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THE OCCURRENCE AND POSSIBLE TOXICITY OF MOLDS IN CORN SILAGE.

ALVIN R. LAMB.

Frequent cases of suspected forage poisoning in this state which apparently were traced to moldy silage, led to this study. The silage in a silo below the surface layer is almost always free from mold, at least when properly packed and containing a sufficient amount of moisture. Occasionally, however, clumps of mold are found far below the surface and in the interior of the mass where the amount of oxygen is almost negligible. In order to secure a considerable number of samples of such moldy silage, notices were sent out to the newspapers of the state through the press bulletin, "Better Iowa."

A number of samples of the kind of material wanted were received. In all cases, as in the case of samples previously sent in for examination, the molds present were of the same characteristic red or green color. In the samples studied the red mold was in each case isolated and identified¹ as *Monascus purpureus* Went, which was found in silage some years ago by Buchanan.² This mold forms in silage thick cottony masses of white mycelium, often tinged with carmine red. In cultures well advanced in age the whole mass takes on this characteristic color. The red pigment is easily soluble in water and diffuses through the surrounding silage, coloring the kernels of corn a homogeneous pink or carmine. The fact that this pigment penetrates beyond the moldy region is sometimes a source of confusion in the examination of such silage.

This mold was grown successfully on various modifications of Raulin's medium. The addition of silage juice to the medium did not generally increase either the color or the luxuriance of the growth. The growth was most luxuriant, of course, with sugar in the medium, but the production of the red pigment was more marked in the absence of sugar. Both on agar and liquid media the pigment was produced below the surface of the medium.

The greatest production of the pigment was obtained in cultures grown on rice flour paste after the method of Buchanan.

¹The identity of these two species was very kindly confirmed by Dr. Charles Thom of the Bureau of Chemistry, Washington, D. C.

²*Mycologia*, Vol. 2, pp. 99-108, 1910.

Growth was luxuriant and the entire medium was deeply colored. According to Buchanan, *Monascus purpureus* is used by the Chinese in the preparation of "red rice," which is used as food.

The green mold was isolated and identified as *Penicillium roqueforti* Thom, which is often referred to in dairy literature as *Penicillium glaucum* Link. It is always found on Roquefort cheese and also occurs on other cheeses. The mycelium is characteristically green or grayish green and becomes a deep brown when two to four weeks old, if exposed to the air. The medium is not colored. It grows equally well on Raulin's medium and on silage juice agar.

From the experience of the writer it seems that these two molds are practically the only ones found in well preserved silage below the surface. Other molds have been isolated from samples of silage, but the fact to be considered is that moldy silage is not generally found except where the silage was not moist enough to be well packed and thus thoroughly exclude the air. If air is not excluded, various molds may be found, but such conditions are not considered here.

TOXICITY TESTS.

Following the methods used by Gortner and Blakeslee,³ water extracts of the mycelium of these two molds were made by grinding the mycelium, grown on agar, with pure ignited sand and filtering with suction. The filtrate was heated just to boiling and quickly cooled, taken up in a sterile glass hypodermic syringe and injected with the usual precautions into the ear veins of rabbits. Various concentrations and amounts, up to 2 c.c. of the concentrated extract, were injected into four different rabbits. In no case was any injurious effect noted. In order to check the procedure, cultures of *Rhizopus nigricans*, the mold used by Gortner and Blakeslee, were grown and water extracts made as above described, using amounts of *Rhizopus* mycelium comparable to those used as mentioned above. The characteristic reaction, followed by death in a few hours, was obtained when the extract was injected into the ear of one of the rabbits.

After going on short rations for a day, two of the rabbits readily ate silage on which these molds (*M. purpureus* and *P. roqueforti*) had been grown. One of the rabbits consumed in two days

one quart of corn silage, which had been sterilized and inoculated with *Monascus* and which was very thickly covered with the mycelium. No ill effects whatever were noted in either case.

These findings confirm practical experience in feeding moldy silage to cattle. It was reported by at least two of the farmers who sent in samples of silage, which were in good condition except for occasional clumps of moldy silage, that the cattle preferred to eat the moldy silage and would leave the good silage untouched until they had eaten the moldy material. They reported that they observed no ill effects. In most of the instances where moldy silage has been suspected in cases of "poisoning" of cattle reported to the Station, the cause has been found to be some acutely infectious disease. In cases where the molding of silage, to which atmospheric air has had more or less access, has progressed to the extent where the silage acids have been destroyed and putrefactive bacteria have begun to grow in the material, the need for caution in feeding is evident. In such cases the possible harm done can not be considered as being due to the mold but to the bacteria. Unpublished results by Grindley and Rusk at the Illinois Station privately reported to the writer show, however, that cattle are apparently resistant to the ill effects of rather badly spoiled silage. It is evident, on the other hand, that where spoiling by bacteria has begun, the possibilities of contamination by very harmful organisms are present. It is known that horses are very susceptible to the bad effects of spoiled silage. This study is, however, concerned only with silage on which mold grows in the absence of air and where further spoiling has not taken place. Using reasonably large amounts of material, it has been found that the two molds here studied are not toxic to rabbits.

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