The Preliminary Incubation Count for Raw Milk

Background and Overview

The Preliminary Incubation (PI) Count for raw milk has been used to potentially detect inadequate hygiene practices on the farm that might be missed by the Standard Plate Count (SPC) method. The test requires incubating or “stressing” a milk sample at 55°F (12.8°C) for 18 hours, after which an SPC or Plate Loop Count (PLC) is performed. The results should always be compared to a fresh SPC. The PI count is based on the theory that the normal microbial flora of the cow will not grow whereas certain microorganisms associated with inadequate hygiene practices could grow to significant levels under these conditions when present in the milk. Factors that can influence the results of this test include:

- the precision of the incubation time/temperature
- the age and storage history of the milk sample
- the type(s), initial numbers
- stage(s) of growth
- optimum growth temperatures of the microflora present in the sample

Because of these factors, and the fact that this test relies on the detection of microorganisms capable of growth under the conditions of the test, results may vary. The counts of the test should be interpreted and used with caution.

Acceptable Levels for PI Counts

It is suggested that a maximum allowable PI count should be 200,000 CFU/ml. Some milk handlers use counts of 50,000-100,000/ml or even lower as their limits. Another approach sometimes used is to consider a milk suspect if the PI count is higher than the SPC by a designated amount (e.g. 3-4 times higher).

The selection of appropriate PI “cut-off” values for those that use the test is sometimes difficult; there is little scientific data on the subject. Values in current use are based mostly on experience and an effort to use the test to improve milk quality. Selecting a meaningful cut-off value is challenging. Proper interpretation of PI results may require a more intuitive approach rather than just established limits. Remember, PI counts are most useful when accompanied by other tests, observations, and inspections.
Trouble-Shooting PI Counts

Guidelines have been developed over the years for trouble-shooting high PI counts. In general, they have focused on most of the traditional sources of bacteria in milk that are not considered the normal flora of the cow. Mastitis organisms are not considered to be likely causes of increases in PI counts over the SPC, although there may be exceptions. General areas include:

- **Cow cleanliness**: teat/teat-end/udder condition & cleanliness, pre-milking hygiene procedures, condition of milk filters
- **Equipment cleanliness**: washed after each milking/pick-up; appropriate water temperatures & detergents; emphasis on bulk tanks, outlet valves, receiver jars & components, vacuum to receiver, and worn rubber parts
- **Sanitation procedures**: should be just before milking with correct sanitizer levels; no untreated water prior to milking
- **Milk cooling & bulk tank cleanliness**: cooled to <40°F, blends not to exceed 50°F, tank washed after each pick-up
- **Water quality/use of untreated water**: check for coliforms & psychrotrophic bacteria counts; all rinses before milking contains sanitizer

How Does the PI Count Relate to the Quality of Raw and Pasteurized Milk?

Gram-negative psychrotrophic bacteria are often the cause of reduced shelf-life in pasteurized milks. Their occurrence in pasteurized milk is mostly the result of post-pasteurization contamination; thus, their presence in raw milk should not influence pasteurized milk quality held for normal sell-by dates (~14-18 days) unless total counts (not PI counts) are well above the regulatory limit of 300,000 CFU/ml.

The PI count alone cannot be directly correlated with the flavor quality of raw milk or the quality/shelf-life of the processed product. There is limited information on the relationship of PI counts to other test procedures for raw or pasteurized milk; however, available studies show little correlation. Using the PI count to predict the quality of products made from milk is not advised, as there is no research to support the use of this test in that way.

Want more information on PI counts and the MQIP? Contact Nicole Martin (nicole.martin@cornell.edu) in the Milk Quality Improvement Program or visit our website [https://foodsafety.foodscience.cornell.edu/mqip/](https://foodsafety.foodscience.cornell.edu/mqip/)

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