

Graduating Thesis
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Subject. — Value of Bacteria
in our Dairy Products.

Whenever they hear the word "bacteria" most people are apt to shudder with horror, and look upon them as the sworn enemy of the human race. We have a sort of a shrinking when anyone speaks of the number of bacteria in the milk or water we are drinking. The reason for this is evident. After bacteria were discovered the first question of importance associated with them was their close relation to the causes of many terrible diseases and epidemics that swept away the population of whole communities. Scientists then began to investigate these microscopic organisms and soon established what is now known as the "Germ Theory of Disease". With their minds intent upon this side of the question they did not pay much attention to the good that bacteria might do in the world. The part they played in disease was a more interesting study. The consequences was that the results of these investigations and studies

was to impress on the minds of the people the great harm done by these invisible pests.

But the fact is, the story of the bacteria has only been half told. It is true that they are often very injurious to us, but it is also true that they are of great economic value. They have been looked upon as belonging to the medical profession, but they are now known to be of still more importance to the farmer, for many of the good results obtained are brought about by these tireless little workers. It is the farmer who should study bacteriology. Farmers do not begin to understand the debt they owe the bacteria for services that nothing but the bacteria could accomplish.

Let us notice the important function of the bacteria in our dairy products. It is they that bring about all the peculiar changes that milk and butter and cheese undergo. As far as the milk itself is concerned

they are very undesirable. They cause it to sour and ferment and are the milkman's worst enemy. If it were not for the bacteria he could keep his milk sweet indefinitely. All who are familiar with the care of milk know that extra precautions must be taken with the utensils in which the milk is kept. The vessels should all be sterilized by either scalding with hot water, which is the cheapest way, or by cleaning with an antiseptic in order to kill the germs. So far as the milk is concerned we see that bacteria are harmful but now let us ^{notice} their value in butter and cheese making.

Every Butter and cheese makers are just as dependent on the bacteria for success as they are dependent on their cows for the milk which they use. Every dairymen is familiar with the fact that he gains in quality and quantity of butter when he allows the cream to stand for about twenty four ^{hours} or so, in a warm place to ripen after it has been collected. During this

time great changes are taking place. The cream turns slightly sour but a peculiar pleasant odor is given off. If a part is examined under the microscope millions of bacteria can be seen growing and increasing with wonderful rapidity.

The longer the cream is let stand the more numerous do these little organisms become and with their increase the changes of the cream increase. After this process of ripening has gone on for a sufficient time the cream is churned. Now, the bacteria influence the cream in at least three ways: first, by making the cream churn easier; second, more butter can be obtained from a given amount of cream than could otherwise be done without the aid of the bacteria; third, and perhaps the most important is the pleasant and delicate aroma and the fine flavor they give the butter.

The explanation of these results is this: fresh cream is difficult to churn because it contains minute globules of butter fat held in position by a

slimy albuminous substance which prevents the globules from collecting by the agitation of churning. In ripening the cream the bacteria produce lactic acid which acts on the slimy material and dissolves it. This frees the globules of butter fat and they can then be easily collected by churning.

In churning fresh cream a large part of the butter fat cannot be extracted at all because some of the globules are so firmly fixed in this slimy substance that it is impossible to collect them. When the slimy material has been dissolved all the globules can easily be collected.

The third advantage from ripening is the development of the aroma. Butter made from sweet cream is tasteless and has no aroma. This valuable quality of butter is a product of decomposition begun by the bacteria. As soon as the bacteria attack the cream decomposition begins and if it were not checked in time they would bring on complete decay. During

this decomposition the albuminoids and sugars are split up and many volatile products which have different odors and flavors are produced and given off, among these being the delicate odor of newly made butter. Just when to check the bacterial growth in the cream is the problem to solve and on this question the judgement and skill of the butter maker depends. The ability to decide this question comes only with experience.

When the cream is ripe enough it is churned and this ends the process so far as the bacteria are concerned, for they cease to grow in the butter. Many of them go off in the butter milk; many more are removed when the butter is washed and what few remain are killed by the salt. When butter becomes rancid it is not the work of bacteria, but a case of simple oxidation by the air. It is true, they may hasten the result, but their presence is not necessary. After the butter is made the bacteria are of no farther use.

Now we see that the bacteria

are of great value to the butter maker and to them the credit is due for the high price that butter brings in the market. Unfortunately, however, of the four or five hundred species of bacteria in the world many are very injurious and if they should happen to get in the cream poor results are sure to follow. While they cut the slime that holds the fat globules together the aroma that some species produce is very undesirable. Others acting alone produce good butter and of course they must be more numerous than the former in order to change the result. Bacteriologists assert that during the ripening of the cream a great battle is going on between the different species of bacteria for the supremacy. Some species find the conditions favorable to their growth while others find it less so and are gradually crowded out. Some species may have the advantage over others at the start in numbers, but another species may make up the deficiency by a more rapid rate of

multiplication. The final result depends on a large number of conditions. The condition of the cow, the method of milking, the manner in which the cream is set, the temperature, etc., will all be important factors favoring one form of bacteria and hindering others. If the struggle is in favor of the beneficial species good butter will be the result, but if the bad species should hold sway poor butter will be produced. The results are beyond the control of the butter maker. By practice he has found the methods that will generally give a good quality of butter, but often it is impossible to control the quality no matter what precautions may be observed. We must not think that bacteria are the sole agents in the variation of the quality of butter. Different conditions of the cows, different food, the care that has been given the milk, etc., will all affect the milk more or less but there is no question in regard to the bacteria playing an important part.

What the dairymen wants is uniformity

in his products in order that he maybe insured against any severe losses. With the progress of bacteriology it does not seem improbable that a time will come when the butter maker may ripen his cream with artificial cultures, just as beer, wine, and other liquors have been treated with such great success. It seems to be entirely possible that a great improvement in this line might be accomplished. Experiments made in Denmark, Germany and this country have pointed in this direction with promises of great success. We may expect, before long, a method by which the production of a good quality of butter will be a certainty. Perhaps the best grades of butter could not be improved upon but it would surely bring the poorer grades up to a higher standard.

While the bacteria are only an aid to the buttermaker they are absolutely indispensable to the cheese manufacturer. Sweet cream butter is enjoyed by some people but no one likes fresh cheese. It is very unpalatable. To make

it appetizing it must first be ripened, that is, the bacteria must decompose it to a certain extent. This process of ripening cheese requires a long time. The millions of bacteria that were in the milk are stored away in the cheese and instead of being killed there as they are in butter they multiply in numbers. In the cheese, also, there is a great battle for the supremacy between the different species of bacteria and the quality of a cheese depends, it is supposed, on the species of bacteria that ripened it. On account of unfavorable conditions the bacteria do not grow so rapidly in cheese as they do in cream and consequently the time it takes a cheese to ripen is very long and the longer it ripens the stronger it becomes. In the case of Limburger cheese the action is carried on to the verge of putrefaction. The bacterial growth can be controlled to a certain extent by regulating the temperature of the ripening cheese. Sometimes cheeses are of a poor quality

when every precaution is taken by the cheese maker to avoid improper conditions. ~~What~~ is the reason? It is simply a ripening by an improper species of bacteria. Often a cheese is poisoned by a certain species of bacteria which produce a poisonous substance called "tyrotoxicon". This happens quite frequently and many people have died from eating such cheese. When the science of bacteriology is better understood very likely this trouble can be avoided.

Whether the different tastes and flavors of some of the noted brands of cheeses is due to the species of bacteria that ripened it is not known for certain although bacteriologists are inclined to think it is. At the rate of progress in this line I think the time will come when this fact will be known. The fine flavor and taste of the celebrated Swiss and Dutch cheeses are said to be brought about by a certain culture of bacteria the manufacturers use in their production.

The investigations of the bacteriologists on this subject of bacteria in the dairy has been of incalculable benefit and interest to the dairymen, and yet the science is only in its infancy. The excellent work of our Experiment Stations is advancing in this direction and we may expect some interesting results before long. What we do know of the bacteria they are certainly of great value in the production of butter and cheese, in fact, we know that cheese cannot be produced without them. We can easily see how artificial cultures might do the required work without the danger of running any risk in getting a poor species and, consequently, poor results. For a long time the manufacturers of beer and whiskies frequently suffered great losses by the wrong kind of yeast, a group of plants similar to the bacteria, getting in the malt and producing a poor fermentation. This risk was entirely avoided after a certain species of yeast had been found that always produced good results when

used as an artificial culture in the malt. Is there any reason that would prevent us from using bacteria in a similar manner? Undoubtedly, this question will be answered within the next few years.