

California Mastitis Test (CMT)

An Invaluable Tool for Managing Mastitis

by

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The California Mastitis Test (CMT) is a quick, simple test that accurately predicts the somatic cell count of milk from individual quarters or on composite milk samples. The CMT is accurate on cow's and goat's milk. The accuracy of the CMT is founded on three principles:

1. Leucocyte (white blood cells) numbers greatly increase in number when an injury or infection affects mammary tissue.
2. Leucocytes: especially, polymorphonuclear leucocytes (PMNs) have large nuclei (DNA) compared to other cells or bacteria in milk.
3. Leucocyte cell walls are mainly lipid (fat).

HOW THE CMT WORKS

CMT reagent is a detergent with a pH indicator added (reason for purplish color). When milk and CMT reagent are mixed in equal amounts, the CMT reagent dissolves or disrupts the outer cell wall and the nuclear cell wall of any leucocyte, which are primarily fat (detergent dissolves fat). DNA is now released from the nuclei. DNA will string or gel together to form a stringy mass. As the number of leucocytes increase in a quarter, the amount of gel formation will increase in a linear fashion. Therefore, the gel formation can now be "scored or read" as follows:

N - (negative=100,000 SCC)

T - (trace=300,000 SCC)

1 - (900,000 SCC)

2 - (2.7 million SCC)

3 - (8.1 million SCC).

Readings of **1, 2 and 3** are definite *positives*. The quarter(s) is infected. A **trace** (T) reading indicates a **possible infection**. If all 4 quarters read “trace”, there is no infection. If one to two quarters read “trace”, infection is possible. A **negative** (N) reading indicates **no infection**.

The CMT can also be scored as yes or no. Is the quarter infected or not? If the gel sticks to the bottom of the paddle (middle) as the mixture is swirled the answer is yes.

CMT reagent can be affected by the quality of water on a farm. One pint of concentrated CMT reagent should be diluted with 7 pints of bottled water or good soft water. If the diluted CMT reagent is not purple, it should NOT be used.

More details on the CMT can be found on the *Worlds' Best Milk Quality Website* from the Department of Dairy Science at the University of Wisconsin-Madison and University of Wisconsin Cooperative Extension. (www.uwex.edu/milkquality)

WHEN TO RUN A CMT

The CMT should be run on foremilk. Foremilk contains the fewest leucocytes. If the CMT is positive on foremilk, you can be assured that the rest of the milk from that quarter will be higher. Strippings (end of milking) will have a SCC that is 2 to 3 times higher than foremilk because leucocytes tend to stay with milk fat. For example: The milk fat content of foremilk is approximately 1% in Holsteins while strippings will be 10% to 13% fat.

Foremilk could have a positive CMT reading, and at the same time, the composite milk from a quarter is less than 200,000. A localized infection in the teat or gland cistern could lead to this result. However, this will happen in very few situations.

Dirt, manure and other particles do not interfere with the CMT reading; because there is no DNA.

USES OF THE CMT

Listed below are various ways that the CMT and resulting data can be used as a management tool.

1. *Purchasing Cows*

An accurate CMT can be conducted on any lactating cow by 6 hours after the last milking. Any quarter that shows a distinct gel formation should be considered infected. Purchased lactating cows that are not cultured or analyzed for SCC must be segregated at milking and milked last until a CMT and/or milk culture can be conducted.

2. *Fresh Cows*

A CMT should be conducted on all fresh cows and heifers by the 3rd or 4th milking. This would also apply for any purchased dry cow or heifer. It is difficult to get accurate CMT readings on colostrum. Any CMT positive quarter should be cultured. Fresh cows (including first lactation cows) with CMT positive quarters caused by a **contagious organism** should be segregated at milking. These cows should remain segregated until all quarters are CMT negative and subsequent cultures are negative. Segregation can be achieved by forming a separate group of cows and milking them last or segregate individual cows at milking with a different milking unit or by backflushing the milking unit after milking a positive cow.

A CMT positive cow at the 3rd or 4th milking is infected or has had a recent infection. Fresh cows do not have CMT positive quarters unless an infection or serious injury has occurred. Conducting weekly CMT tests on fresh cows that tested positive in one or more quarters will be sufficient to detail the progress of the infection; getting better, worse or same. Fresh cows that test CMT positive but culture negative should be considered infected. These cows can be re-tested in 7 to 10 days; CMT and culture. If the CMT remains elevated at a score of 1 or more, but the culture is

negative, the quarter is still infected. Re-culture these cows in 2 weeks and ask for a full screening of all organisms including Mycoplasma, Yeasts, Fungi, Pseudomonas, Serratia and others.

WHAT SHOULD BE DONE WITH FRESH COWS THAT HAVE AT LEAST ONE QUARTER THAT IS CMT POSITIVE AND AN ENVIRONMENTAL ORGANISM IS CULTURED?

The cow has to be segregated at milking unless the bacteria are Streptococcus dysgalactiae. Strep. dysgalactiae positive cows should be considered contagious. Cows that are infected with environmental streps should be re-tested with the CMT on a weekly or biweekly basis. Approximately 50% of environmental infections in fresh cows will spontaneously cure and disappear by 15 to 30 days in milk. If the CMT score increases at 14 to 21 days in milk compared to day 2, the cow (quarter) will require more intense attention at milking time. Antibiotic therapy would be necessary when the cow's quarter or life is being threatened.

When a fresh cow has all four quarters showing some gel formation, but the CMT reading is the same for all quarters, the cultures are negative on the 4 quarters. The increased CMT readings are due to udder conformation, age, injury or other trauma such as milking. As days in milk increase on this cow the CMT readings may decrease or stay the same, but no infection is present.

SHOULD FRESH COWS BE TREATED BASED ON CMT RESULTS?

The answer is a resounding **NO**. The CMT identifies quarters that have a high probability of being infected. The CMT does not identify the causative organism. Only Strep. Ag. infections respond to lactation therapy in an effective and economical fashion. A CMT is conducted on each fresh cow to identify problem quarters to be cultured NOT which quarters to treat. Identifying the causative organism(s) allows each dairyperson to establish the appropriate management changes to prevent those causative organisms from

causing new infections during the dry period or during lactation. Treating fresh cows based on CMT results without first establishing a prevention program will become an endless and costly task.

Research is being conducted on treating fresh cows that test CMT positive. Organisms of concern are environmental streps and coagulase-negative staphylococci.

USING THE CMT TO ASSESS THERAPY SUCCESS

A. Dry cow therapy

Take a CMT at the last milking prior to administering dry cow treatment and record the data. When this data is compared to the CMT readings at the 4th to 6th milking after calving, four results are possible:

1. Quarter was CMT positive at dry off and is negative at calving. Simple conclusion is a cure due to dry treatment or spontaneous cure.

2. Quarter was CMT positive at dry off and is still positive at calving. There are two conclusions to this finding.
 - a. The quarter is still infected with the same infection that was present at dry off. Dry treatment failed. This will be a common outcome with Staph. aureus and mycoplasma infected cows.
 - b. The quarter was cured of the infection that was present at dry off. However, the quarter became re-infected prior to calving with a different organism. Culturing CMT positive quarters at dry off and again at calving would be the only way to distinguish between conclusion “a” and “b”.

However, if the majority of CMT positive quarters at dry off are also CMT positive at calving, one should suspect that those quarters are chronically infected and did not respond to dry treatment. Cows that maintain a chronic infection through the dry period should be segregated at milking time. The causative organism likely is Staph. aureus or

mycoplasma. Infected quarters that did not respond to dry cow therapy will not likely respond to any therapy.

A high percentage of non-cures with dry cow therapy may warrant a change in dry cow antibiotic. Choose a new dry cow antibiotic and continue to follow CMT results at dry off compared to calving. At least 50 infected cows will be needed to form a conclusion on the efficacy of the new dry cow antibiotic.

3. Quarter is CMT negative at dry off and positive at calving. A new infection occurred in that quarter during the dry period or at calving. A high percentage of new infections during the dry period would implicate environmental organisms. Improve the sanitation of the housing for dry cows, pre-fresh cows and maternity cows.
4. Quarter is negative at dry off and is still negative at calving; no infection.

B. Lactation Therapy

Intramammary treatment of a mastitis case likely will increase the SCC in that quarter for one to two weeks. This is especially true for *Strep. ag* and *Staph. aureus* infections. Therefore, an accurate CMT reading cannot be obtained on a treated quarter for two to three weeks after therapy. A positive CMT on a quarter at 3 weeks post-treatment would indicate a failure of treatment. One negative CMT on a treated quarter at 3 weeks post-treatment (clinical cure) would not guarantee that the quarter is free of all organisms (bacteriological cure). However, if subsequent CMT testing at two-week intervals remains negative or the DHI linear remains at 3 or less, one can assume that the quarter (cow) is cured.

A CMT should be run on all four quarters before treating one quarter. Infected cows have an average of two infected quarters. It makes no sense to treat one infected quarter when two or three quarters may be infected. The CMT will help in deciding how many quarters receive therapy.

USING THE CMT TO TEST ALL COWS WITH DHI LINEAR SCORES OF 4 OR MORE

A DHI linear score (LS) of 4 approximates a SCC of 200,000 in a composite milk sample. Twenty to 40% of cows with a LS of 4 will have one or more infected quarters. Therefore, all quarters on cows with a DHI LS of 4 or more should be tested with the CMT. The CMT will determine if any of the quarters are truly positive.

EXAMPLE

A cow is producing 100 lb of milk and has a DHI LS of 4 (200,000). The left rear (LR) quarter is infected and producing 20lb milk. The left (LF) and right (RF) front quarters are producing 25lb milk with a 50,000 SCC. The right rear (RR) quarter is producing 30lb and has a 50,000 SCC. What is the SCC of the left rear quarter to make the composite sample a LS 4 or 200,000? The SCC of the left rear quarter is at least 800,000 or a very definite infection.

$$200,000 \text{ SCC} \times 100\text{lb} = 20,000,000 \text{ cells}$$

$$\text{RF } 25\text{lb} \times 50,000 \text{ SCC} = 1,250,000 \text{ cells}$$

$$\text{LF } 25\text{lb} \times 50,000 \text{ SCC} = 1,250,000 \text{ cells}$$

$$\text{RR } 30\text{lb} \times 50,000 \text{ SCC} = \underline{1,500,000} \text{ cells}$$

$$\text{Total} = \mathbf{4,000,000 \text{ cells}}$$

$$20,000,000 - 4,000,000 = 16,000,000 \text{ cells from LR}$$

$$16,000,000/20\text{lb} = 800,000 \text{ cells or CMT Reading of 1}$$

The infected quarter identified by CMT can now be cultured to determine causative organism. Establishing the causative organism(s) will aid in the development of specific mastitis prevention and control programs for the organism(s) isolated.

Cows with chronic DHI LS of 4 or more do not need a CMT analysis every month.

Cows should be tested that have a major change in linear score; up or down. A CMT

should be conducted on any cow that has a LS of 4 or greater for the first time. One quarter potentially has become infected. If the CMT reading for all four quarters is the same but elevated, an infection is not present, but irritation of the mammary tissue is occurring. If several cows in the herd increase in LS from 3 or less to a LS of 3, 4 or 5, but no quarter is highly positive, there may be a milking equipment or milking procedure problem causing severe irritation. Most likely equipment failures would be overuse of inflations or liners, dipping liners in chlorine, pulsator malfunction, vacuum too high or too low, vacuum regulator malfunction or insufficient air flow.

CMT SCENARIOS

A cow had a DHI linear score of 6. A CMT was done 8 days after the DHI test. The only quarter with any reading was the LR with a trace. What happened?

The infection was cured by the time the CMT was run. The DHI test happened to occur when the infection just started or at a time when the leucocytes were destroying the causative organism and healing damaged tissue. There was an infection and the subsequent low CMT indicates a cure.

A cow had a severe clinical case of mastitis in the RR. The milk turned yellowish and then watery. A CMT was run, but the gel reaction was barely a 1. Why wasn't the CMT a 3?

Leucocyte numbers had already peaked, destroyed the causative organism and were on the way down. Secretory cells had been destroyed and, therefore, no milk was present.

DHI linear on cow 733 is 9. All quarters have normal looking milk except the milk from the rear quarters resembles skim milk when highlighted against a black plate. The CMT reaction is so bad on the rear quarters that the milk and reagent cannot be mixed and the gel sticks to an upside down paddle. How can the CMT score be so high and no major clinical changes have occurred in the milk?

The causative organism likely is Strep. ag. Strep. ag.- infected quarters can have a SCC as high as 20 to 40 million and produce “normal” milk. Only one of every 20 to 40 Strep.

ag-infected quarters will show any clinical signs. However, a CMT will identify every infected quarter.

DO DISEASES OTHER THAN MASTITIS AFFECT CMT READINGS?

NO! SCC levels in milk do not relate to diseases elsewhere in the cow's body such as uterine infections, laminitis or other infections. It is possible that an existing quarter SCC may increase if milk production suddenly plummets. The same number of cells still may be present, but the cells are now concentrated in fewer pounds of milk.

A coincidental increase in bulk tank SCC or DHI SCC or CMT in herd or cows with an increasing incidence of laminitis (for example) is not a result of laminitis. The increased SCC is a result of new mammary infections that are related to teat and udder injuries. Teats and udders get injured as cows struggle to rise on diseased feet and legs.