B. E. HUBBELL, JR.

E. B. COLLINS

Ropiness in milk . . .

PSYCHROPHILIC BACTERIA AND CALIFORNIA MILK QUALITY

Although California's milk supplies, with rare exception, are easily kept well within California Agricultural Code specifications, a few dairy plants have occasionally encountered ropiness in pasteurized milk. This ropiness and some other storage defects such as fruity flavor are attributable to psychrophilic bacteria introduced following pasteurization. Psychrophiles are organisms that grow at refrigerated storage temperatures and can cause noticeable symptoms in milk after about a week. Ropiness in pasteurized milk is likely to become more of a problem for processors as total bacteria counts continue to be lowered by refrigeration and improved sanitation and as storage periods become longer. Under these conditions, a larger fraction of the organisms present in milk will undoubtedly be psychrophiles. Since many of these psychrophiles do not grow at the standard plate count temperature of 35°C used for routine laboratory testing, this study suggests modifications in procedure to allow more accurate determination of the quality of pasteurized milk.

COLIFORM COUNTS on raw milk, occasionally used as an index of milk quality, are expected to increase with the standard plate count. High coliform counts confirm poor practices, but many times they do not correctly forecast the counts that will be obtained after pasteurization. There is good reason to screen raw milk supplies by counts on laboratory-pasteurized samples. Though many producers deliver raw milk with counts of 2,000, laboratory-pasteurized samples from some of those milks still show counts as high as 1,800. Here is definite proof of a problem. The cooling of the milk was good, but thermoduric organisms from dirty equipment and similar sources were present and not eliminated by pasteurization. The laboratory pasteurized count often continues to climb until a clean-up program is begun.

With the prolonged holding of pasteurized milk at refrigeration temperatures that has developed in recent years, interest has developed in determining its quality by the number of psychrophiles (bacteria capable of growing at low temperatures). The standard method for determining psychrophilic bacteria is exactly the same as the standard plate-count method except that plates are incubated 7 to 10 days at 5° to 7° C. Long incubation is necessary because the low incubation temperature necessary to prevent the growth of nonpsychrophilic bacteria greatly slows the growth of psychrophiles.

A recent modification for determining psychrophilic bacteria in pasteurized milk was of sufficient interest to warrant its inclusion in the eleventh edition of *Standard Methods for the Examination of Dairy Products.* After the plate count (32° C for 2 days, or 25° C for 3 days), the sample is held 5 days at 45° F, and the plate count procedure is repeated. Any appreciable increase in count after the refrigerated storage period indicates the presence of psychrophilic bacteria that may lessen normal shelf life of the milk. This procedure will indicate operating conditions that permit contamination after pasteurization. Experiments have shown that negative coliform counts on pasteurized milk do not necessarily mean that psychrophiles are absent.

Several types

Several types of psychrophilic bacteria are important in milk. Possibly the most notorious are those that produce fruity odor and those that produce a ropy condition. These defects occur occasionally in pasteurized milk stored about a week.

A few dairy plant operators, upon encountering ropiness in pasteurized milk, have feared that the organisms producing the ropiness might be survivors of pasteurization, which would mean that procedures preventing contamination after pasteurization might not prevent ropiness. One industry manual suggested an incubation test for determining rope-producing organisms in raw milk. But contamination of pasteurized milk with psychrophilic bacteria is a plant problem and must be solved within the dairy plant. Further, the particular types of psychrophiles present in raw milk, primarily from water and soil, vary from time to time and farm to farm. If raw milk is incubated, the defect or defects that develop from growth of the organisms present are determined by three factors: the dominant type or types of organisms, the temperature of incubation, and competition or lack of competition among the organisms.

The history

The history of psychrophiles that cause ropiness is long. In the early days of milk production, the little cooling practiced was accomplished with water. Water tanks, streams, tubular water coolers, wet cloths on cans, and the moisture in the can itself, all contributed contamination and would frequently cause various defects including ropiness. It was easy to reject raw milk of this type since the defects were so obvious. Gradually, with improvement in farm cooling and over-all dairy practices, little or no raw milk was delivered with obvious defects. Dairy plants would also create problems including ropiness; then there was one thing to do: clean up. Ropy milk was fairly common until plants installed improved equipment, started pasteurizing milk, upgraded cleaning methods, and adopted better sanitizing procedures. Now there are comparatively few outbreaks of ropiness, or other obvious defects, in processed milk.

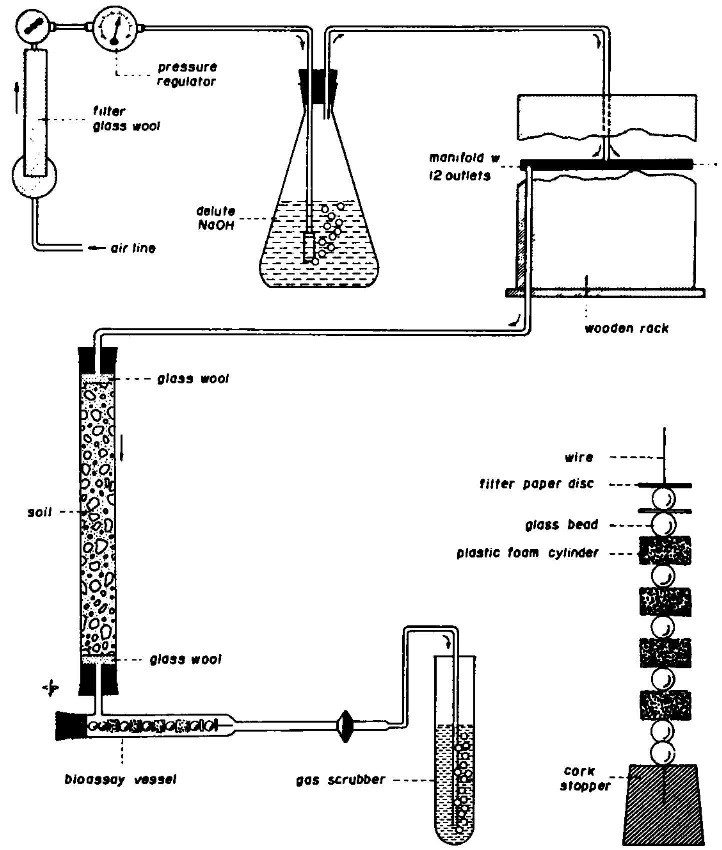
Since fluid Grade A pasteurized milk is on the market as a fresh commodity, there is little reason to expect it to keep indefinitely. Improved packaging and pasteurization equipment would lead one to expect longer shelf life. However, this is not yet assured. The table shows the plate-count history of one of several samples of pasteurized milk picked up at stores. It is typical of commercial samples.

Day	SPC	Psychro.	Coli.
0	600	0	–
1	500	0	–
2	500	0	–
3	700	0	–
4	600	0	–
6	1,200	50	–
7	2,000	400	6
8	4,500	2,000	–
9	30,000	25,000	–
10	520,000	370,000	–
11	9,000,000	4,300,000	–
13	62,000,000	53,000,000	–

The sample was stored in a typical household-type refrigerator, and removed for a few minutes each day for sampling. This removal of the samples from the refrigerator each day somewhat simulated treatment of milk in the home. The flavor deteriorated between the 11th and 13th days, as would be expected merely by looking at the plate counts. Plate counts are generally in the range of 10 to 50 million when off flavors are detectable. The general trend in most samples examined was for the counts to become great by the 8th, 9th, or 10th day. Defects usually were observed about 12 days after pickup. For samples showing a psychrophilic count on the first day, high counts and off flavors developed correspondingly soon. Usually the defect was fruity flavor, putridness or ropiness. A single day's production sufficiently contaminated with psychrophiles to permit immediate detection can bring a flood of complaints from consumers.

Further study of sanitization and handling methods may be necessary to enable dairy plants to bottle milk 100 per cent of the time without occasional low levels of contamination after pasteurization.

Bruce E. Hubbell, Jr., is Lecturer in Food Science and Technology and Specialist in the Experiment Station, and Edwin B. Collins is Associate Professor of Food Science and Technology and Associate Dairy Bacteriologist in the Experiment Station, Department of Food Science and Technology, University of California, Davis.



FUNGICIDES ANALYZED FOR TOXIC VAPOR ACTIVITY

THIS APPARATUS WAS USED in Riverside tests to study the fungicidal activity of air passing through soil that had been treated with fungicides. The soil column, lower left, consisted of 50 per cent peat moss and 50 per cent Oakley loamy sand. Skewered on a wire and placed within the tube below the soil column, were filter paper discs containing spores of *Myrothecium verrucaria* and plastic foam cylinders with *Rhizoctonia solani* and *Pythium ultimum* growing on them. Data were based on the presence or absence of fungus growth from the inoculum carriers when subsequently placed upon potato-dextrose agar. Gas scrubbing solutions were checked with a spectrophotometer.

Compounds with low vapor pressures in aqueous suspensions or solutions, such as captan, nabam, pentachloronitrobenzene and zineb, did not produce fungitoxic vapors. Fungitoxic vapors were produced by compounds with higher vapor pressures, or which readily decomposed in soils to vaporous substances, including Mylone, vapam, and Panogen 15. The volatile toxicant from Mylone and vapam-treated soil was found to be methylisothiocyanate (MIT). The volatile toxicant from Panogen 15 was not identified, but it was long lasting and unusual in that *Rhizoctonia* was highly resistant, but *Pythium* and *Myrothecium* were very susceptible to it.—*Donald E. Munnecke, Associate Professor; K. H. Domsch, Associate, California Agricultural Experiment Station; and J. W. Eckert, Assistant Professor, Department of Plant Pathology, University of California, Riverside.*