QScout® MLD Outperforms CMT
Detect mastitis objectively and accurately

An accurate subclinical mastitis diagnosis is key to guiding appropriate treatment and management actions. Since the 1950s, the California Mastitis Test (CMT) has served as a cow-side tool for identifying subclinical mastitis by an indirect estimation of somatic cell count (SCC) in milk. The CMT test is simple and offers quick results, and therefore it has been considered one of the best ways to detect mastitis. But, at best, diagnoses based on CMT's visual results are highly subjective.

Advances in technology have paved the way for objective, quantitative on-farm tests. QScout® MLD (milk leukocyte differential) test is a next-generation mastitis test that offers dairy producers simplicity and quick quarter-level results reminiscent of CMT, but with the benefits of high accuracy and objectivity.

Simple on-farm test results based on science

QScout MLD test is read by the QScout® Farm Lab, a portable diagnostic analyzer that scans milk samples with a built-in microscope, providing lab quality results. QScout MLD identifies, counts and differentiates leukocytes (white blood cells) in milk, looking for combinations that indicate the presence of subclinical mastitis. Specifically, QScout MLD measures a three-point differential, including total counts and percentages of three leukocyte types (lymphocytes, neutrophils and macrophages), and combines seven measures of the differential to calculate a diagnosis.

Understanding the roles and ratios of the three leukocytes allows for more accurate detection of subclinical mastitis. For example, neutrophils are selectively recruited to fight bacterial infections and an increased presence of neutrophils is a sign of subclinical mastitis. After QScout MLD assesses the cell types in the milk sample based on an index of infection, a color-coded diagnosis by quarter is displayed. Green indicates healthy and red indicates inflammation indicative of subclinical mastitis.

California Mastitis Test vs. QScout® MLD
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Putting mastitis tests to the test

When choosing an on-farm test for mastitis screening, dairy producers need consistent, accurate results to guide their treatment decisions. While the CMT scoring system (Table 1) appears straight forward, multiple thresholds have been published for each CMT score (Milk Money and Mellenberger et al.), making it very difficult to determine a clear diagnosis. It can also be plagued by user bias, which may result in inaccurate results. If the mixture thickens, then the quarter is interpreted as infected. If the mixture doesn't thicken, then the quarter is interpreted as healthy. Based on observations, dairy producers can potentially make further testing and/or treatment decisions.

Unfortunately, CMT results are always left to interpretation. Even highly trained individuals find it difficult to accurately read CMTs. Regardless of the individual's experience, CMT scores vary significantly, and results are difficult to repeat between tests and users.

QScout MLD removes user error and subjectivity

A practicing bovine veterinarian conducted CMTs in his own dairy herd and recorded CMT scores as listed in Table 2. Despite being a skilled CMT user, some of the subjective CMT scores don't align with the objective SCC numbers. Using subjective CMT alone could lead to incorrect treatment.

Using the same milk samples, QScout MLD produced accurate results every time – by quarter.

Differential index-based diagnoses are a powerful indicator

A 2010 study at North Carolina State University (Anderson, et al.) found that diagnostic tests based on a differential index, the basis of QScout MLD, which analyzes individual leukocyte types, proved a stronger indicator of actual udder health and milk production compared to conventional tests. By monitoring cows on day 3 after calving and then reviewing 150-day milk production, diagnoses based on a differential index showed a strong correlation with actual milk production, evidencing its significant predictive value. In fact, neither CMT nor SCC (using a threshold of 200,000) showed a correlation to 150-day milk and were poor predictors of udder health.

During this study (Table 3), CMT scores were troublesome for a well-trained dairy herd manager and post-doctorate veterinary student to accurately interpret. For example, a quarter given a "negative" CMT score had a SCC as high as 873,000. A negative CMT equates to an SCC of either 100,000 or <200,000 depending on the threshold used. Furthermore, one quarter produced milk with 5,000,000 SCC. Yet, that quarter was given a "trace" CMT score.

Table 1. CMT Scoring System

CMT Score	Visual Observance	SCC Range (Milk Money)	SCC Range (Mellenberger, et al.)	Interpretation
Negative (N)	No thickening of mixture	0-200,000	100,000	Healthy quarter
Trace (T)	Slight thickening of mixture	200,000-400,000	300,000	Subclinical mastitis
1	Distinct thickening of mixture but no gel formation	400,000-1,200,000	900,000	Subclinical mastitis
2	Immediate thickening of mixture, with gel formation	1,200,000-5,000,000	2,700,000	Serious mastitis infection
3	Gel forms and adheres to paddle	>5,000,000	8,100,000	Serious mastitis infection

Table 2. Comparative values: CMT, SCC, QScout MLD

Cow ID	Quarter	SCC*	CMT score	QScout
Late	Left Rear	1,025,000	1	Positive
578	Left Rear	243,000	1	Positive
Kapri	Right Rear	388,000	2	Positive
Kapri	Right Front	83,000	2	Negative
7509	Right Rear	74,000	2	Negative
Late	Right Rear	3,082,000	3	Positive

■ In the highlighted examples, CMT testing inaccurately revealed a CMT score of 2, a "serious mastitis infection," whereas both SCC and QScout MLD revealed healthy quarters.

QScout Positive: >35% neutrophils, which is comparable to SCC >200,000 *SCC was measured by DeLaval Cell Center AAD Infection Detection Comparison Study

Table 3. Large variation between CMT and SCC

CMT Score	Average SCC	Minimum SCC	Maximum SCC
Negative	113,465	8,500	873,000
Trace	271,554	15,000	5,000,000
1	259,726	8,500	2,718,500
2	553,048	24,000	3,573,500
3	1,502,339	42,000	4,244,000

Understanding test accuracy

For screening to detect an intramammary infection, producers want a test with high sensitivity. This type of screening test is less likely to miss infected quarters. Marginal sensitivity in screening tests means that some infected quarters will not be identified. Thus, these testing strategies may not foster sound treatment decisions for individual animals.

Research studies have documented the variability of CMT. A 2001 study (Sargeant, et al.) evaluated CMT quarter samples taken on days 3 and 5, using a threshold reaction of greater than zero. On day 3, the sensitivity for detecting an intramammary infection (IMI) with any pathogen was 56.7%, whereas day 5 was 57.4%. Specificity hit 56.2% on day 3 and 72.3% on day 5.

A comparison of CMT vs. QScout MLD

To evaluate the accuracy of QScout MLD and CMT, researchers compared the tests' sensitivity and specificity. Farm employees tested quarter samples using CMT and QScout MLD during a recent trial. The results of each test were compared against diagnosis defined by the

International Dairy Federation (1981), using culture and SCC. The sensitivity and specificity of QScout MLD were superior to CMT (see Figures 1 and 2).

AAD's trials have also found that cows with moderate subclinical inflammation (QScout Setting 10-17) had the most milk production benefit from treatment compared to cows with severe inflammation (QScout Setting >17) or mild inflammation (QScout Setting <10) (Figure 3). Cows with moderate inflammation had a 1,627 lb 305d milk advantage over the no treatment group, while cows with severe inflammation only had a 1,191 lb 305d milk advantage, and cows with mild inflammation had a nominal 195 lb 305d milk advantage. One particular cow in the moderate inflammation group had the lowest SCC (83,000), but was diagnosed as QScout MLD positive due to a high ratio of neutrophils. However, CMT would not have been able to detect this hidden infection, even though she was in the group that benefited the most from treatment. The average SCC of cows diagnosed as positive by QScout MLD at QScout Setting 10 was 243,000, which is below CMT's lower limit of 300,000 (Mellenberger, et al.). This demonstrates that CMT does not have the sensitivity in its lower threshold to detect some of the cows with the most milk improvement potential.
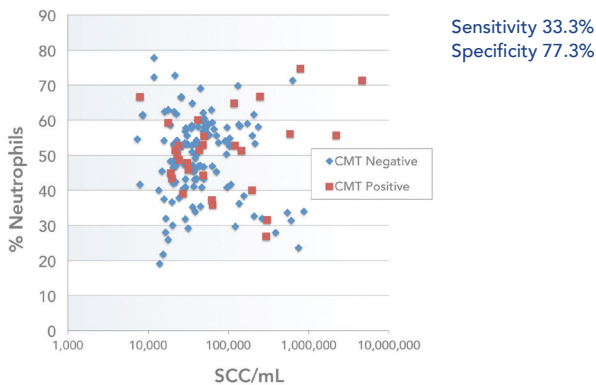
Figure 1. CMT Performance

Sensitivity 33.3%
Specificity 77.3%

Figure 2. QScout MLD Performance
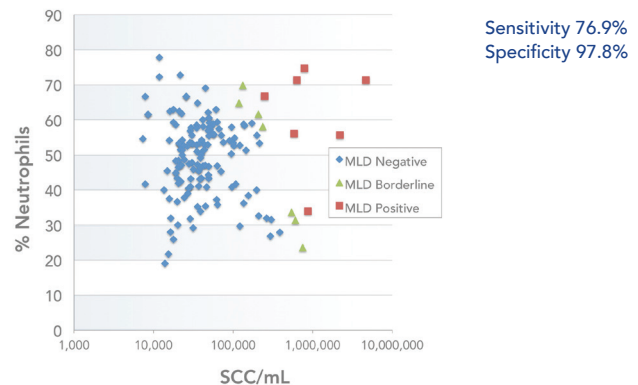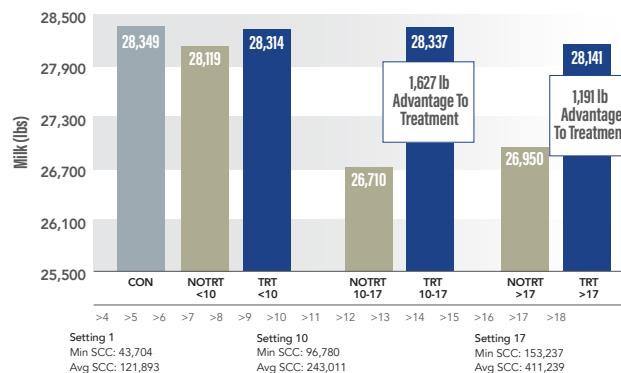
Sensitivity 76.9%
Specificity 97.8%

Figure 3. Projected 305 d milk at end of lactation

QScout MLD surpasses CMT in reliability and objectivity

Based on head-to-head results, QScout MLD provides superior sensitivity, specificity, reliability and accuracy over CMT (see Table 4). A rudimentary on-farm test, CMT is based on subjective readings that often lead to improper mastitis treatment and costly milk production losses and/or dumped milk.

QScout MLD is the next generation of mastitis early-detection technology, generating quick, accurate and consistent results. The on-farm test empowers dairy producers to design responsible and cost-effective treatment protocols. Making informed mastitis treatment decisions based on objective results can lead to higher milk production, enhanced profitability, improved reproductive performance and better udder health.

Table 4. QScout MLD outperforms CMT

Feature	QScout MLD	CMT
Identifies cell types	Yes	No
Cell count	Yes	No
Time to result	Minutes	Minutes
Easy sampling	Yes	Yes
Sensitivity	High	Low
Specificity	High	Low
Quarter result	Yes	Yes

Contact Advanced Animal Diagnostics at (855) Q2COUNT
or visit QScoutLab.com

Resources

Anderson, K. L., M. T. Correa, and R. R. Rodriguez. 2010. Fresh cow mastitis monitoring on day 3 postpartum and its relationship to subsequent milk production. J. Dairy Sci. 93(12):5673–5683.

California Mastitis Test (CMT) Fact Sheet 1. Milk Money, P. Ruegg, 2007. http://milkquality.wisc.edu/wp-content/uploads/2011/09/california-mastitis-test-fact-sheet.pdf

Mellenberger R, Roth CJ (2000). California Mastitis Test (CMT). Fact Sheet, Dept. of Animal Sciences, Michigan State Univ. and Dept. of Dairy Sci., University of Wisconsin-Madison.

Sargeant, J. M., K. E. Leslie, J. E. Shirley, B. J. Pulkrabek, and G. H. Lim. 2001. Sensitivity and specificity of somatic cell count and California Mastitis Test for identifying intramammary infection in early lactation. J. Dairy Sci. 84(9):2018–24.