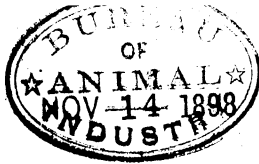


Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.



CIRCULAR No. 24.

(B. A. I. No. 115—DAIRY No. 22.)

United States Department of Agriculture, BUREAU OF ANIMAL INDUSTRY.

COLORED SPOTS IN CHEESE.

Numerous inquiries have been received by the Dairy Division concerning the "disease" of cheese sometimes called "cheese rust," which is more or less prevalent in certain sections of this country and has caused considerable annoyance and loss to some factories and dealers. Although this trouble has been in evidence for a number of years, it has received but little attention from our scientists and experiment stations; and cheese-makers so unfortunate as to have it visit them have explained it in many different ways and dealt with it accordingly.

GENERAL DESCRIPTION.

From about fifty reports received at this office the following facts are gathered: The affection is noticed where white, or uncolored, cheese is made. It may not appear until after the cheese is sold, but is usually first discovered from one to three weeks after the curd is pressed, when there may be seen a number of red to reddish yellow spots on the outside and throughout the body of the cheese; the spots may be detected with the aid of a microscope some time before they are visible to the naked eye. These sometimes seem to be in irregular layers, and when a trier is inserted piercing the layers rings appear on the plug withdrawn. If a cheese affected in this way is cut across the layers it is found to be streaked. The spots increase in size from day to day and vary from mere specks to large patches; they are chiefly in the open spaces, or cells, or interstices, between the pieces of curd, and sometimes resemble a sprinkling of iron rust or red pepper. In some cases they are described as being the size of small shot and are scattered through the cheese as though they "had been dropped into the curd while putting to hoop." In other cases they are as large as silver quarters and occasionally, on the outside of the cheese, especially at the ends which come in contact with the shelves, there are colored patches as large as one's hand. This trouble occurs in hot weather and is at its worst in July and August. Sometimes it affects only a part of the output of a factory, but if it gains a good foothold it is liable to be found in the entire product.

EFFECT OF COLORED SPOTS.

So far as is known, these spots do not have any effect on the consumer. Professor Connell fed mice with cheese containing the reddish yellow spots and at the end of two weeks they were alive and well. Inoculation experiments with guinea pigs resulted in only slight local inflammation. But the unsightliness of the spots naturally has an unfavorable effect on sales, and reductions for this cause from one-fourth to one cent per pound are not uncommon. Such a shrinkage in returns, together with loss of reputation, can be ill afforded by any cheese factory and its patrons.

CAUSE OF COLORED SPOTS.

The cause of cheese rust is not generally known, and it is popularly attributed to numerous conditions, such as feed or water given to the cows, tainted milk, adulterated milk, rusty spots in milk utensils and vats, too quick ripening, poor rennet, uneven coloring (when color is used), uneven cooking, the curd mill, unclean benches in the curing room; in fact, almost everything which comes in contact with the milk or curd during manufacture, and almost every step in the process, has been suspected of being the cause of this disorder. It is sometimes confused with irregular coloring resulting from the use of a poor grade of color or improper mixing.

In recent years cheese rust and other affections of similar nature have been carefully studied by bacteriologists, and they have found that these troubles are usually caused by different kinds of bacteria. Some general characteristics of these tiny creatures are given in Farmers' Bulletin No. 63, "Care of Milk on the Farm," a publication of this Department.

USUAL REMEDY.

The remedy usually adopted is to color the cheese so the spots will be less visible or completely covered, but this is not entirely satisfactory as it does not correct the cause, and frequently the market being supplied demands an uncolored cheese; sometimes the spots are so bad that color enough to cover them would spoil the cheese. Numerous other remedies are suggested, based on the supposed causes given above, but they are generally theories, and in most cases would fail in practice. As suggested later, hastening the ripening of the milk may have the favorable effect of retarding the growth of colored spots. The only perfect remedy is to do away with the cause, and the method of accomplishing this is shown below.

INVESTIGATION OF AN OUTBREAK.

Under the direction of the Dairy Commissioner of Canada, a careful study and report of an outbreak of colored spots in a Canadian factory was made by Dr. W. T. Connell in the summer of 1896.

The factory was found to be well located but not well kept. As is too frequently the case with cheese factories, the utensils and vats in daily use were fairly well cleaned, but in general the factory had an untidy appearance; in particular the drains were very defective and filthy. The drainage from the factory was intended to enter a drain under the floor, but a close connection between the floor and drain was not made and it had to fall about 18 inches to the trough; a considerable part of it splashed over onto the ground underneath, which was kept constantly saturated and in a slimy condition. The color of the slimy mass varied from reddish to reddish yellow or reddish gray. Bacteriological examination of this substance revealed many forms of low organic life, and bacilli were discovered which closely resembled a form found in the affected cheese. The salt, rennet, and samples of milk delivered by the different patrons were also examined, but without finding suspicious germs in any of them. There seemed little doubt but that the defective drain and its surroundings were the source of infection, and to prove that the chromogenic germ,¹ abundant about the drain, could cause the trouble,

¹The organism found to cause the trouble is named by Professor Connell *Bacillus rudensis*; it is described as being in the form of short rods, sometimes curved, though usually straight, and measuring from one twenty-five thousandth to one fifteen-thousandth of an inch in length; they may be in pairs, but do not form long chains. It "stains well with ordinary aniline dyes in recent culture. It stains best with carbol-fuchsin or aniline water, gentian, violet. Older cultures often show rods with unstained beads, one or more. These are evidently not spores; no spores have been demonstrated."

As to its biological characters, it "is aerobic and facultative anaerobic, but grows more rapidly, and pigment is formed a little more freely, with plenty of oxygen. It does not liquefy gelatine. It is freely motile, but no flagella could be demonstrated by Van Ermengem's method."

"In gelatine stick cultures at 70° F. this organism is seen as a faint white growth along puncture line in twenty-four hours, showing as discrete small colonies under lens; in forty-eight hours the growth is clearly seen, and has a faint yellowish tinge; growth is as free in depth as toward surface; in three or four days puncture line becomes of a faint reddish yellow. No liquefaction occurs, nor does growth extend over culture surface. In gelatine slope tubes growth occurs along the inoculating line as discrete, small, rounded colonies, with beveled edges, gradually acquiring a reddish yellow cast. If gelatine be faintly acid, pigment formation is not so great. On agar-agar colonies always remain small and white, not forming any pigment either at room temperature or at body heat."

"On milk growth readily occurs, causing clotting after two days at 70° F., and coagulum gradually acquires a faint, yellow cast. Often, also, pigmentation occurs as faint, red, yellow dots on surface of coagulum."

"On neutral beef-peptone broth this bacillus grows slowly, causing a faint cloudiness chiefly in lower half of tubes. On potato tubes its growth is, however, most typical. On potatoes kept at 70° F. there appear in twenty-four hours faint yellowish colonies which soon acquire a red tinge, gradually becoming in course of three or four days rust colored; these colonies are small, seldom becoming larger than a pinhead, the colonies are rounded and have raised centers and an irregularly sloping edge."

"Cultures in broth of these bacilli, forty-eight hours old, were heated to various temperatures to determine if spores formed. It was found that heating to 155° F. nearly always kills this bacillus, while a temperature of 148° F. for ten minutes was readily withstood. A temperature of boiling water for twenty to thirty seconds was found to kill the micro-organism in all cases. If spore formation occurred, it is almost certain that higher temperature would be withstood for longer periods."

a lot of milk in a factory entirely free from the infection had a culture of the bacilli introduced into it and was made into cheese; within a few days the spots appeared. Prof. F. C. Harrison reports that the same bacillus is found in dirty sinks, vats, etc.

In this instance it was easy to see how the germs could find their way from the infected soil to the vats. When the dried slime was stirred, dust arose and it was carried by the wind into the factory. Some particles settled directly in the vats and on the utensils; others fell in moist places and colonies were started, thus forming nearer sources of contamination. Moist slime and dried slime were tracked into the building by operators and visitors, and the germs were easily transferred from the floor to the milk by cloths, utensils, drafts of air, etc. No theory is given as to the original source of the germs, but it is plainly shown that after they became established a circuit was formed from the drain to the milk and whey and back to the drain again.

Experiments by Prof. J. A. Ruddick showed that when the germs were introduced into milk having considerable acid, less spots were found in the cheese than when they were added to comparatively sweet milk. This is evidently one reason why the makes are differently affected, the milk being riper when delivered on some days than others.

Just how a dairy originally becomes infected with objectionable bacteria which color the milk or cause it to be ropy, slimy, bitter, or soapy, or how a creamery or cheese factory which has had no previous trouble with bacteria, is infected with troublesome forms, is not always known. Occasionally outbreaks occur which are as unexpected and inexplicable as are some outbreaks of infectious diseases in healthy communities. But it should be remembered that bacteria are extremely minute bodies and that many ways of moving about, even long distances, are possible to them. They can often successfully withstand what would seem to be very unfavorable conditions and thus for a long time hold their life as they are carried from place to place, or as conditions about them change, until they find themselves a favorable location for growth, and then immediately commence to multiply at a marvelous rate. They may first be introduced into a factory by impure water, milk from an infected dairy, cans which have been used for other than dairy purposes, and especially by dust or anything which carries dirt.

PREVENTIVE MEASURES.

After objectionable germs have once entered the factory three things are required for their growth or increase, namely, warmth, moisture, and food. It is impossible to keep the temperature from

being favorable to them in the summer time, but by keeping the factory as dry as possible, the food supply scarce, and subjecting the germs to conditions which are fatal to them, such as high heat and disinfectants, it is possible to rid the factory of them.

Soon after a factory is infected with troublesome bacteria, colonies will become established in many places; they are hidden in cracks in the floors and walls and any place which remains continually moist will contain large numbers of them. The entire building and all its contents must be scrupulously cleaned and the work must extend to the whey tank and drain leading to it. Every utensil should be thoroughly sterilized by exposure to live steam during at least ten minutes, and everything not so treated should be disinfected. The inside walls of the building and the outsides of the larger apparatus may be disinfected with boiling water or steam, but if this is not practicable a dilute solution of carbolic acid may be used, at the strength of 1 pound to 25 to 50 of water. This is an excellent disinfectant but should not be applied to any surface which comes in contact with the milk. Sulphate of iron (copperas) is an efficient disinfectant for drains; they should be flushed daily with boiling water and have steam passed through them if possible, then have lumps of copperas placed in them.

At the same time or preceding the work of cleansing the factory, its surroundings should be improved. Pools should be drained and the hollows filled with clean earth. If at any point the soil is saturated with milk or whey, the top part should be replaced with fresh earth, if practicable, and copperas sprinkled about. Treatment of this kind frequently repeated and accompanied by the replacement of decayed boards in the floor or elsewhere, and the repair of drains, waste pipes, etc., and followed by a good coat of whitewash, will usually remove all trouble. If, however, the conditions are not improved after these operations, it is probable the source of infection is external to the factory, and every effort should be made to quickly locate it. An affection once started readily travels from dairy to dairy, and unless it is promptly stamped out an entire district may suffer and great loss result. If it is found by handling the milk from the different dairies separately, or by the use of a fermentation or curd test, that the trouble belongs to a certain one, that dairy should be thoroughly cleaned and disinfected as described in Farmers' Bulletin No. 63. If the water is found to be to blame, a new supply should be obtained, or an arrangement provided to boil all the water used.

The infection of the factory above referred to was entirely overcome by remedying the faulty draining facilities and thoroughly cleaning and disinfecting the factory, its contents, and surroundings.

In one factory which had been troubled for several years the difficulty disappeared with a change of operators; the new man gave everything a thorough cleaning and saw nothing of rust spots. In another case the renovation, and in fact the reconstruction of a factory, failed to remedy the trouble, which was finally located in the dairies of some of the patrons.

R. A. PEARSON,
Assistant Chief of Dairy Division.

Approved:

JAMES WILSON, *Secretary.*

WASHINGTON, D. C., *July 22, 1898.*

○