Safe Milk Supplies of Cities and the Public Health Laboratory

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Suggested Code of Interpretation of Procedures of Department of Public Health of San Francisco

THE production of good milk is a technical procedure which requires experience. Maintenance of satisfactory standards has for years meant the use of control measures to keep within bounds milk from producers who lack experience, who are careless, or who are unscrupulous.

This has led to inspection systems in the various units of government. Inspectors are expected to keep within defined boundaries, the procedures of the producer, the transporter, the processing or pasteurizing plant, and the distributor. These four elements are usually combined into one or two units; e.g., one man owns the cow, milks it, and transports the milk to a depot, and another processes and distributes it. Processing plants have their own inspectors; they, too, are concerned with proper standards of production without which they fall under censure or yield to more careful processors.

Inspection presumes authority to demand that milk shall be produced under sanitary conditions and that it shall be safe. The constitutional rights of the producer are presumed to protect him from unreasonable demands. It is incumbent upon inspection services to demonstrate that anything they require for sanitation and safety is imperative toward that end. It is equally proper that producers be protected from improper requirements.

The evolution of this form of control has resulted in laws and ordinances fortifying inspection systems which deal with sanitation, safety and nutritional problems. Legal judgment is necessary to settle differences of opinion.

One service performed by the laboratory is the support, by objective evidence, of either side of these controversies. Such evidence has to be objective and the interpretation put upon it must be valid. Laboratory evidence does not necessarily fill either of these requirements.

A second service performed by the laboratory is the aid given to inspectors as evidence, which added to their observations, enable them to trace difficulties, to raise the standards of producers, and to check points which, from observation alone, are not possible to follow. Properly used, evidence from the laboratory may be a guide toward tangible results which inspectors hope to achieve. This is the basic service of the laboratory, for legal problems arise only over equivocal issues which, in an ideal sense, would not exist in a perfectly coordinated scheme.

Interpretations of results of laboratory tests are opinions. Exact methods for these tests are put down in writing and are generally followed throughout the United States. This is not done for the interpretations, though a degree of uniformity in this respect is perhaps as much needed as uniformity in the procedures of the laboratory tests.

It is the purpose of this article to establish, for the Department of Public Health of the City and County of San

Francisco, a code of interpretation of the results of laboratory tests of dairy products. Our goal is to promote understanding and coordination in the use of data from the laboratory.

The city is one of our larger cities. Its inspection service is backed by considerable experience and the standards and quality of its dairy products are reasonably high. It would be possible, by including some minority opinions, to establish on a wider basis a code of interpretation of data from the laboratory. Uninterpreted, reports are useless.

SAFETY OF DAIRY PRODUCTS

This is the *essential* feature of control. Unsanitary milk will sooner or later be unsafe and milk low in total solids or butterfat is substandard nutritionally, but there is no danger from it.

Tuberculosis and undulant fever may come from infected cows.

Directly or indirectly, human contamination of milk may cause cases of typhoid fever, paratyphoid fever, the dysenteries, food poisoning, diphtheria or streptococcus sore throat (tonsillitis, septic sore throat, and scarlet fever).

There are perhaps five tests, or sets thereof, pertinent directly to the safety of dairy products.

A. *Tuberculin test:*

This test, performed by veterinarians, is made by inoculating cows in the caudal fold near the base of the tail with small amounts of extracts of the bacilli of tuberculosis. Cows react to this substance provided they have a moderately well developed tuberculosis.

Reports of these tests are made by veterinarians. They are obliged to report that their opinion is that each cow tested is "positive" or "negative." They do not and cannot report for each cow that it has or has not tuberculosis; interpretation is necessary.

The accuracy is perhaps as high as 90 percent, meaning that perhaps as many as 90 of 100 cows are properly labeled as tuberculous or non-tuberculous. There are several reasons for this.

Some tests are uncertain so that the veterinarian may erroneously consider them positive or negative.

In the early stages or advanced stages the tests may give erroneously negative results.

Tests have under certain circumstances been masked by unscrupulous producers.

Infections can develop faster than tests can be performed. An animal can shift from negative to positive in two weeks or a month; tests oftener than once a year are burdensome. In a given herd with 20 tuberculous animals, several might be missed on testing and the number would rise toward 20 during the following year. With 2 infected animals, one might easily be missed and there might be 2 or 3 by the end of the year.

The tuberculin test is a means of reducing the number of tuberculous animals. The errors inherent in the test must be frankly recognized.

B. *Brucella agglutination test:*

This test is performed in the laboratory by mixing the blood serum of each cow with the organisms of undulant fever (in cattle, contagious abortion). With serum from most infected cows a reaction occurs.

Reports made by the laboratory indicate a positive or negative reaction with serum from the blood furnished through the veterinarian.

Interpretations, as with tuberculin tests, are useful in the control of undulant fever. Serum becomes reactive several weeks after injection. Reactions can be observed with fair accuracy in the laboratory.

Errors may arise in spoilage of specimens, improper containers, processing the serum, or in handling it. Some animals respond poorly in the production of reacting substances. The

use of vaccines renders the test valueless.

Tests cannot be done frequently enough to catch new reactors.

This test is a means of reducing the number of infected animals. Its inherent errors must be recognized.

C. *Tests of personnel:*

Organisms causing the following diseases may originate with persons in contact with milk: typhoid and paratyphoid fevers; the dysenteries; food poisoning; streptococcus sore throat (scarlet fever, septic sore throat, and tonsillitis); and diphtheria.

There is no practical medical test, clinical or laboratory, suitable for recognizing routinely possible disseminators of the above organisms.

When epidemiologic evidence appears to incriminate some member of the personnel in a given producing or processing plant, concentrated studies may be made to find a person carrying typhoid or paratyphoid organisms. The only conclusive evidence is the identification of these organisms in the laboratory from certified specimens, though tests of the serum of the personnel may be suggestive and epidemiologic evidence may be presumptive.

Under provocation, the laboratory may undertake tests for carriers of the organisms of dysentery, streptococcus sore throat (cows are also suitably tested for these organisms), and diphtheria. Even concentrated effort is usually not helpful, partly because of the time elapsing between infection and the taking of specimens and partly because tracing a few organisms over a wide area is difficult. The effort may be worth while when epidemics are of particular significance, when the evidence requires support from the laboratory, and when the evidence is focused on a few persons sufficiently to give some chance of success.

D *Phosphatase test:*

This test is a color test demonstrating the degree to which an unstable substance has been destroyed by pasteurization. Since infection in neither cows nor employees can be more than partially controlled, the only solid safeguard for milk and dairy products is pasteurization.

This test is relatively simple and has few inherent errors. The results are rated as acceptable evidence, supporting inspection, to indicate failure to pasteurize adequately.

This is rated as the preferred test in control of failure in pasteurization through a break-down in machinery, impatience, carelessness, or lack of integrity.

E. *Tests for pathogenic bacteria:*

There are no practical methods whereby pathogenic bacteria in milk can be detected. The most delicate test is the drinking of milk by consumers; even then, with several glasses per consumer tested, not everyone is infected.

SANITATION IN DAIRY PRODUCTS

The main emphasis in the control of dairy products is on sanitation rather than safety; that is, cleanliness and esthetics are given first consideration.

In the broad sense sanitation includes all moves which have to do with safety. The emphasis on sanitation is in this sense over and above the interest in safety; no reasonable precautions which have to do with safety are overlooked.

Furthermore, it is true that there is a close correlation between improved sanitation and increased safety in milk. Cleanliness will not eliminate tuberculous cattle; the operator of a clean dairy is more likely to reduce tuberculosis in his herd than the operator of a dirty dairy.

A. *Bacterial count:*

The laboratory is able to determine approximately the number of clumps of live bacteria of certain kinds in a given quantity of milk. The procedure is applicable to cream, ice cream, milk

drinks, and rinse waters. Results are reported as the Official Colony Count. These figures are approximate indices of certain phases of sanitation. They should be neither overrated nor underrated.

The count is an index of three features of samples tested: (1) the extent of contamination from miscellaneous, not specific, sources; (2) the temperatures at which the milk has been held; and (3) the age of the milk when tested. The count does not give a clue as to which of these points is at fault, when this count is "high." A "low" count, however, indicates attention to all three of these features.

The index figures, or counts, cannot be rated as more significant than the accuracy of the test warrants. No significance should be attached to *single tests* in which the variation is under 100 percent; i.e., if Dairy A gave a test of 50,000 this week and another week showed a change to more than 25,000 or less than 100,000, no particular significance could be attached to it.

Multiple tests increase the accuracy. For yearly averages a number of figures can be used. Care is still necessary in interpretation. Series of tests, neither single nor numerous, find usefulness to inspectors in endeavoring to trace difficulties and overcome unsanitary practices. Consistent improvement in count, though not great, is useful to inspectors.

The count should never be considered the goal in sanitation, in which inspection is a matter of collecting specimens. It is rated primarily as an aid to the inspector. To make the count a collection of figures for the files is as bad as making the index a substitute for inspection.

B. *Breed count:*

This is a microscopic count of all bacterial cells, regardless of kind, clumping, or whether they are alive or dead. Pasteurization does not affect this count. Organisms such as thermophiles from dairy equipment, missed by the colony count, are caught by this method. The error inherent in the test is high. There is no correlation between the breed count and the colony count.

The method is not considered applicable to western milk, most of which has counts too low to take advantage of its benefits over the colony count.

C. *Coliform tests:*

The test is made by inoculating samples of milk into a broth which is selective for coliform organisms. The test is not perfectly selective and some errors occur. Furthermore, the coliform organisms, originating in manure and perhaps grain and dust, become widely distributed.

The significance to be attached to "high" or "low" figures for coliform organisms, again calling for judgment as to what may be called high or low, depends on empirical observations. Some unsanitary condition must correlate with high figures and this must improve when the figures go down.

Present opinion suggests a correlation between coliform counts and unsanitary pasteurizing equipment. This correlation is found often enough to make the test useful to inspectors, when and if they choose. It is insufficient evidence by itself for condemnation.

There is presumed to be some correlation between this test and adequacy of pasteurization. It is one of the less satisfactory means of determining adequacy of pasteurization and is therefore not acceptable for this purpose.

D. *Streptococcus tests:*

The most acceptable method of testing, a plating method with a medium containing blood, does not lend itself to routine work. The greater proportion of colonies which appear to be streptococci are not.

This test, or the Hotis test which is inferior to it, is sometimes used as a

method for getting an index of mastitis. It could become the simplest method for this purpose, but it is not now satisfactory.

E. *Sediment tests:*

Sediment tests for visible dirt are not routinely applicable. They are in the nature of an inspector's test rather than a laboratory test.

Centrifugalization of warmed milk under proper conditions reveals blood and pus indicative of mastitis or other inflammatory injury. The procedure does not have the status of an official test but deserves consideration.

No definite stand is taken with regard to laboratory tests for mastitis. Support in this is needed, for the control of mastitis is a move in sanitation which is receiving increasing attention.

F. *Methylene blue and resazurin tests:*

Dye is added to samples of milk and, through the action of a bacterial by-product the quantity of which depends roughly on the number of bacteria, the color is reduced to a lighter color or white. The time consumed is a measure of the number of bacteria present at the start, in theory.

These tests are considered failures with good milk and with pasteurized milk. They are inferior to other counts and offer nothing additional in the way of information. They are wrong in theory. They are not accepted for any purpose.

G. *Taste, odor, etc.:*

There are tests of considerable value which are subjective in nature though they have the objective equivalence to laboratory tests. Experience is necessary and they are made by inspectors. Their significance and importance should be bolstered while the significance of laboratory tests is reduced in order to derive a fair appraisal of all means of testing.

H. *Tests of equipment:*

There are as yet only general official tests for "sterility" of equipment, all based on rinsing whole surfaces and making colony counts of rinse waters. The contact or spot plate procedure tests a given area but has the same principle. There is no official method for testing spots likely to be uncleaned, such as corners, junctions in pipes, or cracks. Swabs are permissible but are supposed to cover four square inches.

With judgment and experience in the selection and taking of specimens, bacterial counts can be definitely useful in improving sanitation. Their significance is in support of investigations by inspectors.

These tests, so adapted to surfaces primarily smooth, are not representative of areas most appropriately checked in examinations for cleanliness. This loophole in the tests deserves emphasis particularly in view of the increasing use of chemical disinfectants, which are blocked by dirt and milk deposits in corners where washing may be imperfect. With steam heat, penetration is better.

I. *Tests of disinfectants:*

There are no simple tests for chemical disinfectants. Only prolonged chemical and bacteriologic study under various conditions, both in the field and in the laboratory, can properly determine the properties of a chemical disinfectant. Some properties which must be known are: toxicity, detergent action, action on metals of various sorts, action in the presence of alkali, soaps, or acid, effect of milk whey or cake on it, stability, penetrating ability, variation in activity at different temperatures, and effect on various kinds of organisms. This partial list of properties indicates the impossibility of superficial evaluation.

NUTRITIONAL VALUE

All ingredients of milk have nutritional value. The elements may be

considered as butterfat, solids not fat, and water (including dilution of milk or the addition of preservatives). The natural ingredients vary with the breed of cows and sometimes from other factors. This is not a matter of safety or sanitation but a problem of guaranteeing an article to be as represented.

A. *Butterfat:*

The standard Babcock test is virtually universally accepted as a satisfactory measure of butterfat as a basis for payment or for any other purpose.

B. *Total solids:*

This is likewise a chemical test in which the accuracy is adequate for any significance likely to be attached to the results.

Purchasers who pay the price of milk for water which is in excess, either as formed in the cow's udder or when added to dilute the milk, are cheated.

C. *Adulterants:*

Chemical tests for common adulterants are known and are regarded as unsatisfactory. The same is true of preservatives. It cannot be said that tests for all possible adulterants or preservatives exist, however.

The significance of tests for adulterants is clear. There are no circumstances in which adulteration is permissible barring recognized practices, such as manufacture of dairy products.

There are two fears from preservatives. That they are toxic is possible, though this danger is not great. The principal objection is to their action in masking improper sanitation.