

Guide to udder health for dairy goats – Providing guidance for veterinarians and producers in improving milk quality

Paula I. Menzies, DVM MPVM DipECSRHM

Department Population Medicine, Ontario Veterinary College, University of Guelph, Guelph, Ontario CANADA N1G 2W1, pmenzies@uoguelph.ca

Abstract

An udder health guide developed for dairy goats provides guidance to producers, veterinarians, and dairy support personnel in how to control mastitis and maintain milk quality. It is divided into 8 sections that cover normal anatomy and physiology, the causes of mastitis and how to detect it, best practices for milking management, maintenance of milking equipment, and troubleshooting poor milk quality. Other sections cover treatment and control of mastitis, monitoring udder health, and health management of the dairy doe. More research is needed in some areas, although there is sufficient information available to provide a high quality udder health program to this dairy sector.

Key words: dairy goats, milk quality, udder health, mastitis

Résumé

Un guide de la santé du pis développé pour les chèvres laitières fournit des directives aux producteurs, aux vétérinaires et au personnel de soutien de la ferme laitière dans le but de contrôler la mammite et d'assurer la qualité du lait. Ce guide est divisé en huit sections qui couvrent l'anatomie et la physiologie normales, les causes de la mammite et sa détection, les meilleures pratiques pour la régie de la traite, le maintien de l'équipement de traite et la résolution des problèmes associés au lait de mauvaise qualité. D'autres sections couvrent le traitement et le contrôle de la mammite, la surveillance de la santé du pis et la régie de la santé de la chèvre laitière. Bien que de plus amples recherches soient nécessaires dans certains domaines, il y a assez d'information disponible pour avoir un programme de santé du pis de grande qualité dans ce secteur laitier.

Introduction

This guide is designed to help educate producers, veterinarians, and extension and dairy support personnel on how to best to produce quality milk by keeping the udder healthy. The information in this guide has come from a number of sources, but includes extension information from both the small ruminant and cow sectors, and new information

from the latest research from around the world. The entire guide is available online for American Association of Small Ruminant Practitioners members on their website.

Quality milk is defined by its characteristics:

- The level of bacteria in the milk;
- The number of somatic cells;
- The freezing point if the milk is abnormal in composition;
- Presence of residues of veterinary drugs and other chemicals or toxin; and
- By its color, flavor and odor.

Most processors have standards, and provinces (and states) have legislation, governing what is acceptable quality for goat milk. None of the components of this guide are part of a regulatory process, but its contents will assist understanding how to produce better quality milk, with particular reference to the health of the udder.

The term “udder health” refers to those measures that keep the udder healthy so that it can produce high-quality milk. But of course, the udder is attached to the doe and the doe lives with other goats – so really “udder health” also refers to those practices designed to keep the herd healthy so that the does can produce healthy milk.

Mastitis is the number 1 reason for poor udder health and is the major focus of the guide, but overall doe health also influences the ability for it to produce quality milk. Udder health is an integral component of producing quality milk – in terms of the level of somatic cells (a measure of mastitis), some aspects of bacterial counts, and of course residues of drugs in the milk. So in summary, this guide will emphasize milk quality within the context of udder health.

The guide is organized into 8 sections. The presentation will be organized in the same manner. It also has 3 appendices: definitions of words or phrases, a self-assessment quiz, and additional resources and references.

Section I. The normal mammary gland system of a doe

This section establishes baseline knowledge of the normal anatomy of the udder and teats as well as the normal physiology of lactation, including the hormones involved in initiation and drying off. The anatomy of the teat is emphasized so that producers understand the role it plays in

prevention of mastitis and factors that put its integrity at risk. Goats are very different from cattle in the volume of milk that can be held in the cistern; this will affect how goats are milked, in order to minimize the amount of residual milk left in the udder.

The process of apocrine secretion is explained, important when somatic cell counts are discussed. The role of oxytocin, including its triggers for release or inhibition of release, is explained so that producers understand milk letdown. Dry-off is particularly different in the doe, with extended lactations becoming common.

Normal milk production levels for the different breeds, as well as the shape of lactation curves for those breeds are provided. The factors that affect peak milk and lactation length are reviewed including photoperiod, frequency of milking, pregnancy, and others.

Section II. Mastitis – What causes it and how it is detected

Mastitis means inflammation of the mammary gland and change to the anatomy and/or physiology of the udder. Inflammation is the animal's response to a microorganism (e.g. bacteria, viruses) but may also be a response to injury or systemic illness. Inflammation can be seen because the udder will become red, swollen, and painful – indications that the immune system is active in the udder. "Intramammary infection" (IMI) is a term often used instead of mastitis, but is caused by a microorganism.

The economic costs of mastitis in goats have not been well described in terms of dollars, but the factors to be considered are known. Mastitis causes loss in milk production and the quality and yield of milk products (e.g. cheese, yoghurt, fluid milk). It cannot be eradicated, but a control program can reduce the losses. The program should be able to provide a favorable benefit-cost ratio and a substantive "avoidable loss" – the difference between current losses and achievable losses given an udder health management program.

The costs associated with mastitis aren't just from lost milk production but also include: earlier culling and lost opportunity sales of young-stock to replace those does; difference between a cull doe slaughter price (or dead doe) and the value of a replacement doe; lost bonuses for producing quality milk; rejection of milk due to low quality; lost kid production; veterinary costs for treating clinical mastitis; value of discarded milk and risk of inhibitors; increased feed cost associated with feeding less-productive does; and increased management costs to manage mastitic does. Welfare costs related to sick animals should also be considered.

The costs of a mastitis control program include improvements in housing, milking equipment and its maintenance; improved hygiene at milking and products to support it; preventive therapies such as intramammary antibiotics; routine monitoring for mastitis including somatic cells and culture; and changes in policy on maintaining infected goats, e.g. with *Staph aureus* mastitis. The costs of the program (or

investments in the program) should be much less than the benefits realized because the costs of mastitis are avoided.

The public health risk associated with poor udder health should also be part of understanding the benefits of mastitis control. Zoonotic bacteria, contamination with antimicrobials, and risk of antimicrobial resistance are some of what needs to be considered.

This section also covers the clinical presentation of mastitis:

- Severe clinical mastitis – the doe is ill, e.g. fever, dehydration, off feed with changes in udder and milk and includes gangrenous mastitis;
- Moderate clinical mastitis – the doe is not ill but there are palpable or visual changes in the udder (e.g. swelling, redness, fibrosis, abscessation) as well as changes to milk;
- Mild clinical mastitis – the doe is not systemically ill and the udder has no changes but the milk is abnormal, e.g. clots, discoloration;
- Changes in mild and moderate mastitis may be acute or chronic.

Subclinical mastitis occurs when no changes are clinically apparent but inflammation or infection can be detected. Production losses occur as well.

Agalactia may also be a feature of mastitis. This may be due to loss of alveolar tissue from mastitis including alveolar tissue at the top of the teat; caprine arthritis encephalitis (CAE) infection causes loss of alveolar tissue and scarring; teat wounds and secondary scarring from biting, causing blockage; congenital blockage which is not common; and starvation or severe debilitation.

The microorganisms commonly responsible for mastitis in goats are covered, and differentiated by whether they are considered contagious (spread goat to goat) or primarily contracted from the environment.

Contagious Pathogens

Staphylococcus aureus (SA)

In goats, this is the most common etiology of clinical mastitis and can be responsible for a range of presentations from subclinical changes in the milk to gangrenous mastitis. SA infections may come from other animals, but also people and teat lesions. As with cattle, chronic SA infections are almost impossible to cure.

Coagulase-negative Staphylococci (CNS)

This group of organisms comprises up to 95% of positive cultures. The most commonly isolated organisms are *S. caprae* and *S. epidermidis*. There is variation in pathogenicity between species, with *S. caprae* appearing to be the most pathogenic. IMI is considered to be present when > 5 colony forming units (cfu)/ μ l milk and 1 to 3 colony types are present. Self-cures do occur during lactation and during the dry period.

Streptococcus agalactia

This very important cause of contagious mastitis in dairy cows appears to be rare in dairy sheep or goats.

Mannheimia spp

These organisms are not a common isolate of goat milk. In sheep the strains of *M. haemolytica* are identical to those isolated from the nasopharynx of lambs. It may be similar to meat goats.

Caprine arthritis encephalitis virus (CAEV)

This virus targets the mammary tissue as well as joint, bursal synovium, and lung. Infection in does > 1 year of age is associated with elevated somatic cell counts (SCC) and approximately 10% reduced milk production compared to seronegative goats.

Orf virus

This parapox virus does not invade the mammary gland, but infects the teat end and allows colonization of the lesion with SA, which frequently results in severe clinical mastitis. This infection usually occurs if kids are allowed to nurse dairy animals.

Mycoplasma mycoides subsp capri

This is a virulent organism that can cause severe outbreaks of kid septicemia, septic arthritis, and pneumonia. In adults it can also cause subclinical to severe clinical mastitis, mild to severe agalactia, and occasionally septicemia. Does infected as kids will shed the organism in the milk and colostrum.

Mycoplasma agalactiae

This is a common cause of small ruminant mastitis in the Mediterranean countries and is considered exotic to North America at this time.

Environmental Pathogens

Streptococcus uberis, S. dysgalactia, Enterococcus spp

These organisms are a common cause of mastitis of dairy cattle, and less so of small ruminants, although some dairy goat herds report a high incidence of *Strep* mastitis. A dirty housing or milking environment is generally associated with this disease agent. In heavily infected herds, *S. uberis* can also act as contagious bacteria. This organism has also been implicated in dairy goat herds as a mastitic cause of elevated standard plate counts (SPC), a measure of milk quality.

Coliforms

This group of organisms traditionally includes *E coli*, *Klebsiella pneumonia*, and *Salmonella spp*. These organisms occur much less frequently than in dairy cattle, but they tend to cause severe clinical mastitis and are associated with dirty housing conditions.

Pseudomonas aeruginosa

This organism can be responsible for outbreaks of severe clinical mastitis with up to 20% morbidity in some dairy goat herds. It is primarily an environmental organism and often associated with dirty or contaminated water, e.g. wash water for udders.

Yeast

Usually due to intramammary treatment with antibiotics but can also be poor infusion technique. *Cryptococcus* rarely resolves, while candida will spontaneously resolve with stripping.

Listeria monocytogenes

Although mastitis due to this organism is not common in goats and sheep, shedding may be. This becomes an important human health hazard if raw milk is consumed either as fluid milk or semi-soft and soft cheeses. *Listeria* may survive longer than 60 days, making raw milk hard cheeses also a possible source of human infection.

Presence of a pathogen alone rarely causes mastitis; risk factors are discussed in detail. Table 1 indicates some of those factors.

Table 1. Risk factors for mastitis in dairy does.

Factor	Risk
Kidding time	Weakened immune system; number of kids born; difficult kidding
Stage of lactation	The prevalence of infection increases in late lactation
Nursing kids	The risk increases if kids are allowed to nurse. They can transmit bacteria and orf virus. Additionally, they may damage the teat from biting.
Dry-off	Timing and method of dry-off
Lactation number	Older does tend to be more at risk for mastitis
Viral infections	CAE virus; orf virus
Udder shape and size	Poor shape interferes with milk-out; poor size will reduce milk production; poor teat placement and teat size will interfere with milk-out. This includes extra teats. Worn out suspensory ligaments will cause the teats to be low and susceptible to damage.
Teats	Teat-end calluses from over-milking or long milk-out times; warts
Environment	High stocking densities; poor ventilation; wet and cold floor and dirty bedding; air temperature too hot or cold; high humidity; inclement weather; relocating and mixing does
Milking technique and equipment	Poor udder preparation – cleanliness and milk let-down; dirty hands; cracked and worn teat liners; high vacuum levels; inadequate vacuum reserve; incorrect pulsation rate and ratio; over-milking; failure to properly teat dip
Genetics	Resistance to mastitis
Nutrition	Low energy; selenium, and vitamin E

How do we detect mastitis in an individual goat?

Clinical examination of the udder, teats and milk is reviewed, including what is normal and abnormal. Abnormal milk, as defined by the Ontario Provincial Milk Act:

- a) Comes from an animal 15 days prior to and 3 days after parturition (or longer if it still contains colostrum);
- b) Contains blood or other foreign particles;
- c) Is watery or coagulated;
- d) Has odors that adversely affect its organoleptic characteristics; or is,
- e) Contaminated by chemical, toxin, drug, or any other foreign substance.

Somatic cells and somatic cell count (SCC) in goats are described in detail. Goats are somewhat unique because of the nature of apocrine secretion leading to misidentification of milk particles as SCCs (as high as 150,000 particles/mL/milk), but also because days-in-milk has such a profound effect on SCC levels, with late-lactation does having values similar to those with subclinical mastitis. Older does also have much higher SCC than primiparous. This makes screening of goats for mastitis using SCC challenging.

Based on the literature, the following is proposed for interpretation of SCCs (Figure 1). These limits can be adjusted down in early lactation and up in later lactation.

LINEAR SCORE	SOMATIC CELL COUNT (Cells/ml milk)	
0	12,500	↑ Healthy
1	25,000	
2	50,000	
3	100,000	↕ Suspect
4	200,000	
5	400,000	↓ Mastitis
6	800,000	
7	1,600,000	
8	3,200,000	
9	6,400,000	

Figure 1. Linear score and somatic cell count limits for goats.

The application of the California Mastitis Test (CMT) is described, including how to interpret the amount of gelling. A video of this is available online at <https://www.youtube.com/watch?v=5Mplg93MUz8&feature=youtu.be>. The decision to perform a milk culture is usually based on diagnosis of clinical mastitis, but should also be done when using a screening test such as SCC or CMT detects inflammation. A good screening test has excellent sensitivity (i.e. ability to detect cases of mastitis) but specificity may be moderate (i.e. will culture milk that turns out to be normal). The manual describes how to properly take a milk sample to optimize the chance it is not contaminated during the sampling process. Interpretation of culture results should be done in consultation with the herd veterinarian, i.e. what positive, no-growth, and contaminated actually mean and how do we interpret the number of colony forming units (CFU) per mL of milk and types of colonies. While most milk samples are taken at the doe level (both glands into 1 sample, also called composite) or gland level, bulk tank or bucket milk samples may also be taken. We know less about how to interpret results compared to dairy cattle.

Section III. Milking Management

This section takes the producer from udder preparation to management after release from the milking parlor. Equipment should only be put on a clean and dry udder. This starts with clipping the long hair from the udder and teats. Many producers skip udder cleaning and preparation – it is not clear why this is done so routinely. The procedure is well described in the chapter. How-to and reasons for pre-dipping are also covered. A list of approved dairy cow disinfectants for washing, as well as post-dipping products is provided so that producers can select a product that is safe and effective. Post-dipping is discussed, including whether to use a non-return teat dip cup vs spraying.

Hand cleanliness is emphasized for both hand and machine milking. Staphylococcal bacteria may be a contaminant from dirty, chapped hands. Number of goats/milking units is discussed in terms of time for udder preparation, milking out and post-dipping. If not enough milkers are used, there is a risk of over-milking and improper udder preparation and post-milking management, all of which can increase the risk of mastitis. Automatic take-offs can help to reduce this risk, but will not mitigate the risk from poor udder preparation. Poor milk letdown as well as poor udder conformation can lead to the practice of machine stripping. Aggressive and repeated stripping may lead to teat-end damage, slower milking, and increased risk of mastitis. Machine set-up with respect to vacuum levels, pulsation rate, and ratios are all goat-specific. These values are provided in Table 2.

Milking order can be used to lower risk of mastitis transmission from chronically infected does. Those identified as SA carriers, but not yet to be culled, should be milked last. CAE-positive animals in herds attempting to eradicate

Table 2. Standard values for milking equipment in dairy goat parlors.

Equipment parameter	Standard value
Pulsation speed	60 to 120 cycles/min – 90 most commonly recommended
Pulsation ratio	50 to 60%
Vacuum at peak flow (kilopascals = kPa)	At the teat: 35 to 39 kPa (10 to 11.5 inches Hg) Low Line System: 35.5 kPa (10.5 inches Hg) High Line System: 39 kPa (11.5 inches Hg) 1 kPa = 0.295 inches of mercury (Hg)

this virus should be milked before them. Doelings should be milked first, but this should include consideration on how the parlor is to be cleaned between groups, including the head gates and bars (caseous lymphadenitis) and feeders if present in the parlor (CL and CAE). Segregation of animals in the barn may be for naught if there is risk of transmission in the parlor or when travelling to and from the parlor. Once the does have left the parlor, they should be offered free-choice water and feed to keep them standing for 30 minutes until the teat sphincter had recovered; the environment should also be clean and dry.

Section IV. Proper maintenance and use of milking equipment

The different types of parlors and their components are reviewed. The next section covers proper cleaning and sanitation in detail and focuses on the 4 factors (physical action, time, chemical strength, temperature) for the 4 steps (pre-rinse, hot wash, acid-rinse, sanitize). The set-up and maintenance of milking equipment is covered with a more in-depth discussion of why it is set up as recommended from the teat cups to the tank or bucket.

Section V. Milk quality

This section reviews what is acceptable milk quality in Ontario for Grade A milk, and where to find information on the standards for the premises. For Ontario herds:

- Contain less than 321,000 individual bacteria cells (IBC)/mL using the Bactoscan method or less than 50,000 bacteria/mL by the Standard Plate Count method;
- Be inhibitor free;
- The somatic cell count for milk shall not exceed for each mL of goat's milk 1,500,000 somatic cells. This is a new requirement as of 2018.
- Be normal as indicated by a maximum freezing point 31°F (-0.534°C);
- Be sweet and clean;
- Be free from objectionable flavor or odor;
- Be from healthy goats; and,
- Be free from adulteration and from contaminants.

The section focuses mostly on bacterial contamination of milk and how to trouble-shoot where it is coming from and how to correct it. High bacterial counts in pooled milk are correlated with poor milking hygiene, inadequate maintenance of milking equipment, and udders with intramammary infections. If there are residues or films of milk or milk stone on any milking equipment, bacteria can grow and affect the bacterial levels in a bulk tank. Specifically, the following are more common sources of high bacterial counts:

- Poor udder preparation prior to milking, including dirty udders and wet teats;
- Unsanitary milk handling equipment including milk claws, pipelines, hoses, buckets, and bulk tank;
- Inflatons that are overused and cracked, causing bacteria to become trapped;
- Bulk tanks or buckets that are unsanitary, and not maintained at the proper temperature for cooling milk (33.8° to 39.2°F [1° to 4°C]) can drastically increase the bacterial count in tanks;
- Water heaters in the sanitation system that do not reach optimal temperature or that have insufficient capacity for the entire cleaning process;
- Udder infections primarily caused by bacteria such as *Streptococcus uberis* and *Streptococcus dysgalactiae*;
- Increased external temperature and humidity.

Proper maintenance, repair, and replacement of worn parts are described. How to prevent and address deposits such as biofilms and milk stone is also addressed. Proper cooling of the milk for storage (i.e. bulk tanks) is emphasized, as this is a problem for the dairy goat industry when milk pick-up frequency is more than 48 h. Issues specific to hand-milking (e.g. hand cleanliness) as well as fly control are also touched upon. What is poorly understood is the role of mastitis in high bacterial counts. This is not common in dairy cattle, but there is mounting evidence that goats may be different. To properly understand this, more research is needed.

Because no animal health products are licensed for dairy goats in Canada, assuring no chemical residues in the milk can be very challenging. A guide is provided to troubleshoot adulteration by antibiotics or other veterinary treatments in the milk. OMAFRA has published many excellent fact sheets on maintaining acceptable milk quality and are recommended for producers struggling with this issue, or for new producers just learning the ropes.

Section VI. Treatment and control of mastitis in dairy goats

This section was the most difficult to write, since specific drugs cannot be recommended when there is nothing approved. The first part of the section focused on principles of selecting treatments and considerations for extra-label drug use. Testing of milk for inhibitors is covered, including tests validated for use in goats. Proper record keeping and

identification of treated animals is emphasized and includes communicating treatments with the milker so that milk from treated animals does not accidentally go in the tank. Principles addressed in the Canadian on-farm food safety program for sheep and goats are used to describe how that should be done.

Selecting goats for treatment (local or systemic) is reviewed. Intramammary infusion products need to be administered properly to avoid contamination of the insertion tip. Splitting tubes between glands should never be done because of this risk. The decision to blanket dry-treat or not is not straightforward. With dairy cows, SCC is used as a selection criterion to reduce antibiotic use. SCC cannot be reasonably used in dairy goats. Culturing each doe at dry-off is an option, but adds expense. Very little research has been published on the best dry-off and treatment methods for goats. Also to consider is that because of the smaller volume of milk produced by a goat, milk withdrawal periods may be longer than for cattle.

Because of the negative effect of CAE on milk production, eradication should be encouraged. A short description of a CAE program is provided, although more detail is necessary at the herd level. Environmental mastitis is too common in Ontario goat herds. This may be related to high stocking densities and poor bedding management. Water can carry *Pseudomonas aeruginosa* and poorly maintained forage and ensiled feeds can grow *Listeria*, both of which can cause mastitis and be a public health problem.

Staphylococcus aureus deserves special attention because of the contagious nature of the bacteria, the severe illness it can cause, and the difficulty in curing infections. The following recommendations are provided to also receive input from the herd veterinarian:

- Culture all does with clinical and subclinical mastitis to detect “staph” does;
- Permanently identify “staph” does and milk separately, either by bucket milker if the does are not segregated from the healthy herd, or preferably segregated from herd (e.g. as a “staph string”) and milked last in the parlor;
- Aggressively treat on the advice of your veterinarian - newly identified “staph” does, particularly if they are recently fresh doelings;
- Treatment is more effective if the doe is dried-up and dry-treated rather than treated while still milking;
- Perform follow-up culturing to determine if cured;
- Blanket dry-treat all does as not all “staph” does can be identified by culture;
- Always wear gloves to milk does to prevent transmission from people to does;
- Do not allow kids to nurse does, particularly if infected with orf;
- Prep the udder and teats carefully using single-service towels;
- Make sure milking equipment is properly calibrated and maintained to prevent vacuum fluctuations and

back-jetting of the milk from doe-to-doe;

- If new cases of “staph” continue to happen, consider culturing the entire milking herd to detect all “staph” does;
- Culture all “staph” does at kidding to determine if dry treatment has cured the infection;
- Cull does with a history of clinical mastitis due to “staph”, particularly if udder damage remains. This includes does with a history of gangrenous mastitis;
- Cull does which do not respond to treatment, i.e. are still culture-positive for “staph”; and,
- Monitor the herd using bulk-tank culture.

Decision making on when a doe should be culled due to mastitis, is reviewed. The Canadian regulations for organic dairy production are provided in part so that producers with an interest in this form of production can determine if they are able to comply without jeopardizing animal health and welfare.

Section VII. Monitoring and goal setting

This section is to guide producers how to set goals, monitor udder health, and then develop a plan to reach those goals using the SMART approach (Specific, Measurable, Achievable, Realistic, Timely). Monitoring measures of udder health should be done routinely, in addition to the monitoring already done for processing and regulatory purposes. This can be done by private testing, testing through the Can-West DHI program, and/or using CMT and culture. There is a lack of good information on monitoring using bulk-tank measures of SCC and bacterial cultures as it relates back to mastitis – more research is needed here. Some ways to measure udder health and suggested goals:

- Annual incidence of clinical mastitis - < 5%;
- Prevalence of does with a blind gland - < 5%;
- Proportion of does with linear score 6 (800,000 SCC) or higher - < 20%;
- Incidence of new infections (change from < LS6 to \geq LS6) - < 5%;
- Prevalence of chronic infections (\geq LS6 at 3 more tests in a row) - < 10%;
- Prevalence of infections at first test post-kidding (\geq LS 5 or 400,000 SCC) - < 10%;
- Turnover rate due to mastitis (cull and death) - < 5%;
- Proportion of does culled that were culled due to mastitis - < 20%.

For each, if this represents an area where the herd fails to meet the goal, areas of additional assessment are recommended.

Section VIII. Dairy goat health management

This section briefly reviews some of the other important aspects of dairy goat management, focusing on the adult doe. These include:

- Vaccination programs for clostridial disease;

- Control of caseous lymphadenitis including vaccination;
- Control of common infectious causes of abortion, including risk of human health;
- Late gestation and early lactation nutrition including body condition scoring, as well as mineral and water needs;
- Control of metabolic diseases including pregnancy toxemia and hypocalcaemia;
- Management of kidding time to optimize birth outcomes;
- Management of newborn kids including colostrum management;
- Environmental management of the doe;
- Feeding management of the lactating doe and avoidance of ruminal acidosis;
- Issues around feeding and housing and bacteria in the milk;
- Reproductive management of the doe including programs to induce estrus out of season;
- A brief overview of parasite control. This is covered in more depth in the *Handbook for Control of Internal Parasites of Sheep and Goats*;
- Diseases that cause chronic wasting;
- Biosecurity; and,
- How to find a veterinarian.

Conclusions

Management of the commercial dairy goat and control of mastitis so as to optimize udder health and milk quality has many similarities to that of the dairy cow. However, there are significant differences in many respects. The animal is different, the pathogens are different in some respects, and management of the animal can be quite different. Veterinarians familiar with udder health programs in cattle, but who may feel they are deficient in lacking understanding of the goat, can and do provide valuable services to their dairy goat clients and it is hoped that this guide can assist in this.

Acknowledgements

Contributors to this guide include Dr. Jocelyn Jansen, Animal Health and Welfare, Veterinary Science, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA); Colleen Walpole (Fitzpatrick), Western College of Veterinary Medicine, University of Saskatchewan; Michael Foran, Raw Milk Dairy Specialist, Dairy Food Safety Program, OMAFRA; Phillip Wilman, Raw Milk Program Coordinator, Dairy Food Safety Program, OMAFRA. Funding was provided by the University of Guelph – OMAFRA Partnership KTT program, Ontario Goat and Hewitt's Dairy.