THE RELATIONSHIP OF THE WHITESIDE TEST ON BULK HERD MILK AND THE INCIDENCE OF MASTITIS IN THE HERD

C. Jensen, I. A. Schipper and P. W. Aschbacher

Departments of Dairy Husbandry and Veterinary Science

North Dakota Agricultural College, Fargo

(Received for publication November 18, 1957)

The results of 26 farm visits and several hundred Whiteside tests on bulk herd milk indicate that there is a relationship between the Whiteside reaction of bulk herd milk and the incidence of mastitis in the herd. Mastitis was detected by use of the strip cup on milk from each quarter of the udder.

Although all do not agree on the proper methods of controlling mastitis in dairy cattle, all dealing with mastitis agree that it is a most serious problem. This belief is so universal that it is unnecessary here to document it or to approximate economic losses, which certainly are great.

The direct economic loss to the farmer from decreases in production and loss of animals is not the only effect of mastitis. It is very probable that abnormal milk from mastitic cows is mixed with normal milk and sold from the farms. Such a practice can only result in lowering the quality of milk and dairy products.

The public health is also involved. Although most milk borne infections are caused by contamination of milk after it is drawn from the udder, some have been traced to udder infections (7). However, this is not the only threat to public health. At the present time there are many antibiotic preparations which a farmer may buy for infusing into mastitic quarters. The milk drawn from quarters infused with such preparations will contain appreciable quantities of antibiotics for at least 72 hours (16). Studies have shown that antibiotics, especially penicillin, can be found in fluid milk supplies (2,16). Presence of an antibiotic in milk may cause sensitization of a consumer which could possibly result in severe reactions if the antibiotic was later administered by a physician. Other investigators have isolated antibiotic resistant strains of possibly pathogenic organisms from cheese which they suggest is the result of the presence of antibiotics in the raw milk (15). Schipper (14) and Doan (4) have discussed these problems more fully in recent papers dealing with indiscriminate use of antibiotics.

A quick, reliable, and simple test devised to detect the practice of mixing mastitic with normal milk would provide dairy plants and sanitarians with a basis for a program of controlling such practices. The use of the Whiteside test has been suggested for this purpose (6,7,11,12). Petersen and Schipper (12) examined the milk from 24 herds and found that 19 of them exhibited a strongly positive reaction to the Whiteside test performed on bulk milk. Only one of the 19 did not show mastitis in the herd when checked by the strip cup method. Based on these observations it was decided to investigate further the use of the Whiteside test for detecting the mixing of mastitic milk with normal milk.

PROCEDURE

Samples from milk delivered to creameries were taken intermittently over a period from December, 1955, through August, 1956. A total of 1825 samples...
from approximately 440 herds were taken. The modified Whiteside test of Murphy and Hansen (10) was performed on each sample. The test consists of mixing 5 drops of milk with 1 drop of N sodium hydroxide solution. The mixing is done on a glass plate placed on a black background. After approximately 30 seconds the test is read. If no precipitate forms the test is negative. A thick viscid mass is classified as 4+. If a thick viscid mass forms which later breaks up into large particles of precipitate, the test is classified 3+. A 2+ reaction shows smaller particles than a 3+, and when the precipitate is composed of small particles dispersed throughout the mixture the test is classified 1+.

Bacterial counts were also made on 331 of the samples by the plate count method.

Visits were made to 26 of the producers from which the previously mentioned samples originated. The producers were selected on the basis of willingness to cooperate, geographical location, and results of previous Whiteside tests. At the time of visits an appraisal of the environmental conditions and milking practices were made, as well as strip cup examinations of the milk from each quarter. Clinical mastitis was classified as follows:

**Very mild** — slightly abnormal secretion exhibiting small quantities of clots.

**Mild** — abnormal secretion exhibiting various amounts of clots, with probable swelling and heat in the infected quarters.

**Acute mastitis** — Abnormal secretion exhibiting various amounts of clots and/or serosanguineous, purulent or watery secretions. In addition, infected quarters exhibiting one or all of the cardinal symptoms of inflammation, with body temperature above normal.

Seventeen of the farm visits were made at milking time and the Whiteside test was performed on the bulk milk from that same milking. Visits were made to nine producers whose bulk milk had been checked by a series of Whiteside tests performed between December 20, 1955 and the first week in February, 1956. These nine visits were made during the last week in January, 1956; Whiteside tests were not carried out on the milk produced the same day as the farm visit.

### RESULTS AND DISCUSSION

Table 1 shows a summary of the 17 farm visits when strip cup tests of individual quarters were made along with the Whiteside test on bulk milk from the same milking. An inspection of Table 1 shows that as the Whiteside reaction changed from negative to 3+, the incidence and severity of mastitis increased. Similar results occurred when the information from a farm visit was compared to a series of Whiteside tests made before and after the farm visitation. A summary of this work in Table 2, shows that in herds where the series of Whiteside tests were predominantly negative or doubtful, there occurred only few very mild cases of mastitis as shown by the strip cup. In the three herds which exhibited predominantly positive reactions, there was a much higher incidence of acute mastitis as shown by the strip cup test.

Table 3 shows the relationship of the Whiteside test and bacterial counts of 331 bulk milk samples.

#### Table 1 — Incidence of Mastitis in Herds and the Whiteside Reactions of Bulk Samples Taken the Day of the Farm Visit

<table>
<thead>
<tr>
<th>Whiteside reaction</th>
<th>No. of herds</th>
<th>Total No. of cows</th>
<th>No. of herds in which mastitis occurred</th>
<th>Very mild</th>
<th>Mild</th>
<th>Acute</th>
</tr>
</thead>
<tbody>
<tr>
<td>−</td>
<td>4</td>
<td>119</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>+</td>
<td>5</td>
<td>150</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>++</td>
<td>0</td>
<td>32</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>+++</td>
<td>2</td>
<td>32</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>17</strong></td>
<td><strong>425</strong></td>
<td><strong>13</strong></td>
<td><strong>17</strong></td>
<td><strong>7</strong></td>
<td><strong>1</strong></td>
</tr>
</tbody>
</table>

*aBased on abnormal milk detected by strip cup.

#### Table 2 — Incidence of Mastitis in a Herd and Whiteside Reaction of a Series of Bulk Samples Taken Before and After Farm Visit

<table>
<thead>
<tr>
<th>Herd No.</th>
<th>No. of cows</th>
<th>Whiteside reactiona</th>
<th>No. of quartersb with mastitis</th>
<th>Very mild</th>
<th>Mild</th>
<th>Acute</th>
</tr>
</thead>
<tbody>
<tr>
<td>259</td>
<td>12</td>
<td>(−)</td>
<td>(++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>599</td>
<td>18</td>
<td>(+)</td>
<td>(++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>411</td>
<td>18</td>
<td>(++)</td>
<td>(++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31</td>
<td>18</td>
<td>(++)</td>
<td>(+++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>(++)</td>
<td>(+++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>500</td>
<td>9</td>
<td>(++)</td>
<td>(+++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>400</td>
<td>23</td>
<td>(++)</td>
<td>(+++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>417</td>
<td>21</td>
<td>(++)</td>
<td>(+++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>558</td>
<td>20</td>
<td>(++)</td>
<td>(+++)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>9</strong></td>
<td></td>
<td><strong>148</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

*aSamples for Whiteside tests were collected over a period of approximately 7 weeks, and farm visits to perform strip cup tests were made during later part of 7 week period.  

*bBased on abnormal milk detected by strip cup.
The Relationship of the Whiteside Test

Table 3 — Summary of Relationship of Whiteside Test and Bacterial Counts of Bulk Milk

<table>
<thead>
<tr>
<th>Whiteside</th>
<th>(−)</th>
<th>(+)</th>
<th>(++)</th>
<th>(+++)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av. bacterial count per ml.</td>
<td>160,000</td>
<td>170,000</td>
<td>300,000</td>
<td>220,000</td>
</tr>
<tr>
<td>Range</td>
<td>4,000−</td>
<td>5,000−</td>
<td>5,000−</td>
<td>5,000−</td>
</tr>
<tr>
<td></td>
<td>7,500,000</td>
<td>1,400,000</td>
<td>4,400,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>No. samples in each group</td>
<td>123</td>
<td>65</td>
<td>96</td>
<td>25</td>
</tr>
<tr>
<td>No. of samples too numerous to count at dilutions used</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

There is a gradual increase in bacterial counts as the Whiteside test changes from negative to 3+. However, the range of values in each category is similar. This can probably best be interpreted as meaning that there is a general relationship between overall management and bacterial counts, and also a general relationship between overall management and Whiteside reaction (or mastitis, assuming positive Whiteside tests indicate mastitis). The relationship of the Whiteside test to bacterial counts of bulk milk at the receiving station is more likely to be indirect rather than direct. There is also a wide range of bacterial counts for milks showing any one Whiteside reaction.

The relationship of acute mastitis to bacterial count in milk delivered to the dairy plant was observed in nine cases. Plate counts were made from samples collected at the receiving station on two or three days near the date of the farm visit for strip cup tests. Counts from two of the three herds showing acute mastitis were below average, and in the third herd the counts were only slightly above the average for this study. (Not shown in Table 3). Such factors as contamination from utensils and improper cooling probably contribute far more to total bacterial counts than the initial count of milk as drawn from the udder. Swab tests also were made on teat cups of milking machines and other utensils, but there appeared to be no relationship between contamination of these objects and acute mastitis.

Of the 1825 samples on which Whiteside tests were performed, 612 (33.3%) were negative, 309 (16.9%) were doubtful, 624 (34.2%) were 1+, 131 (7.2%) were 2+, 47 (2.1%) were 3+, and 2 were 4+. It has been shown that the presence of leucocytes in milk are largely responsible for the Whiteside reaction (5,13). The leucocyte content of normal milk varies greatly between cows and from day to day within the same cow (1,3,8). Colostrum contains very large numbers of leucocytes and occasionally very high counts are observed in late lactation, although the leucocyte count is usually normal by the third week after parturition (1,8). No satisfactory explanation has been given for all the variations in leucocyte count. A high leucocyte count may be associated with bacterial infection of the udder (3,7,9). MacLeod et al. (9) estimates that 78% of the variation of leucocyte counts in herd milk can be explained by the amount of mastitis in the herd. If this is true it is reasonable to suspect that when herd milk is consistently very high in leucocyte count, mastitis is a problem in that herd.

Summary and Conclusions

The Whiteside test is a rapid and simple test for detecting high leucocyte counts in milk. It requires no special equipment and any technician can learn to perform it. Routine checks of herd milk can be made by dairy plant operators or sanitarians. From evidence obtained in this study it would appear that bulk milk which consistently shows strongly positive Whiteside reactions can be suspected of coming from herds where mastitis is a problem. The authors feel that control of mastitis is mainly a management problem on the farm. When problem herds have been identified it should be possible for quality control fieldmen or sanitarians to work with these herds in an attempt to improve milking practices and general management. In this manner it should be possible to decrease the incidence of mastitis, which will decrease the losses to the farmer, and also improve quality of milk and dairy products.

References

3. Cherrington, V. A., Hansen, H. C. and Halversen, W. V.

There is a gradual increase in bacterial counts as the Whiteside test changes from negative to 3+. However, the range of values in each category is similar. This can probably best be interpreted as meaning that there is a general relationship between overall management and bacterial counts, and also a general relationship between overall management and Whiteside reaction (or mastitis, assuming positive Whiteside tests indicate mastitis). The relationship of the Whiteside test to bacterial counts of bulk milk at the receiving station is more likely to be indirect rather than direct. There is also a wide range of bacterial counts for milks showing any one Whiteside reaction.

The relationship of acute mastitis to bacterial count in milk delivered to the dairy plant was observed in nine cases. Plate counts were made from samples collected at the receiving station on two or three days near the date of the farm visit for strip cup tests. Counts from two of the three herds showing acute mastitis were below average, and in the third herd the counts were only slightly above the average for this study. (Not shown in Table 3). Such factors as contamination from utensils and improper cooling probably contribute far more to total bacterial counts than the initial count of milk as drawn from the udder. Swab tests also were made on teat cups of milking machines and other utensils, but there appeared to be no relationship between contamination of these objects and acute mastitis.

Of the 1825 samples on which Whiteside tests were performed, 612 (33.3%) were negative, 309 (16.9%) were doubtful, 624 (34.2%) were 1+, 131 (7.2%) were 2+, 47 (2.1%) were 3+, and 2 were 4+. It has been shown that the presence of leucocytes in milk are largely responsible for the Whiteside reaction (5,13). The leucocyte content of normal milk varies greatly between cows and from day to day within the same cow (1,3,8). Colostrum contains very large numbers of leucocytes and occasionally very high counts are observed in late lactation, although the leucocyte count is usually normal by the third week after parturition (1,8). No satisfactory explanation has been given for all the variations in leucocyte count. A high leucocyte count may be associated with bacterial infection of the udder (3,7,9). MacLeod et al. (9) estimates that 78% of the variation of leucocyte counts in herd milk can be explained by the amount of mastitis in the herd. If this is true it is reasonable to suspect that when herd milk is consistently very high in leucocyte count, mastitis is a problem in that herd.

Summary and Conclusions

The Whiteside test is a rapid and simple test for detecting high leucocyte counts in milk. It requires no special equipment and any technician can learn to perform it. Routine checks of herd milk can be made by dairy plant operators or sanitarians. From evidence obtained in this study it would appear that bulk milk which consistently shows strongly positive Whiteside reactions can be suspected of coming from herds where mastitis is a problem. The authors feel that control of mastitis is mainly a management problem on the farm. When problem herds have been identified it should be possible for quality control fieldmen or sanitarians to work with these herds in an attempt to improve milking practices and general management. In this manner it should be possible to decrease the incidence of mastitis, which will decrease the losses to the farmer, and also improve quality of milk and dairy products.

References

3. Cherrington, V. A., Hansen, H. C. and Halversen, W. V.
The Relationship of the Whiteside Test

The Leucocyte Content of Milk as Correlated with Bacterial Count and Hydrogen ion Concentration for Detection of Mastitis. J. Dairy Sci., 16:59.1933.


10. Murphy, J. J. and Hanson, J. J. A Modified Whiteside Test for the Detection of Chronic Mastitis. Cornell Vet., 31:47.1941.


