Correct Interpretation of Bacteria Counts*

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Those who are not bacteriologists do not understand about bacteria and their significance. As a result there is a great deal of misunderstanding and misinterpretation of bacterial plate counts and the direct microscopic counts by the laity and even some public health officials. This is most aptly illustrated by an actual occurrence in one of our large cities. One of the dairies was producing a high quality milk and by almost superhuman efforts had reduced their bacterial plate counts to around 2,000 per ml. or less. They were so proud of the accomplishment that they announced the fact by having it printed on their delivery trucks and wagons. Their competitors knowing the ignorance of the average milk consumer regarding bacteria were quick to sense the mistake and took advantage of it by having their drivers canvass the customers of the company producing the high quality milk and asking them, "Do you want to drink milk containing 2000 bacteria per ml.?" "Do you want to feed such milk to your children?" Needless to say the signs were quickly removed and a real campaign started to regain the customers which they had lost.

Bacteria Common to Milk

The conditions under which milk is produced precludes the possibility of it being produced sterile. So it always has a few hundred or even a thousand bacteria present when first produced. In fact if one were to produce milk aseptically under the same conditions as a doctor would perform a major operation, that is with everything sterile, the teats, the pails, the milking machine, and everything sterile, even then the milk from most cows would contain from a few hundred to a few thousand or in some cases a few hundred thousand bacteria per milliliter. This is because as, numerous experiments have shown, certain bacteria inhabit the udder of cows and apparently live there all or most of the time. So no matter how carefully the cows and milking equipment are cleaned, normal milk from the average herd has a few hundred (usually less than a thousand) bacteria per milliliter present.

Now every operation except pasteurization from the time the milk is drawn from the cow until it is used, may and usually does add from a few hundred to thousands of bacteria to the milk. Therefore, if milk is handled carelessly from the time it is milked until it reaches the pasteurizer, it will have a large number of bacteria. The type and kind of bacteria will depend upon how and who handled the milk. For this reason many health departments have a bacterial standard for raw milk. This is justifiable because there is nothing in pasteurization to correct the biochemical changes which these millions of bacteria have caused in the milk. Likewise there is no evidence to indicate that the large number of bacteria present are superior in nutritive value to the milk which they have consumed. On the contrary there is evidence that the metabolic products of certain bacteria are irritating to the

intestines and may cause nausea, vomiting, and diarrhea especially when present in large numbers.

Happily nature has provided an abundance of lactic acid bacteria which sours the milk under ordinary conditions before the bacteria producing undesirable changes can do much harm. The lactic acid produced not only warns us that the milk has been handled carelessly but it also prevents the multiplication of many harmful bacteria.

**Pasteurization as a Safeguard**

Many think that pasteurization is a cure-all or panacea for dirty or unclean milk. All pasteurization does is to kill the asporogenic pathogenic bacteria and most of the asporogenic, non-pathogenic. The temperature is not sufficiently high to inactivate toxins or destroy any undesirable metabolic products. A milk that is dirty and insanitary before it is pasteurized is dirty and insanitary after it is pasteurized. The most one can say is that if properly pasteurized the milk is usually safe.

**Methods for Determining the Sanitary Quality**

Since it is highly desirable to know the sanitary quality of milk, several methods have been used to try and determine the sanitary quality of milk. The first and oldest is known as the plate method. This method has been in use since it was first introduced by Koch in 1883. The merits and demerits of this method have been discussed in the literature many times. Briefly they are that it does not give you a correct picture of the bacterial population of the milk since only a certain percentage of the bacteria present grow due to nutritive, temperature or oxygen requirements. One cannot tell whether those growing are pathogenic or non-pathogenic. And finally it is time consuming and expensive.

The direct microscopic method was next introduced and had certain advantages over the more slow and cumbersome method. While only a fractional part of the milk can be examined, yet it can be done quickly and cheaply. A very good idea of the many types of bacteria present their numbers and to some extent their significance may be obtained.

**Dyes for Determining Sanitary Quality**

Other methods in use are the methylene blue and the resazurin methods. Both are used as preliminary tests to pick out grossly inferior milk usually at country-receiving stations. These tests help eliminate the poorer grades of milk before they make the long haul to the city and before they contaminate the good milk. These tests are valuable to the milk inspector. Some inspectors, however, use the microscopic test for the same purpose. Here again it is quicker and cheaper and tells more than either the methylene blue or resazurin tests.

For raw milk all four tests may be used, viz., plate count, the microscopic count, methylene blue test and resazurin test. However for pasteurized milk only the plate count and the microscopic count are usually used.

**Most Information for Least Work**

Within the past few years, several state and city health departments have settled on three tests to determine the sanitary quality of milk, viz., the microscopic test for the general overall bacterial picture, the phosphatase test to determine whether the milk has been properly pasteurized, and finally the coliform test to determine recontamination after pasteurization.

**Tendency to Eliminate Different Grades of Milk**

There has also been a tendency to do away with grades of milk based on bacterial counts. The feeling has been that there are just two grades of milk from a health standpoint—good
and bad. A milk is either fit to use or it is not. If it is not, then it should not be used.

This is aptly illustrated by an analogous situation in surgery. If you had to have an appendectomy and your surgeon told you in discussing the operation that he had three grades of operation. The best or grade A was where the operation was done under aseptic conditions, that is all instruments, sutures, linen, and bandages were sterilized and the abdomen shaved and sterilized. The hands washed and sterilized as nearly as possible and then sterile gloves worn in addition and the cost was $100.00. In the grade A operation your chance of surviving was most excellent. In a second or grade B type operation not all the instruments were sterile, the sutures, linen and bandages might have a few bacteria present. The cost was $50.00 and your chance of surviving was about 50-50. A third type of operation known as grade C, in which nothing was sterilized. It only cost $25.00 and your chances of surviving were practically nil. There is little doubt which of the three operations you would choose. In medicine there is but one type of operation or one treatment—the best that science provides.

So it should be in the dairy industry. Every dairymen should be taught his responsibility in producing milk or dairy products. He should produce the best according to the latest and best scientific methods available. Then there would be only one grade—the best.

Unfortunately there is no one general method to determine the presence of pathogenic bacteria in milk. If we want to determine the presence of any of the many pathogens which might be present, we must use special or specific methods. The best we can do is to determine the presence or absence of certain types such as excessive numbers of sporogenic, sapro- 
genic bacteria whose presence indicates carelessness in washing utensils, equipment, etc. Excessive numbers of acid-producing bacteria is indicative of improper cooling of the milk, washing, and care of the utensils. Large numbers of coliform bacteria in raw milk indicates improper washing of udder, fecal, feed, or dust contamination as well as improper cooling. Yeasty milk or cream comes from improper washing of udder, utensils, and cooling of milk. Ropy milk is caused by certain groups of bacteria such as Aerobacter aerogenes, Alcaligenes viscosus, Lactobacillus casei, Lactobacillus bulgaricus, and Streptococcus hol-landicus. Ropy milk usually appears in spring and fall and is greatly influenced by the temperature and other conditions at this time of year.

Summary

In conclusion then it is evident that there is no one method for determining the total number of bacteria in milk. The method that gives the most complete information in the shortest time possible and for the least cost is the microscopic method. To determine the presence of pathogenic bacteria in milk, specific and in some cases laborious, time consuming methods must be used.

In view of these facts the bacteriologist has assumed that the presence of excessive numbers of bacteria in milk was indicative of carelessness in some particular such as the health of those handling the milk or of the cow or in the method of milking the cows, cleaning the utensils and equipment, and cooling and transporting the milk. Carelessness in handling such an easily contaminated product as milk can not be condoned or tolerated from the public health standpoint since it is a potential health hazard. Therefore, milk containing excessive numbers of bacteria has always been condemned as unsafe for human consumption.

Fabian, F. W. The Function of the Laboratory in the Control of Milk Supplies. Jour. Milk Tech. 6, 278-284 (1943).