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Tuberculosis of Fowls

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TUBERCULOSIS OF FOWLS

CECIL ELDER AND A. M. LEE

Tuberculosis of fowls is a very common disease in Wyoming. The condition is also called "spotted liver", "going light", and "rheumatism". It is a chronic infectious disease of mature birds in which tubercles or nodules form in the internal organs, especially the liver, spleen, and intestines.

IMPORTANCE IN WYOMING

This disease has been found in many counties in this state. In one county where a large number of flocks were examined, one-third were found to be infected, and in these infected flocks sixty-six per cent of the birds were diseased. Its widespread distribution over the state makes it a serious disease to poultry raisers and one that should receive their careful attention. The loss of the diseased birds is not the only thing to be taken into consideration from the economic standpoint. Diseased birds are a constant source of infection to healthy birds, and may infect other domestic animals, especially hogs. The loss from decreased egg production and feed that brings no return is enormous in flocks that are maintained after the disease has made its appearance.

SUSCEPTIBILITY

Of all domestic birds, chickens are by far the most susceptible to tuberculosis. One breed is just as susceptible as another. Older fowls are the most commonly affected, as the disease is very seldom seen in birds under one year of age. Turkeys, geese, ducks, and guinea fowls have been found to have the disease. Hogs frequently contract the disease from chickens. It has been proved recently that cattle may be infected with the same type of tubercle bacillus that causes the disease in chickens. Sparrows and pigeons also have been proved to be susceptible. As to whether or not man is susceptible to this type of tuberculosis there

*Small superior numbers refer to "list of references" at end of bulletin.
are conflicting opinions, but people are no doubt very resistant to avian tuberculosis and the possibility of infection from poultry is slight.

CAUSE AND METHOD OF INFECTION

Tuberculosis in poultry is caused by an organism microscopic in size, which is called *Mycobacterium tuberculosis avian*. This type is closely related to the ones that usually cause tuberculosis in people and cattle.

By far the most common method of infection is from one fowl to another. Diseased birds discharge the causative organisms with the droppings. Healthy birds pick up these organisms in their feed and water. The eating of poultry refuse and carcasses of tuberculous chickens by healthy birds is a common method of infection.

Just how the disease is brought into a healthy flock is sometimes hard to tell, but it is often brought in by the introduction of new fowls from infected flocks. There may be some possibility of bringing in tuberculosis with eggs purchased for hatching, but such chances are very slight. The part played by sparrows, pigeons, rats, and mice in introducing infection may be an important one.

The infection of chickens from people may be possible and has been reported. In regard to infection of chickens from human and bovine types of organisms, it may be possible that such infection was produced by the avian type which had been transmitted to hogs, cattle, or people, from poultry and then back again to the fowls.

LESIONS AND APPEARANCE OF CARCASS

Fowls that die in the last stages of tuberculosis always have a very emaciated carcass. Figure 1 shows such an emaciated condition, due to tuberculosis.
Tuberculosis of Fowls

A very characteristic thing about tuberculosis is the production of nodules. These nodules or tubercles vary in size, depending upon the extent and virulence of the infection and the resistance of the bird. In fowls tuberculosis is a disease of the abdominal organs, and any one or a number of these organs may be affected. The most common location for the tubercles or nodules is the liver. The spleen is next in order for frequency of organs affected. The nodules vary in size from that of a pin head to a pea, or even a black walnut. They may be on the surface or embedded completely or partially in the organ involved. The smaller nodules are usually opalescent and shining. The larger ones are more opaque, and whitish yellow in color. Frequently several nodules grow together and form a large tubercular mass. Inside the larger nodules is found a dry caseated (cheesy) mass, yellowish in color, which contains large numbers of tubercle bacilli. Figure 2 shows tubercular lesions in the liver.
Fig. 2. Tuberculosis in liver of a hen.
The intestines are very frequently the seat of tuberculous growth. The nodules may be small and on the inside lining of the intestines, or larger and embedded in the whole of the intestinal wall, or they may be attached to the serous or outer covering of the intestines. (See Fig. 3.)

Other organs and places where lesions of the disease have been reported, but with considerable less frequency, are the peritoneum, lungs, joints, kidneys, ovaries, testicles, gizzard, skin, inside lining of eyelids, and lymph nodes.

In some birds that die of tuberculosis there are no lesions that can be seen by the unaided eye, although these birds show symptoms of tuberculosis after the disease has become well established in the system. Smears made from the liver of such birds, stained by a special method, and examined with the microscope, will show the organism that causes the disease. For such cases of tuberculosis, because nodules, loss of weight, and lameness, may be found in other diseased conditions, it may be necessary to have a laboratory examination in order to establish a positive diagnosis. This
is especially so in flocks at the time the first bird is found which the owner suspects has tuberculosis. The laboratory staff for the investigation of animal diseases at the Agricultural Experiment Station, University of Wyoming, will aid in making such a diagnosis free of charge.

Fig. 4. A hen with symptoms of tuberculosis.

SYMPTOMS

By far the greatest number of tubercular fowls show no symptoms, but in most diseased flocks there are some birds showing outward signs of the disease. The authors have found in very badly diseased flocks as high as one-third of the birds showing symptoms of tuberculosis, but in general the proportion is much smaller.

Emaciation or “going light” is the most consistent symptom. Fowls which were fed tubercular material often lost two-thirds of their weight in three months. The amount of weight which is lost in a certain length of time will, however, depend on the number and strength of the invading organisms, and the resistance of the fowls.
Tuberculosis of Fowls

Paleness of the comb and wattles is a common symptom, although the authors have found congestion of these structures in many fowls in the advanced stage of tuberculosis.

Lameness and swollen joints, while in most cases not present, are observed somewhat frequently in highly diseased flocks. In one badly infected flock lameness was found in as high as one-fourth of the birds showing symptoms of emaciation. But in most badly diseased flocks only one or two lame birds could be found, and in some diseased flocks no lameness was observed. Sometimes swollen joints are noticed.

DETERMINING THE PRESENCE OF TUBERCULOSIS

It is usually not difficult to determine the presence of tuberculosis in the flock. The history of having lost several hens a week for a comparative long period is often found. In case the disease has had a chance to get well established, there usually can be found a few fowls showing symptoms. An autopsy on a few of those extremely light in weight will reveal the lesions as described. In some flocks there may be only a few diseased birds and these may not have reached the stage of the disease characterized by symptoms. Often the disease can be found in such flocks by killing several of the oldest hens and examining for tuberculosis. The tuberculin test might be of value here in determining if the disease is in the flock. It is good policy to watch for tuberculosis in mature birds that may be found dead, or that are killed for food. In this way it may be possible to find the disease in the flock before many birds become affected.

After the disease has been found to exist in the flock it is much more difficult to ascertain which birds are diseased and which are not, since so many diseased ones will show no symptoms. The only way which always finds all the birds showing lesions of the disease is to kill and examine every bird over one year old. The young birds then in time may develop lesions of tuberculosis. Another method, but not nearly so accurate for finding all the diseased birds, is the tuberculin test.
THE TUBERCULIN TEST

The three tuberculin tests, the subcutaneous, ophthalmic, and intradermal, are very efficient in the diagnosis of tuberculosis in cattle. The subcutaneous or temperature test on poultry has been tried by Ward, Moore, Higgins and Wickware and others and has been found to be of no value. Van Es and Schalk, Giltner, Higgins and Wickwire and others were unable to make chickens react positively to the ophthalmic test.

Experiments with the Ophthalmic Test.

The authors tried an ophthalmic test on forty-two mature hens and were unable to get a single reaction, although ten of these later reacted to the intradermal test. Avian tuberculin was used but only one dose was placed in the eye. With the idea in mind that in order to get a reaction to this test it might be necessary to use a sensitizing and a diagnostic dose, the test was repeated on a different flock, the hens of which were in various stages of the disease. The diagnostic dose was placed in the eye forty-two hours after the sensitizing dose was given. No positive or suspicious reactions were found, although the birds were examined every hour for thirteen hours.

The Intradermal Test for tuberculosis in poultry has been used in the field and by experimental workers for a number of years with a rather varying degree of success. The test now used was first introduced and tried by Van Es and Schalk. It was an application to poultry of the intracutaneous method of Moussu and Mantoux.

The test consists of injecting about one-twentieth of a cubic centimeter of avian tuberculin into the wattle quite near the surface. Van Es and Schalk say that the injection must be made in such a manner that tuberculin is principally deposited along the stratum Malpighi, and that tuberculin injected into the deeper layers of the skin of the wattles is lost and even in diseased birds will not produce a reaction. If the injection is made too superficially, there is danger of it bursting through the epithelium with the result that a diseased bird would not react.
Experiments with Intradermal Tests.

Work by the authors leads us to this same conclusion about the site of the injection. In one flock, one-half of which was found diseased, we intentionally injected the birds in the deeper layers of the skin of the wattles with result that there was not a single positive reaction. It is believed that such an injection into the deeper layers of the skin is, in many cases, very hard to avoid unless the person making the injection has had a very large experience in testing chickens. We think this will account for some of the diseased birds which we found that had failed to react positively to the test. Also, many birds that are diseased fail to react to the test because they are in too far an advanced stage of the disease. In flocks where quite a number of birds are showing symptoms of tuberculosis, there will be many diseased birds that fail to react. The only noticeable symptom of some of these birds will be a slight emaciation or loss of flesh. Some chickens, however, react positively to the tuberculin test in the very last stages of the disease when they are down and unable to walk.

EXPERIMENTS ON REACTION TO TESTS

The authors have made an attempt to determine what per cent of the diseased birds would react after they had developed symptoms varying from hardly noticeable loss of flesh, to very advanced symptoms of the disease.

One experimental flock of twenty hens was tested with avian tuberculin. Every hen in the flock showed more or less pronounced symptoms of tuberculosis ranging from slight and hardly noticeable emaciation to definite indications of an advanced stage of the disease. Great care was taken to place the tuberculin in the proper location. Only four of the hens gave positive reactions to the test at 24, 48, or 72 hours. A few days after the readings had been taken all twenty hens were autopsied, and it was found that every one had lesions of tuberculosis.

Another series of ninety-eight hens, forty of which were showing symptoms as in the previous flock, were tuberculin tested. There were twenty-three which gave a good, positive reaction, one gave a suspicious reaction, and the remainder were negative to the test. An autopsy of these ninety-eight birds
showed sixty-nine to have lesions. All that gave a positive and the one that gave a suspicious reaction were found to be diseased. The twenty-three which gave a positive reaction included only seven of the forty with symptoms. The following is the result in tabular form:

<table>
<thead>
<tr>
<th></th>
<th>With Symptoms</th>
<th>Without Symptoms</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds Tested</td>
<td>40</td>
<td>58</td>
<td>98</td>
</tr>
<tr>
<td>Positive Reactors</td>
<td>7</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>Suspicious Reactors</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Birds with Lesions</td>
<td>40</td>
<td>29</td>
<td>69</td>
</tr>
<tr>
<td>Number with lesions which gave negative reactions</td>
<td>33</td>
<td>12</td>
<td>45</td>
</tr>
</tbody>
</table>

**DISCUSSION OF RESULTS**

It is hard to account for the fact that among the ninety-eight hens there were twelve diseased birds not showing symptoms which failed to react positively to the test.

Van Es and Schalk tested 601 birds and later autopsied 277 of them, which seemed to include all that were diseased. There were found 125 with lesions, 88 of which gave a positive reaction and were diseased, 2 gave a positive reaction but no lesions were found, 27 were doubtful in their reaction, and 10 diseased were negative. The percentage of diseased birds in the flocks tested by them, however, was much smaller than it was in those tested by us.

Jakob and Gazenbeek tested twenty-four birds and then autopsied them. Sixteen were found diseased, of which six gave a negative reaction, two a doubtful reaction, and eight a positive reaction. They say in their conclusion that the test is to be considered of importance in the early diagnosis of the disease.
Egge tested a number of birds and found the test to be of practical value in detecting avian tuberculosis but that it was necessary to repeat the test on negative and doubtful reactors. They also found that avian tuberculin was superior to old tuberculin [Koch’s O. T. avian] and to a commercial [foreign] tuberculin.

We have found that a fifty-per cent solution of crude tuberculin avian (Koch’s O. T. avian) is more efficient than bovine intradermal tuberculin in the diagnosis of tuberculosis in poultry. Panisset and Verge also have made a comparison and state that similar reactions are found but that avian tuberculin gives much more intense reactions than bovine tuberculin. Stubbs found that a ten per cent solution of powdered tuberculin avian was superior to the fifty per cent solution of crude tuberculin avian which we used. He found when using the latter that 47.7 per cent of the birds that reacted negatively to the test had lesions, while in using the powdered tuberculin, only 6.7 per cent of the negatively reacting birds in another series had lesions.

METHOD OF TESTING

A syringe of small caliber and a twenty-six gauge needle are the most suitable for making the injections. The readings on the
tuberculin test should be taken the 48th hour after injection. A positive reaction often does not show at seventy-two hours. The injected wattle appears swollen in a positive reaction and the swelling varies from a slight increase in size to an increase of two to five times the thickness of the uninjected wattle. The swollen wattle is usually tense, shining, edematous, and paler in color. Figures 5 and 6 show very pronounced positive reactions.

**Fig 6.** A positive reaction showing a very pronounced swelling.

Many times birds fail to react to a single test, although they are diseased, but will react to a second test. Pröscholdt finds the tuberculin test of use in flocks not showing symptoms of tuberculosis and recommends three tests one month apart. Van Leeuwen finds the intermission of several weeks is unnecessary and that reinjections may be made during or shortly after the reaction, and that the state of nutrition must be taken into consideration in judging a reaction. By four tests from several months to a year apart, Stubbs was able to reduce the percentage of reactors in the same flocks from over thirty per cent to less than two per cent.
VALUE OF THE TEST

In the summary we might say that the tuberculin test in poultry, when applied by persons who have had considerable experience and skill in the injection technique, is of value in determining the presence of tuberculosis in flocks where the disease has not made enough headway to produce symptoms. It also is of value in determining which birds in the flock, not showing symptoms, are diseased. But it can not be depended upon to discover all the diseased ones, and several repetitions of the test are necessary. Even then a few diseased birds might be left in the flock, and these would continue the infection on the premises.

HANDLING TUBERCULOSIS IN THE FLOCK

After tuberculosis has been found in the flock, the methods for combating the condition will sometimes vary, depending on how many birds are showing symptoms, the size of the flock and the value of the birds for laying and breeding purposes. Treatment for the diseased ones is always useless, and should never be attempted.

We are suggesting three methods for handling tuberculosis, and a method suitable one place may not be the most practical in another.

First Method

This is the most efficient in eliminating tuberculosis. It is especially recommended on the average ranch, or farm, where the flock is small in number and the birds are not of an especially valuable breeding strain. It consists of killing the whole flock, either at once or over a short period of time so as to permit the owner to use the healthy birds for food. See Figures 7 and 8.

If all are not killed at once, at least all that are showing symptoms or that are light in weight should be killed immediately and burned. In case there is a local market for the healthy birds, there is no object in distributing the killing over a short period of time. After all birds have been disposed of, as practical a cleaning and disinfection of the premises as possible should be undertaken. At least the hen house should be cleaned and the manure and litter burned. Also other places where the chickens gathered fre-
Fig. 1. Illustrating Method of Eradicating Tuberculosis in a Flock

Fig. 7. Illustrating Method of Eradicating Tuberculosis in a Flock

sequently should be cleaned and the manure disposed of as above. The hen house should be disinfected with a reliable disinfectant, such as one of the coal-tar preparations or dips. In making up this disinfectant for use, the directions found on the container should be followed. Before bringing in new chickens all buildings, such as the house, granary and sheds should be fixed so that poultry cannot get under them, because tubercle bacilli will remain alive much longer in such dark places than they will in other parts of the premises where sunlight reaches. It is best to wait a whole season before restocking, but if all other precautions are taken a few months may be sufficient. It is best to restock from eggs or from chicks a few days old. It is possible that eggs may contain tubercle bacilli, but such possibility is rare, and even if a few did, such eggs often do not hatch, or the chicks do not live long enough to become diseased to such an extent that they will be the cause of infection of other chickens. Fitch,
Lubbehusen, and Dikmans\textsuperscript{14} found after examining 876 eggs from tubercular hens that less than one per cent of the eggs contain living tubercle bacilli. They also state that indications are that thirty per cent of the tuberculous hens in all stages of the disease do not lay.

\textbf{Second Method}

This method may be used in very large flocks where the birds are expensive, purebred, high egg-producers and the owner wishes to maintain the strain in his flock. It is applicable only in localities where it is possible to obtain the services of a skilled veterinarian. All birds showing any symptoms of tuberculosis should be killed and burned. All birds over three years old should be killed and those not diseased may be used for food. A tuberculin test should then be made on the remainder of the flock and all positive reactors burned. The premises should then be treated as in the first method. The tuberculin test should be repeated twice more at thirty-day intervals and all reactors burned. Tests at six to twelve month intervals continued until two or three consecutive tests have been made with no positive reactors should eliminate the disease from the flock.
Third Method

In localities where it is impossible to have the tuberculin test made, and the flock is as valuable as those mentioned in connection with the second method, this third method may be used. In the fall, after the weather is freezing, destroy all birds over two years old, using those not diseased for home use if no local market is available. The place should be disinfected and prepared as in the first method. The following year repeat the killing of all birds that have passed two years of age. The diseased birds found will be a small percentage of what were found the first year. Every year all birds over two years of age should be disposed of. From the standpoint of poultry husbandry, this is a good practice and it will also help to control tuberculosis. It is a makeshift method of eradication, however.

Prevention

It is to the prevention of tuberculosis that all raisers of poultry should give consideration. The introduction of new birds that are more than a few weeks old should be especially avoided. If absolutely necessary to introduce new mature stock, it should be that from a flock whose history is known and in which there is or has been no tuberculosis, or if the birds are from a flock not known to be free from tuberculosis, a tuberculin test should be made before they are allowed in the healthy flock. If neighboring flocks are known to have tuberculosis, it is advisable to guard against pigeons, sparrows, etc., as much as possible. In case the disease should be brought in, a tuberculin test every six months to one year will help to recognize it in the early stages and the loss will be less.

The feeding of poultry offal to fowls should be avoided. This is a common method of infection in the small back-yard flocks in town.

All poultry raisers should certainly be willing to give some time to preventing this very common and serious disease of fowls.
SUMMARY

In one county in which extensive field work was conducted, one-third of the flocks had tuberculosis and in the diseased flocks two-thirds of the birds were diseased.

From correspondence and material sent to the laboratory, indications are that in many other localities there is considerable tuberculosis among poultry.

Infection usually takes place from one fowl to another by means of contamination of the feed and water with the manure of tubercular birds.

Fowls do not show symptoms until the flock is badly diseased, then loss in weight is the most characteristic symptom.

The oldest birds are most frequently and most severely diseased. Those under one year of age are very seldom affected.

The carcasses of the fowls that have tuberculosis almost always contain nodules in the liver, spleen or intestines.

The tuberculin test is very unreliable unless administered by an experienced and skilled person.

The efficiency of the tuberculin test is greatly increased by first eliminating by physical examination all birds showing symptoms of tuberculosis. This will include all those with slight loss of flesh.

Of the three methods suggested for handling the tuberculous flock, the method of complete destruction of the whole flock is the most efficient, and in Wyoming it will be found to be usually the most economical and practical.

Prevent tuberculosis by avoiding the introduction into the flock of mature birds of unknown history.

ACKNOWLEDGMENTS

We wish to thank Doctor J. T. Dallas, Inspector in Charge of the Bureau of Animal Industry for Wyoming, for his helpful cooperation in the field work done in this state.
REFERENCES

7. Moussu and Mantoux (Exp. Station Record 21-582).