WHITE PAPER

Bulk tank milk *Staphylococcus aureus*-specific antibodies as an indicator of subclinical herd infection

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Subclinical *Staphylococcus aureus* (*Staph. aureus*) mastitis causes major global financial losses in the dairy industry predominantly driven by reductions in milk yield and quality.

Economic impacts of subclinical *Staph. aureus* infections

- **Drop in milk production:** Milk yield losses range from 4% to 15% per infected cow.
- **Somatic Cell Count (SCC) penalties:** Elevated SCC levels cause dairy farmers to miss bonus incentive payments or face strict milk-price penalties.
- **Premature culling:** Chronic, difficult-to-cure *Staph. aureus* infections often force farmers to cull cows early in their productive lifespan.
- **Cumulative hidden costs:** Because subclinical cases show no visible signs of inflammation, the infection spreads undetected through herds, causing cumulative economic damage that frequently surpasses overt clinical cases.

Subclinical *Staph. aureus* infection remains one of the most difficult mastitis problems to control. Infected cows remain frequently undetected, shed bacteria intermittently, clinical signs are absent, and treatment success is highly variable. For herd monitoring this creates a practical problem - infection may be present and spreading even when culture of bulk tank milk is negative.

Why look at antibodies in bulk tank milk (BTM)?

Cows infected with *Staph. aureus* develop specific antibodies that can be detected in milk. These antibodies are detectable even when bacterial shedding is low or absent. If milk from infected cows contributes proportionally to the BTM, the level of *Staph. aureus*-specific antibodies should therefore provide an indication of infection pressure within a herd.

StaphGold® is an ELISA developed specifically for the detection of *Staph. aureus*-specific antibodies in milk. At cow level the test has a high diagnostic performance. We therefore investigated if the same antibody signal, measured as an **S/P* value, can be used at bulk tank level to estimate herd infection status and if the test complements routine testings such as for bulk tank somatic cell count (BTSCC) and by culture.

***S/P ratio** is a relative measure of Staph. aureus antibody levels. Higher S/P values indicate higher antibody levels.*

Study approach

The work combined three data sets:

A. BTM *S/P* values were first compared with individual cow *S/P* results in 15 herds.
B. 231 early-lactation herds and 254 late-lactation herds BTM samples were assessed using BTM *S/P* values, BTSCC and *Staph. aureus* counts.

Key findings

A. BTM *S/P* clearly reflected the proportion of positive cows in a herd despite the relatively small number of herds for which both individual cow and BTM *S/P* data were available. BTM *S/P* was clearly strongly positively associated with the percentage of StaphGold-positive cows (***Table 1***). Higher BTM *S/P* was associated with more positive cows in the herd.

Bulk tank milk *S/P* comparison	**Association (Spaerman ρ)**	**Interpretation**
Proportion of StaphGold positive cows in a herd	0.793	Strong positive association between BTM *S/P* and StaphGold positive cows.
Mean individual cow *S/P* of the herds	0.786	BTM *S/P* reflects the overall antibody level of the herd.

***Table 1**: Relationship between bulk tank milk (BTM) and individual cow StaphGold results (S/P).*

B. Antibody levels varied widely between herds and were higher late in lactation. Mean BTM *S/P* was 13.4% early, and 23.9% late, in lactation (Table 2). BTM StaphGold *S/P* was clearly positively associated with BTSCC (Table 2). This is important because BTSCC is a key indicator of udder health and milk quality. In contrast *Staph. aureus* culture counts were only weakly associated with both StaphGold *S/P* and BTSCC (***Table 2).***

	Early lactation	Late lactation
Mean BTM *S/P*	13.4%	23.9%
S/P vs BTSCC, Pearson r	0.640	0.412
S/P vs Staph counts, Person r	0.190	0.203
BTSCC vs Staph counts, Person r	0.271	0.224

Table 2: *Association of bulk tank milk (BTM) StaphGold S/P with BTSCC and Staph. aureus counts in early and late lactation herds.*

The most important result was the strong positive association between the BTM antibody signal and the proportion of positive cows in a herd. Although the number of herds with individual cow data was small, the associations were strong and statistically highly significant. This supports the concept that *Staph. aureus*-specific antibodies in bulk tank milk reflect the infection level within the herd.

The higher mean *S/P* observed late in lactation is consistent with increasing infection pressure during the season. However, the early and late lactation samples originated from different herds and this seasonal effect should be confirmed by following the same herds over time.

Why BTM culture alone is not enough

BTM culture has limited use for subclinical *Staph. aureus*. A positive result confirms that the organism is being shed from infected cows into the tank milk. A major limitation is that shedding is highly variable, ranging from no detectable shedding to very high levels. A negative culture result therefore does not exclude infected cows in the herd, while a positive culture result does not allow conclusions to be drawn about the level of infection within the herd.

The presented data clearly demonstrate this limitation. *Staph. aureus* counts were only weakly associated with both StaphGold *S/P* and BTSCC results, and culture-negative samples occurred across low and high StaphGold *S/P* and BTSCC values. Culture reflects bacterial shedding only at the time of sampling, whereas *Staph. aureus* specific antibodies indicate the host response to infection and remain relatively stable when shedding is intermittent or below the culture detection limit.

Practical use in herd monitoring

The value of BTM StaphGold testing is to add another layer of information especially to BTSCC. A single BTM sample can indicate whether a herd has

negligible, low, moderate or high *Staph. aureus* antibody levels, while repeated testing can show whether infection pressure is increasing or decreasing. StaphGold testing for BTM can be used to:

- Identify herds with elevated *Staph. aureus*-specific antibody levels.
- Prioritise herds for individual cow testing.
- Monitor changes in infection pressure during lactation.
- Support interpretation of BTSCC.
- Assess the effect of *Staph. aureus* control programmes.

Conclusion

Staph. aureus specific antibody levels in BTM vary widely between dairy herds and are positively associated with BTSCC. The BTM StaphGold signal was strongly associated with the proportion of StaphGold positive cows.

These findings indicate that BTM *Staph. aureus* antibody testing can provide a useful estimate of subclinical herd-level *Staph. aureus* infection.

Selected references

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