Preliminary Statement

This paper is a brief report in which milk yields of animals negative to mastitis diagnostic tests are compared to yields of the same animals after they had become positive to these tests.

It is now taken for granted that cows yielding abnormal milk, as a result of udder infections, should have no place in a dairy. Moreover, dairymen have learned through experience that the quantitative yield of clinically affected cows has become, or may be destined to become, so diminished as to render them unprofitable.

With the development and improvement of diagnostic tests it is now possible to detect mastitis in its incipient stages before udder symptoms or abnormal milk become evident to the casual observer. These tests are now being used extensively to control and eradicate mastitis, so it is of great importance to the owner of dairy cattle to know to what extent mastitis both in its incipient and chronic stages adversely affects the volume of production. Evidence has begun to appear on this question but as yet only a few reports bear definitely on the problem as here presented.

Ernst, Klimmer, and Rudolf, as quoted by Seelemann (6), estimate that milk yield is reduced about 10 per cent (Rudolf 500 pounds in Austria) by mastitis. Seelemann (6) made a comparison of infected quarters with the corresponding opposite quarters of the udders of twelve cows and found a small reduction in yield. However, Seelemann states that occasionally the total yield of the udder was apparently normal, possibly as a result of compensation made by the normal quarters.

Shaw and Beam (7) have recently reported on a study of 86 cows over one year in which infected quarters were compared to the corresponding opposite quarters. Their study shows that the normal quarters yielded 2.3 pounds of milk and 0.1102 pound of fat testing 4.79 per cent, and the infected quarters yielded 1.5 pounds of milk and .0723 pound of fat testing...
4.82 per cent. After correcting for natural differences in yield of front and rear quarters (4:5.1, Seelemann), Shaw and Beam estimated a reduction of 22 per cent in milk and 24 per cent in fat due to infection. The tests employed were bromthymol blue, chloride, leucocyte, and catalase and quarters were pronounced infected when reacting to not less than three of these tests.

Still more recently Minett and Martin (2) have reported on three large herds, one Ayrshire and two Holstein, in England, seriously infected with mastitis and infectious abortion, and occasionally also with tuberculosis and Johne’s disease, but corrections for these troubles were made as carefully as possible by the authors. “Cows were classed as ‘mastitis infected’ (a) when one quarter of the udder at least was definitely infected with *Streptococcus agalactiae*, irrespective of herd history, (b) when the milk was definitely abnormal at one or more examinations as regards reaction of centrifuge deposit, even although recognizably pathogenic bacteria were not demonstrable, but only if the owner could state the animal had suffered from udder trouble.” Exclusion of all doubtful cows was rigorous. The reduction in yield in the Ayrshire herd was 10.8 per cent; and in the Holstein herds 16.5 and 19.5 per cent respectively.

**SOURCE OF DATA AND METHODS**

The data presented here were from yields and tests in the Connecticut State College dairy herd and in one farmer-owned herd. A few of the College herd records extend back to 1926 when pooled udder samples were studied, but since 1931 the data have been derived from separate quarter samples. During this period several diagnostic tests have been studied, as previously described in bulletins and papers from this Station (3, 4, 5). Four tests employed consistently have furnished the basis for this study, namely: identification of organisms; bromthymol blue test; leucocyte count, and sediment test. The interpretation of these tests has been described in the bulletins noted above.

The herds have been free from tuberculosis consistently and from Bang’s abortion disease for the greater part of the period under consideration. The herds have not been widely troubled with any other disease so far as is known. Only animals that have to their credit both one or more normal lactations and one or more lactations while reacting to the diagnostic tests have been included. These criteria thus have eliminated all animals that have never reacted positively to mastitis, as well as a very few that became infected or suspicious during the first lactation. Altogether the records present an experience with 30 cows in the College herd and 22 cows in the farmer’s herd, a total of 90 normal and 108 infected lactations of the same animals.
In both herds animals whose udders were badly involved and whose yields were obviously diminished thereby were disposed of in routine management, so this study is chiefly concerned with incipient and mild cases of the disease and not with severe and acute ones.

In the College herd there are Ayrshires, Guernseys, Holsteins, and Jerseys, and in the farmer's herd Holsteins only.

Because of varying length of lactations and time of breeding and conception, the yields of only the first 240 days of the lactation have been employed. All records have been corrected to full age, using breed association conversion factors. The records of the College herd are presented on a basis of three milkings a day, as this was the most frequent milking pattern in the herd, while in the other herd, the records having been made on two milkings, the data are presented on that basis. Records in the College herd made as Advanced Registry or Register of Merit tests were subjected to a further reduction of 11 per cent, after Fohrman (1), to correct for conditions somewhat more favorable than applied in the other lactations. There is some room for doubt about the magnitude of the influence to be attributed to Advanced Registry and Register of Merit management in this herd, but the conditions are admittedly somewhat more favorable for production. Having no more accurate data than the 11 per cent factor it has been applied. Corrections for differences in butterfat test of individual cows was not necessary inasmuch as with these data each animal appears both as a normal and as an infected animal.

RESULTS

The normal yield for the animals in the College herd was 9557 pounds of milk. The yield when reacting to mastitis tests in one or more quarters was 9094, a loss of 463 pounds of milk or 4.84 per cent.

The reader should be reminded that these animals did not necessarily display clinical evidence of infection, especially in the first lactation of infection; also, that an animal was pronounced infected even though only one quarter showed evidence of infection by the laboratory criteria.

Twelve animals show a higher yield and 18 a lower yield after giving evidence of infection. The effect on yield in the incipient and latent stage of infection is therefore not consistent, and as suggested by others, may be compensated by the normal quarters.

The data for the farmer's herd are similar. There was an average loss in yield of 425 pounds of milk, in which 14 of the 22 cows experienced a loss in production.

Judged by the evidence so far presented, one would be forced to the conclusion that from a purely economic standpoint a farmer is scarcely justified in sacrificing animals solely because of the test. This conclusion would stand were it not that other factors are involved. Infection usually
becomes more severe and tends to spread to all quarters as the animal advances in age. In these two herds it is the usual practice to dispose of badly infected cows. Obviously if such animals had been kept longer in the herd more striking effects on production would be in evidence. All dairymen who have encountered mastitis are quite aware of this. Thus, the infected group has been favored in the evidence by the disposal of pronounced cases.

The data have been further broken down on the basis of number of quarters involved. The condensed data for the College herd are presented in Table 1.

**TABLE 1**

*Comparison of production by animals in normal and infected lactations*

<table>
<thead>
<tr>
<th>QUARTERS INFECTED</th>
<th>GAIN OR LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>One quarter</td>
<td>Two quarters</td>
</tr>
<tr>
<td>9196</td>
<td>9307</td>
</tr>
<tr>
<td>10061</td>
<td>.............</td>
</tr>
<tr>
<td>1009</td>
<td>.............</td>
</tr>
<tr>
<td>9183</td>
<td>.............</td>
</tr>
</tbody>
</table>

No loss is shown with one quarter involved but with two, three, and four quarters the loss is progressive from 340 with two quarters to 1046 pounds, or 11.4 per cent, with all four quarters reacting.

In the farmer's herd the results are similar, there being a loss of 27 pounds with one quarter reacting and a loss of 1063 pounds with four quarters involved.

The data on the College herd were then tabulated and studied on the basis of tests employed. These results are presented in the following table.

**TABLE 2**

*Evidence of mastitis and milk yield on basis of tests used*

<table>
<thead>
<tr>
<th></th>
<th>SEDIMENT TEST</th>
<th>BROMTHYMOL BLUE</th>
<th>LEUCOCYTE COUNT</th>
<th>INFECTION WITH STREPTOCOCCUS MASTIDITIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>9689</td>
<td>10075</td>
<td>9841</td>
<td>8972</td>
</tr>
<tr>
<td>Positive</td>
<td>9093</td>
<td>9238</td>
<td>9268</td>
<td>7872</td>
</tr>
<tr>
<td>Loss</td>
<td>506</td>
<td>837</td>
<td>573</td>
<td>1100</td>
</tr>
</tbody>
</table>

It is generally known that the diagnostic tests here employed do not agree in all instances, but rather that they supplement each other. When the data are studied from the standpoint of each individual test some differences are noted. Those giving positive evidence to the sediment test showed a loss in milk of 506 pounds; to the bromthymol blue test 837 pounds; those with high leucocyte count 573 pounds; and those infected with *Strepto-
**CHRONIC BOVINE MASTITIS AND MILK YIELD**

_coccus mastiditis_ 1100 pounds. The loss in the latter case was 12.26 per cent.

The above table is a composite of results with one to four quarters involved. In cases where all four quarters were involved the sediment positives showed a loss of 723 pounds, the bromthymol blue positives 1360 pounds, the leucocyte positives 1627 pounds, and the _Streptococcus mastiditis_ positives 1100 pounds. From this it seems that the sediment test (0.5 per cent or more sediment by volume) is the least significant of the four tests from the standpoint of complete glandular involvement, which confirms a conviction previously arrived at regarding this test.

**DISCUSSION**

The detailed data present some peculiar and interesting evidence. A few cows with latent infection have reacted over a period of years and yet have not suffered in yield so far as is evident. Add to this the practice of eliminating from the herd animals showing aggravated clinical symptoms of mastitis and it is seen that the evidence is biased to the advantage of mastitis reactors. During the past seven years 40 cows from the College herd have been sold to the butcher. Twenty-five of these were reactors to mastitis tests and 15 at the time were producing a mere fraction of their normal yield.

At first thought it would seem that the loss in yield due to mastitis shown in this study is much below that reported by Shaw and Beam (7) and others. However, only animals with four quarters involved are comparable with the Shaw and Beam results, since these authors reported only on infected quarters. The loss in all four quarter cases amounts to 15 to 20 per cent by our data.

Lactation yields of three infected cows are presented in Graphs 1, 2, and 3 to show variation in performance. The normal lactation expectancies are those developed by Larro Research Farm.²

*Graph 1* describes the production of Radiant Romance Storrs, a Jersey cow. This is a case of latent infection of long standing. During her first lactation, starting on February 14, 1925, no observations were made. She again calved August 31, 1926, and pooled quarter sample tests were begun in December of this year, in which she was normal. Calving again October 12, 1927, she was normal throughout this lactation. These first three lactations are combined therefore to represent a disease-free performance with an average yield of 9474 pounds.

In the next two lactations this cow was positive, based on pooled sample tests. The average yield was 7942 pounds. These lactations are combined on the graph. During the next five lactations the cow was positive to

² Interpretation of milk production by use of standard production graphs. Charles Staff, Larro Research Farm, Detroit, Mich.
GRAPH 1. Radiant Romance Storrs. During lactations 1 to 3 she was assumed to be normal and the average mature equivalent milk yield was 9474 pounds; during lactations 4 and 5 she was positive to pooled udder samples and the average yield was 7942 pounds; during lactations 6 through 10 she was positive in all four quarters and milk yield was 9454 pounds.

Quarter sample determinations and these results are combined into one curve on the graph. The average yield was 9454 pounds.

This cow has shed long chain streptococci from all four quarters during the last five lactations and yet her yield has apparently been unaffected. In the full year's test just completed she produced over 15,000 pounds of milk (actual, no conversion factors applied), the highest record of her career.

This is one of a half dozen somewhat similar cases in the herd which of course has favored the infected group, since no animal whose yield was decidedly affected remained long in the herd to offset these cases.

Graph 2 presents the case of the Holstein cow Seneca Papoose Storrs. Her first calving was on May 17, 1930, and she completed four lactations, the fifth being terminated by her elimination from the herd.
During her first lactation she shed staphylococci intermittently and was classed as suspicious. In her second lactation she shed staphylococci constantly from all quarters and was classed as positive. She also showed clinical symptoms at times. Her first lactation coincided on the whole with the curve of expectation, while her second performance exceeded normal expectations, although there were two sharp breaks in the production curve, both of which she overcame.
In her third lactation she shed streptococci from three quarters and staphylococci from the fourth quarter in all samples tested. Her performance here was considerably below expectations. In her fourth the laboratory evidence was similar to the previous lactation. A comeback was made, but in this case the production curve is too wavy for a normal performance.

The fifth lactation was a complete failure and the cow was eliminated after three months. The milk from three quarters shedding streptococci was thick and bloody, while the right front quarter, still shedding staphylococci, yielded normal-appearing milk.

This cow's record is not included in the summarized data as she did not have a completely disease-free lactation.

Graph 3 presents the case of a Guernsey, Splendent Sagacious Storrs. She calved first on February 13, 1930, and was negative to mastitis during the first lactation. Her performance was above expectations.

During the second lactation this cow, freshening in April, 1931, showed clinical symptoms in the right front quarter in October and November, accompanied with a high leucocyte count and staphylococci organisms. Her performance was not as good as in the previous period but coincided well with the curve of expectation.
In the third lactation, S. mastiditis was shed intermittently and her yield was much below expectations, the curve of decline being quite sharp. In the fourth lactation, after a long dry spell as a result of failure to conceive promptly, all the quarters were negative to the tests except the left hind quarter which shed S. mastiditis throughout. The cow made partial recovery in yield but the curve of production was below normal, especially between the second and sixth months.

This cow did not conceive again.

**SUMMARY**

Observations on the production of animals before and after the development of laboratory evidence of mastitis were made. These data are derived from animals in the early stages of infection and animals in which the disease was latent in character. In many cases no clinical evidence was observable during most of the mastitis reacting periods.

Since animals showing obvious clinical evidence of mastitis were eliminated from the herds as a matter of routine practice before the full impact of chronic mastitis on production of milk was manifested, it is evident that the full adverse effect on yield is not here measured. Rather, these data tend to show that a loss in yield may occur in the majority of cases during the incipient stage of the disease.

In 240-day lactations of a group of 30 cows having a history both as mastitis free and mastitis positive based on the bromthymol blue test, the sediment test, the leucocyte count, and the shedding of organisms, there was a loss of 463 pounds of milk attributable to mastitis. In another herd of 22 cows there was a loss in yield of 425 pounds. These reductions are between 4 and 5 per cent and are not particularly significant. A loss in yield was manifested in about two thirds of the individual cases.

When only one quarter was positive there was no loss in yield. Such are usually incipient stages, and possibly also compensation in yield is made by the unaffected quarters. The loss, however, increased in magnitude with each additional quarter involved amounting to about 15–20 per cent with all four quarters positive.

When the results were segregated for each diagnostic test it was found that for those reacting to the bromthymol blue test the loss in yield was 837 pounds, and for those shedding S. mastiditis the loss amounted to 1100 pounds per lactation. The loss in yield of sediment positives was 596 pounds and of leucocyte positives 573 pounds.

No effect on the butterfat percentage was observed.

**REFERENCES**


