milk Quality and Mastitis BMP #2 - Documented milking procedures and SOPs**

Consistency in teat preparation and milking procedures allows for improved milk hygiene, improved milk quality, and improved health of the mammary gland. Standard operating procedures for milking should be developed in consultation with your veterinarian and...
milking equipment dealer. Use of pre-dips and post-dips is documented to significantly impact milk quality in dairy cows and is strongly recommended for dairy goats. The SOP should address teat preparation, the time from preparation to milking unit placement, how to observe and determine when the machine should be removed, and the appropriate post-milking dip and management. Machine stripping should be discouraged.

Routine milking systems management and maintenance are important and should be monitored and recorded on a regular basis (every 1,200 hours of use or annually). These measurements should include vacuum pressure (measured at teat end), pipeline or bucket cleaning procedures, regular replacement of the teat liners (follow manufactures recommendation but typically run every 1,200 to 1,500 milkings for rubber inflations and roughly every 6,500 milkings for silicone inflations), and assessment of milking machine leaks during milking. There should be less than a 0.6 inch fluctuation in vacuum pressure on a bucket milker while placed on an animal and for units with more than one claw there should be less than 0.6 inches of vacuum fluctuation when a single claw falls off a doe or is left open. Pulsation rates are generally recommended to run between 60 to 90 pulsations per minute but faster rates may lead to more rapid wear on inflations and require more frequent replacement of inflations.

**Milk Quality and Mastitis BMP #3 - Read and utilize milk quality reports**

Every milk shipper provides reports to the producer of the milk quality parameters measured by the creamery and/or state department of agriculture. It is important that the producer learn to read these reports and review these reports with the herd veterinarian in order to assure that issues are promptly identified and managed. The most common issues involve high somatic cell counts or high bacterial counts in the bulk tank. Although goats tend to have higher somatic cell counts than cattle, these issues can be addressed and cell counts less than 500,000 are readily achievable and will often result in premiums from the milk shipper. Milk quality reports should be evaluated for every shipment by the producer and should be discussed on a quarterly basis with the herd veterinarian.

**Milk Quality and Mastitis BMP #4 - Proper milk cooling**

Proper and rapid cooling of milk is necessary for a variety of reasons. In addition to controlling bacterial replication, rapid cooling provides for a more consistent flavor and longer shelf life of the product. Producers should work with their state dairy inspectors to assure that proper cooling is occurring to meet regulatory requirements. Temperature recorders are required on all bulk tanks for commercial sale. Cooling will typically be prolonged for the first milking that goes into an empty tank since there is no cold milk to mix with the new milk. Some general guidelines (may not apply to all jurisdictions for milk cooling) are as follows: For the first milking in the tank, cooling to 34 to 40°F (1 to 4°C) should occur within 2 hours and ideally within 30 minutes. For subsequent milkings, the blend temperature should never rise above 50°F (10°C) and the tank temperature should return to 34 to 40°F (1 to 4°C) within 1 hour and preferably within 30 minutes. Ideal storage temperature between milkings is 34 to 36°F (1 to 2°C).

Milk and colostrum for use in feeding kids should be managed in a similar manner. If milk is not properly cooled, bacterial overgrowth can rapidly occur and result in neonatal diarrhea issues for kids consuming the milk. Intermittent temperature checks and charting should be done on milk used to feed kids to assure the quality. Use of stainless steel temperature data recorders (similar to HOBO® data loggers) can be useful in assuring proper cooling for producers that do not utilize bulk tanks.

**Milk Quality and Mastitis BMP #5 - Protocols for identifying, diagnosing, and treating both subclinical and clinical mastitis**

Mastitis is a leading cause of economic loss in dairy goat operations and results in significant animal health and welfare concerns. Producers should develop a "mastitis management team" that includes the farm employees responsible for milking, the farm manager, the herd veterinarian, the milk plant field representative, milking equipment specialist, and extension personnel. This team should provide annual input on mastitis management plans and SOPs after careful review of the previous year's milk quality records and the milking system evaluation. SOPs should be developed for the following specific areas: 1) Identification of both clinical and subclinical mastitis in does, 2) Treatment intervention in clinical and subclinical mastitis including follow-up and precautions to prevent antibiotic residues from entering the bulk tank, and 3) Appropriate use of dry treatment protocols to minimize the prevalence of subclinical mastitis in the herd. It is important that the producer understands the use of both somatic cell count (SCC) and on farm tests such as the California Mastitis Test and PortaSCC® Goat Milk Test (PortaCheck, Inc.) for mastitis monitoring and management. Animals that have recurrent bouts of mastitis should be considered for culling and animals with significant increases in SCC on monthly reports or with chronically high SCC should be thoroughly evaluated for clinical or subclinical mastitis.
Best Management Practices in Management and Proper Care

Management BMP #1 - Provide proper care to all animals

Goats should have daily observation and care to lead healthy, productive lives. Observing animals during feeding and milking and learning their normal behavior allows a producer to immediately sense when something is "wrong" and extra attention is needed.

Proper care of goats begins with care of pregnant does, including nutrition, housing, vaccination, and avoiding stress. Properly cared for does will have healthier kids with fewer future health problems. Care should be matched to animal age and expected production level. Trim hooves as needed to prevent foot and leg problems. At all times, the welfare of the goats should be considered and efforts made to minimize pain and stress on the animals. This promotes a healthy production environment and reduces the need for medicines and veterinary costs.

Management BMP #2 - Use proper gathering and handling techniques to reduce animal stress

The herding behavior and flight zone of goats should be understood in order to make moving animals in and out of the parlor and around the farm easier. When herding goats, move calmly and let goats go at their own pace. Most people will move faster than the rate at which goats normally walk, thus it is often necessary for animal handlers to walk slower than their normal pace. When animals are being held in holding pens prior to being milked they should be calm and rapid parlor entry should be encouraged through acclimation to routine and the use of flight zones. Shouting, loud noises, and excessive flailing of arms should not be necessary to move animals into the parlor; and cases where these are necessary should be evaluated for design flaws. Goats should not be caught or held by grasping the hair or skin, or by catching a leg or tail by hand. Animals should not be subjected to undue stress during gathering and handling.

Management BMP #3 - Provide training in proper goat care and handling techniques to personnel working on the farm

All persons who care for or manage animals on your farm should receive training in proper goat care and handling. This will pay dividends in better animal productivity and reduced injuries and disease incidence. If many people are employed or the production system is complex, a training manual providing information on the management and care practices used on-farm could be devised and available for employee use.

Management BMP #4 - Inspect facilities periodically to maintain them in good working condition

Buildings and fencing should be inspected periodically and repairs made. The condition of buildings and facilities can affect the welfare and productivity of goats. Injuries due to poorly maintained facilities can leave an animal open to infection, necessitating additional expenditures for veterinary care and/or long-term problems. In extreme cases, death can result from inadequately cared for buildings or fencing. An example, injuries to dairy does requiring antibiotic use necessitate the dumping of milk during the withdrawal period. In general, money spent in maintaining facilities will be recouped in reduced veterinary costs and death losses.

Management BMP #5 - Facilities should have adequate housing and feed space for the number of animals housed in a pen

Goats have a very strong social order and need adequate housing and feed bunk space to assure proper nutrition and health. Although rigid guidelines do not

Table 1. Goat space requirements

<table>
<thead>
<tr>
<th>Housing type</th>
<th>Doe</th>
<th>Buck</th>
<th>Young kids</th>
<th>Weaned kids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedded pen</td>
<td>12 - 18 ft²</td>
<td>30 - 40 ft²</td>
<td>3 - 6 ft²</td>
<td>8 - 10 ft²</td>
</tr>
<tr>
<td>Dirt lot</td>
<td>25 - 40 ft²</td>
<td>100 ft²</td>
<td>NR</td>
<td>20 - 30 ft²</td>
</tr>
<tr>
<td>Paved lot</td>
<td>16 ft²</td>
<td>NR</td>
<td>NR</td>
<td>10 ft²</td>
</tr>
<tr>
<td>Total confinement</td>
<td>20 - 25 ft²</td>
<td>NR</td>
<td>8 - 10 ft²</td>
<td>8 - 10 ft²</td>
</tr>
<tr>
<td>Individual pen</td>
<td>6' x 6'</td>
<td>6' x 6'</td>
<td>4' x 4'</td>
<td>4' x 4'</td>
</tr>
<tr>
<td>Pasture</td>
<td>0.5 acre</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Feed bunk space

| Limit feeding        | 16" - 20"        | 12"             | 9" - 12"   | 9" - 12"    |
| Feed always available| 4" - 6"          | 6"              | 4"         | 4"          |

From Ensminger & Parker, Sheep and Goat Science, 1986.
exist for benchmarks on space requirements, the recommendations in Table 1 are utilized in most scenarios.

**Best Management Practices in Record Keeping**

**Record Keeping BMP #1 - Identify each animal**

Identifying animals is essential for good record keeping and all animals should have a unique identifying number. Some breed registries may require a tattoo be applied and have their own policies concerning placement and numbering. If used, neck chains should be moderate in strength allowing them to break if the chain gets caught in brush or on fencing where it could be a choking hazard. Ear tags should be applied properly between the cartilage ribs on the ears. If clip type ear tags are used on young animals, the tag should be placed allowing for future growth of the ear. Radio frequency chips embedded in ear tags, ruminal boluses, and other forms are also appropriate methods of permanent identification. Goats should never be hot or freeze branded.

**Record Keeping BMP #2 - Keep and maintain records on all animals on pertinent production parameters, vaccinations given, and other drug treatments**

Complete, accurate records of animals on your farm will assist in making management decisions regarding breeding, culling, and sale. Records of health treatments given to animals are necessary to prevent the sale of milk or the harvest of animals prior to completion of withdrawal periods, to prevent multiple doses of a drug being given to a particular animal, and to check on treatment progress. Records on chemical use, feed and drug purchase, etc., can also help safeguard your operation should questions arise concerning animals you may have sold. Each treatment record should include the identification of the animal, the purpose for treatment, the dose and route of treatment, the required withdrawal time, and the date when the animal will complete the withdrawal period. It is imperative that the withdrawal period be calculated from the last dosage given. The record should also provide a means of cross-checking to assure that animals do not get treated repeatedly for the same purpose.

Breeding records are necessary for management decisions and potentially for registration purposes. Keep written records in a safe place and ensure backup copies are made of any electronic files kept on a computer.

**Record Keeping BMP #3 - Periodically review records for completeness and accuracy**

Records are most useful when complete and accurate. A periodic review of records and record keeping methods will help catch mistakes and oversights while they can still be easily corrected. This review should happen at least annually. A better management practice would be to review records quarterly. Ensure that all new employees are trained in record keeping to prevent mistakes from occurring.

**Record Keeping BMP #4 - Keep a purchase log of all drugs and medicated feeds purchased for the farm and their expiration date**

In order to track drug usage and assure compliance with withdrawal times, it is recommended that a list of all drugs or medicated feeds purchased by the farm be kept in a central location. Each purchase should list the drug name, prescribing veterinarian, source, appropriate SOP to be utilized, the required milk and meat withdrawal period as well as the expiration date of the product. This log allows for rapid identification of drug options for therapy and when reviewed with your veterinarian assures that all compliance issues are addressed in advance.

**Best Management Practices in Biosecurity**

**Biosecurity BMP #1 - Establish a biosecurity plan for your farm**

A biosecurity plan reduces the risk of diseases entering and spreading within your farm and prevents diseases your animals may have from leaving your farm. Consider your production operation and devise a plan to ensure your animals are protected from diseases entering your herd. Potential ways in which diseases could enter your farm include: visitors, feed deliveries, new animal acquisition, show animals returning to the herd, stray animals, rodents, birds, and others. The potential risk from these various areas should be examined in the context of your production situation. Plans should be made to protect animals from identified risks and to deal with animals that become ill or die so that diseases occurring on your farm are not transmitted beyond your farm gate.

**Biosecurity BMP #2 - Minimize or avoid contact between your animals and animals not on your farm**

Many diseases are transmitted through animal to animal contact. Avoiding contact with animals not on your farm will reduce disease outbreaks. This contact could be via fence line exposure or by showing goats at a local fair. Consider the location of pastures and grazing areas in relation to your neighbors’ animals. If new facilities are planned, consider the location of neighboring livestock barns and pens. Do not build facilities in or near drainage areas from livestock facilities. If your animals are very valuable, for example breeding males whose semen is collected for sale, consider double fencing.
along adjoining property lines to further protect them from neighboring animals. At exhibitions, house animals using solid partitions to minimize contact. Control stray animals, both domestic and wild. Maintain quarantine procedures. Do not haul other animals with your own goats or with your trailer. Clean mud and manure from livestock trailers.

**Biosecurity BMP #3 - Establish a quarantine protocol for animals entering your herd**

Preventing diseases entering your herd from new animals begins during purchase. Be sure to ask the seller for health and production records on animals you plan to buy. Ask about the disease or herd health program followed. Also, look at the whole herd, not just the few animals you plan to purchase. This will give an indication of the health program followed.

Upon arrival at your farm, place new animals in quarantine for a minimum of 30 days. Consult a veterinarian for a quarantine vaccination and deworming protocol and any diagnostic tests that should be performed. Buckets, shovels, fencing, etc., used in the quarantine area should not be moved and used in the general herd. Feed and care for quarantined animals last and do not re-enter your herd before changing clothing and washing boots to prevent carrying diseases from new animals to your herd. Or you may wish to have a separate set of boots and clothing for the quarantine area. As an example, if a quarantined animal has a caseous lymphadenitis abscess that bursts, a person may inadvertently step in the pus from that abscess and carry that on his or her boots. If that person then re-enters the farm herd, he may contaminate the ground or other animals.

Quarantine animals upon return from exhibitions or fairs if they have had contact with other animals. Follow the same quarantine guidelines for these animals as with purchased animals. Do not haul animals other than your own to and from shows.

**Biosecurity BMP #4 - Establish a protocol for visitors to your farm**

Many visitors to your farm will likely be producers themselves. To ensure that diseases are kept from entering your farm area, establish a protocol for any visitors and their vehicles. Control traffic entering your farm and have a separate parking area or ensure that vehicles are clean of mud and manure. This includes livestock trailers, feed delivery trucks, and veterinary vehicles. Consider having disposable boots available for visitors who wish to tour your facilities and herd. Alternatively, have a footbath with disinfectant where visitors can clean their shoes before and after seeing your animals. Have a wash basin or facility for visitors to wash their hands before and after handling animals. Explain that your procedures protect not only your herd, but theirs as well.

**Biosecurity BMP #5 - Do not allow persons who have had contact with livestock in foreign countries on your farm, or bring clothing or other items from them to your farm, for a period of 5 days after their arrival in the US.**

Largely in response to outbreaks of foot and mouth disease (FMD) in other countries, the USDA published guidelines for persons from, or who have traveled to, foreign countries where FMD is present. These persons are encouraged not to have contact with livestock for 5 days after entering the US. Some states or institutions, such as Langston University, recommend a 10-day waiting period. The virus causing FMD can be carried in hair and nasal passages, clothing, luggage, shoes, etc. Following this BMP helps safeguard the entire US livestock industry. Outbreaks of FMD, while not a threat to humans, result in the necessary destruction of all infected and potentially infected animals with enormous industry and economic consequences.

Preventing or minimizing contact between foreign travelers and your herd for the period after their arrival may also prevent the spread of other diseases as well.

**Long-term Benefits to the Dairy Goat Industry**

Adoption and use of a DGQA program sends a signal to the livestock industry and to consumers that the production of dairy goats is continuing to grow and become an economically viable nationwide industry. Sustaining and enhancing this growth requires increasing the availability of safe, wholesome goat products in the marketplace. Using procedures included in a DGQA program can assist livestock owners in making correct production decisions. The Best Management Practices (BMP) may also bring new ideas or approaches to existing management activities. Utilizing HACCP-like principles in implementing the DGQA program promotes a quality management style that anticipates and prevents problems.

Adhering to a DGQA program benefits all aspects of the dairy goat industry from raising healthy, productive animals to producing high quality milk and dairy products. This embodies a total quality management approach to the dairy goat industry assuring consumers of the wholesomeness and quality of US-produced goat products.
Resources


