

# SOMATIC CELLS IN GOAT MILK

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## **Background and Introduction**

Dairy goat producers have been deliberating about milk somatic cell counts (SCC) because it is a complex and confusing issue. However understanding the relationships among SCC, dairy goat health and the economic survival of the dairy goat farm are of paramount importance for the goat producer. Somatic cell counts have legal, goat health, milk quality and productivity implications and each is important.

To understand the origin, physiological function and importance of somatic cells in dairy goat production, let's consider several basic biological concepts.

First, the *ACell Theory*®, provides three fundamental principles:

- \_ all organisms are made of one or more cells
- \_ the cell is the basic unit of organization
- \_ all cells come from preexisting cells

Secondly, there are at least four *Cell Types*:

- \_ Prokaryotes - cells that have no nucleus. The term *prokaryote* comes from Greek words that mean "before, or pre-, nucleus."
- \_ Eukaryotes - cells that have a true nucleus.
- \_ Somatic cells - cells that make up the body [from Greek soma = body]
- \_ Gametes - sex cells or reproductive cells like eggs and sperms.

The type of cells concerning this workshop is **somatic cells**.

## **What Are Somatic Cells?**

The cells called *somatic cells* are white blood cells (leukocytes) and are the defense against bacteria that penetrate the physical barrier of the udder's teat canal. Infecting bacteria causing clinical or subclinical mastitis (Greek: *mastos, breast; -itis, inflammation*) produce tissue harm and leukocytes are involved in repairing the damage and destroying bacteria. Somatic

cells are equipped with a variety of tools to accomplish these functions. These somatic cells are constantly circulating in the blood stream and when infection or udder damage occurs, the body then sends high numbers of them to the injured or infected site. Leukocyte (somatic cells) numbers increase markedly in response to invading pathogenic bacteria, and may reach concentrations of millions per milliliter (ml) in acute mastitis cases. Therefore, high somatic cell counts may signal a mammary gland infection (mastitis).

### **How Is Milk Produced?**

Goat milk is produced in the udder, which contains two mammary glands. Mammary glands are considered skin glands made-up of connective tissue (fatty and fibrous) and secretory tissue (epithelium, which is a membranous tissue covering the inside walls of the gland). Each mammary gland has a gland cistern (also called udder cistern) which opens directly into the teat cistern and functions for milk storage. Each gland is divided into numerous lobes; each lobe made up of many lobules. Each lobule contains up to 200 alveoli. The alveolus (Latin: *small sac; plural: alveoli*) is the functional unit and it is a tiny capillary-rich sac where milk is synthesized and released. Capillaries bring the milk building blocks to alveoli cells for milk assembling. The alveoli cells are secretory epithelial cells and myoepithelial cells (Greek: *mous, mus*, muscle) which contract in response to oxytocin, causing milk letdown.

It is important to mention that milk secretion in goats is different to that of cows. Milk secretion in the goat is apocrine, compared to merocrine in cows (see picture 1). Apocrine secretion results in the shedding of nucleated and non-nucleated cytoplasmic particles into milk. Nucleated particles will be included in the total cell count

### **What Is a Somatic Cell Count (SCC) and Why Is It important?**

As explained, leukocytes (somatic cells) migrate into the mammary tissue to provide the first immunological line of defense against bacteria that penetrate the physical barrier of the teat canal. One generally accepted conclusion is that the concentration of somatic cells, in the milk, is directly related to the infection status of the udder. All other possible factors are of lesser consequence. Stated another way, if the somatic cell count is high the doe or cow has mastitis or inflammation of the mammary gland. No other factor(s) influences the milk somatic cell count to the degree that bacterial infections do. Inflammation can and does result in the loss of function characterized in mastitis by lowered milk production. Inflammation is a reaction to tissue injury (change in composition) due to the doe/cow's immune response. Therefore, in the day to day management of the dairy, infection status of the herd can be monitored effectively by monitoring the SCC of bulk tank milk or individual doe or cow samples. Also there are crucial legal aspects related to the SSC. Each producer must be acquainted with the requirements of the governmental agency (State Department of Agriculture or Public Health Department) under whose authority he or she operates. Regulatory agencies generally operate on the basis that milk is milk, whether obtained from a dairy cow or a dairy goat. Thus, the goat milk producers are expected to meet the same requirements as the cow dairy

To obtain a SCC, a dairy producer takes a milk sample (from an individual doe or cow, or from the bulk tank and sends the sample to a laboratory for analysis. Direct microscopic cell count or electronic somatic cell counting can do the SCC. In the first method the sample is smeared on a glass slide, stained and the stained cells are identified and counted. Electronic methods include Coulter Counter and Fossomatic Cell Counter.

Normal goat milk has a higher cell count than normal milk from cows. This has long been a concern of goat owners because of regulatory standards and marketing problems. Current Grade standards require that milk contains no more than 1,000,000 somatic cells/ml. The SCC limit was lowered to 750,000/ml for cow milk in 1993 and there are proposals for a reduction to 450,000 somatic cells/ml. Despite this reduction for cow milk, regulatory standards for goat milk remain at 1,000,000/ml for now. This is because SCC in goat milk may easily approach 750,000/ml and still be wholesome milk secreted by a healthy udder. Extension specialists and researchers at the E. (Kika) de la Garza Institute for Goat Research, Langston, OK, conducted several studies showing that measuring SSC in goat milk is not the best indicator of udder health that SCC is for cows.

The higher cell count of goat milk is in part caused by an increase in rate of sloughing of these epithelial cells and the presence of cytoplasmic masses which occur as a consequence of the apocrine secretory process. Electronic cell counters cannot accurately differentiate between epithelial cells, cytoplasmic mass, or white blood cells. Consequently, when epithelial cells and/or cytoplasmic mass are present in high concentrations, cell counts may be artificially elevated if enumerated by electronic cell counters. This results in diagnostic difficulty and circumstances where normal milk would be inappropriately labeled unfit for sale. Only those counting methods that are specific for deoxyribonucleic acid (DNA) can distinguish cell-like particles from somatic cells and thereby give reliable estimates of somatic cell numbers in goat milk. Unlike in milk from dairy cows, the somatic cell count in goat milk is influenced by the presence of nucleated cytoplasmic particles, stage of lactation, parity, and caprine arthritis-encephalitis (CAE). The approved direct microscopic method for SCC in goat milk is the pyronin y-methyl green, which stains the cell DNA. Also, studies conducted at the E. (Kika) de la Garza Institute for Goat Research, Langston, OK, have shown that a 27% reduction in SSC is obtained if the Fossomatic electronic cell counter is calibrated with goat milk standards instead that using cow milk standards. However, in many other respects regulation of bovine and caprine lactation seems to be quite similar.

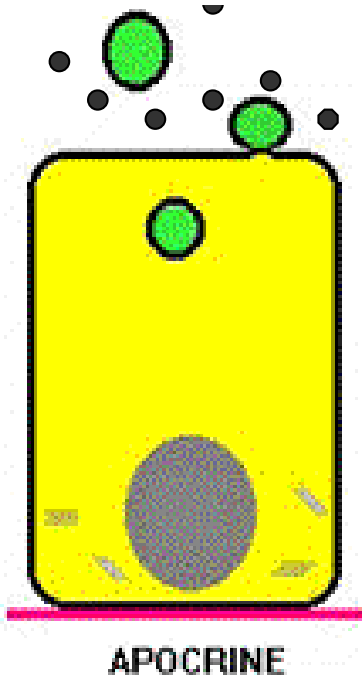
Many dairy goat producers estimate SCC on goat milk and screen for possible mastitis using the California Mastitis Test (CMT). The CMT reagent reacts with genetic material of somatic cells present in milk to form a gel and compare the results with the information in Table 1 to identify potential sick animals early. The CMT detects gel formation when DNA in somatic cells reacts with a detergent. The reaction occurs on a paddle (CMT) and is graded subjectively (negative, trace, 1,2,3). For reliable results, tests should be conducted just before milking after stimulating milk down and discarding the foremilk.

TABLE 1.- Interpretation of California Mastitis Test scores in goat milk

CMT Score	Description of Reaction Between CMT Reagent and milk	Estimated number of white blood cells per ml
0	No reaction	Below 200,000
Trace	Slight slime, tends to disappear with continued swirling	150,000 to 500,000
1	Distinct slime but without gel	400,000 to 1,500,000
2	Immediate gel formation; moves as a mass during swirling	800,000 to 5,000,000
3	Gel develops a convex surface and adheres to the bottom of the cup	Over 5,000,000

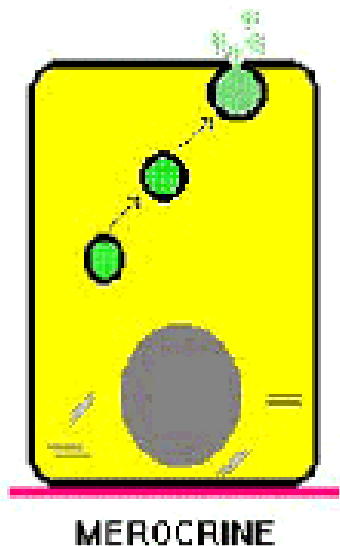
## Picture 1.- Milk secretion differences between goats and cows

(Adapted from <http://www.mc.vanderbilt.edu/histo/BasicTissue/Gland.Epith.Top.html>)



### **APOCRINE MILK SECRETION (Goats, humans)**

Milk secretions in the high point of the cell and a portion of the cell itself (including the plasma membrane) is pinched off for secretion. Some cytoplasm may be discharged with the secretion (represented by black dots).



### **MEROCRINE MILK SECRETION (Cow)**

Secretory milk minute droplets form in the cells and accumulate in the high point. The droplets fuse with the uppermost plasma membrane and are secreted into the lumen of the gland by a cellular process called exocytosis (Greek: *exo*, outside of; *cyto*, cell).