

## *Notes on Dairy Bacteriology.*

L. H. Pammel and I. J. Mead.

It is a well known fact that milk varies greatly in quality. Some of it will make butter of the highest quality, some again, owing to injurious organisms, will not make prime butter. The injurious fermentations are much worse at times than at others. Milk as it is received at the creamery, is often "off" in odor. It is, therefore, desirable to know what patron is responsible for this tainted milk. It was supposed by patrons that these odors had their origin in weeds, etc.

Some years ago Mr. Monrad gave, at one of the meetings of the Iowa State Dairy Association, a simple test for detecting these odors which is largely used in European dairies. Samples of milk from different patrons are placed in glass tubes and then allowed to stand for a day or less, in a warm place to allow the bacteria to develop. The odors and gaseous fermentations may easily be detected.

In our work we proceeded as follows: Test-tubes were sterilized and plugged with cotton to keep out all foreign organisms. Then samples of milk were put into the tubes directly from the patrons' milk.

Prof. H. L. Russell\* suggests the following method: Sterilize the tubes and then to each tube, after it is filled with milk, add an equal quantity of rennet and note rapidity of curdling. Milk that curdles very rapidly, or milk that curdles slowly is abnormal. The precaution should be taken to use the same kind of rennet extract and an equal quantity for each sample of milk, otherwise the test will prove unreliable. He also suggests the incuba-

---

\*Outlines of Dairy Bacteriology. Second Edition p. 179.

tion of the tubes for several hours at a constant warm temperature of 95 degrees F.

Our work was done in the summer and while there was a little difference between night and day temperature, this did not change the results. In the winter it is, of course, advisable to maintain a constant higher temperature. Several bitter organisms develop best at lower temperatures, if it is desired to test for these, parallel tests should be made at low and high temperatures.

After making some preliminary tests in noting changes due to abnormal fermentations, fifteen samples from as many different patrons were selected. These were selected because of peculiar odors other than lactic acid present in the milk.

These samples were numbered consecutively and allowed to stand in a warm room. In twenty-four hours all the samples of milk had curdled, and numbers 2, 3, 4, 7, 8, 9, 10, 11 and 14 contained gas bubbles. These bubbles began by small rents in the bottom of tube and soon a passage started, working its way upward. Samples were kept under observation for fourteen days and physical conditions noted.

It may be noted here that gaseous development in milk is not necessarily an accompaniment of bad quality. No. 9 developed gas very freely and only at the end of four weeks did decomposition set in. Some of the most offensive and putrefactive did not develop gas, as in Nos. 1 and 13. No. 14, however, produced an abundance of gas and was very offensive.

It is highly probable that the odors so common in milk are not always to be credited to weeds, but they arise from the decomposition of the albuminoid products in milk, brought about by bacteria. The odors in some cases were strongly suggestive of vegetables.

Pure cultures were made of some of these organisms and it may be of interest to give in a general way, a few of the results obtained. Agar plate cultures were made from Nos. 1, 2, 9 and 15. Cultures A and B were obtained from No. 1; C, E, F and G from No. 2; L from No. 9 and H, and I from No. 15.

*Summary of Characters.*

Number of Sample.	Condition in 24 hours	Condition in Fourteen Days.	Condition in Four Weeks	Gasol. Condition in 24 hours.
No. 1 .....	Curdled	Cheesy, viscous, pale yellow, offensive odor, casein digested.	Badly decomposed, viscous, yellowish brown, a very offensive odor.	
No. 2 .....	"	Decomposition and digestion of casein, offensive odor.	As in No. 1, but had not proceeded so far.	Abundant.
No. 3 .....	"	Still curdled, faint odor.	Surface brownish (due to a mold) and greasy, still some curd.	"
No. 4 .....	"	Still curdled, a perceptible odor.	Like No. 3.	"
No. 5 .....	"	Rapid decomposition, strong offensive odor	Like Nos. 3 and 4, but strong odor,	"
No. 6 .....	"	Curdled, good condition.	Like Nos. 3 and 4, odor like No. 5 but not so strong.	"
No. 7 .....	"	Rapid decomposition, with offensive odor.	Heating removed some of organisms and bad odor. New odor of cheese partially curdled.	"
No. 8 .....	"	Lost.		
No. 9 .....	"	Curdled good.	Curdled in good condition	"
No. 10 .....	"	Decomposition, digestion of casein, bad odor.	Like No. 5, odor more offensive, like rotten eggs.	"
No. 11 .....	"	Curdled, but had partially undergone digestion, odor slight.	Like No. 3.	"
No. 12 .....	"	Curdled, good.	Like No. 9, with slightly more offensive odor.	"
No. 13 .....	"	Curdled, slight odor	Surface brownish due to molds, casein partially dissolved, strong and disagreeable odor.	"
No. 14 .....	"	Curdled, slight odor.	Partially dissolved, liquid, greenish, odor of decomposing fruit or vegetables.	"
No. 15 .....	"	Curdled, good.	Strong petrefactive odor otherwise like No. 14.	"

Some of the samples which were in good condition August 4th and August 18th, were now, Sept. 2, undergoing decomposition, with digestion of casein, as Nos. 12, 13 and 14.

A. *Bacillus*, viscous, rapidly liquifying gelatin, milk not curdled, yellow, alkaline. Produces a small quantity of gas in glucose, consisting of carbonic acid (CO<sub>2</sub>) and hydrogen.

B. *Bacillus*, viscous, rapid liquefaction of gelatin, milk became viscous, yellow, not curdled, strong alkaline reaction. Produces gas very slowly in fruit sugar, and in small quantity.

C. *Bacillus*, viscous, rapidly liquefying gelatin, milk not produced in any of the sugars. Milk slowly changed to a viscous mass, not curdled, alkaline reaction.

E. *Bacillus*, does not liquefy gelatin, milk light yellow, not curdled. Gas produced in glucose, consisting of Carbonic acid (CO<sub>2</sub>) and Hydrogen (H).

F. *Bacillus*. Does not liquefy gelatine, milk light yellow, not curdled. Gas produced in glucose, consisting of Carbonic acid (CO<sub>2</sub>) and Hydrogen (H).

G. *Bacillus*. Does not liquefy gelatin, milk changes slowly, light yellow, not curdled. Strongly alkaline. Gas produced in glucose, consisting of Carbonic acid (CO<sub>2</sub>) and Hydrogen (H), and also a small quantity in cane sugar, on the seventh day.

H. *Bacillus*. Gelatin rapidly liquefied. Milk light in color, liquid, with an offensive odor, and strong alkaline reaction. Produced gas rapidly in milk sugar, consisting of Carbonic acid (CO<sub>2</sub>) and Hydrogen (H), also a medium quantity in cane sugar and a small quantity in glucose.

It will be noted from the above that most of the species here isolated had an alkaline reaction. These organisms would have a tendency to counteract the action of the normal lactic acid organism. While lactic acid species may not be essential for the production of a high quality of butter, we are strongly inclined to think that they are most essential, at any rate, the American tastes are in that direction. These species cannot be looked upon but as injurious.

L. *Bacillus*. Liquefies gelatin as well as blood serum. Milk light yellow, watery, with a rather pleasant odor, alkaline reaction. Gas was not produced in any of the sugars.

I. *Bacillus*. Liquefies gelatin rapidly, light yellow, watery, and with an offensive odor, alkaline reaction. Produced gas rapidly in milk sugar and glucose, and moderately in cane sugar. The gases in each case consisting of Carbonic acid (CO<sub>2</sub>) and Hydrogen (H).

It is interesting to note that the pure cultures produced the same odors in milk, observed in the original, so that this simple bacteriological test will serve to locate any troubles that may arise in the creameries. It also shows that weeds are not responsible for all of these off odors and tastes.

Patrons should exercise the greatest care in keeping their premises clean, especially the stable, barnyard, and dairy utensils.