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SWINE BRUCELLOSIS: RESULTS OF A VACCINATION EXPERIMENT[1]

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This discussion will consist of a consideration of the results obtained in a recently concluded brucellosis vaccination or exposure experiment in hogs together with a brief review of the results reported by others.

The main part of the vaccination experiment will be reported first. In this, there were 12 experimental or vaccinated gilts and six control gilts. Two virulent strains of Brucella suis were employed both as the vaccine and as the challenge in testing for immunity. In the vaccination or original exposure 2 ml. of a suspension was injected subcutaneously and 5 ml. were given intranasally. That given subcutaneously has a density of about No. 1 on the McFarland nephelometer and that given intranasally, a density of No. 6. At the time of vaccination all the animals were sexually immature—from 83 to 161 days old. All the experimentals reacted to the agglutination test shortly after vaccination. They all ceased to react before they were bred. Within one to five days after breeding the experimentals were exposed to the challange dose of Br. suis. This was a suspension of the organism made to a density of about No. 6 on the McFarland nephelometer. The suspension was made in physiological salt solution containing 10% of normal bovine or swine serum. Several ml. of this were placed in the vagina, the same amount in one nostril, and a few drops in the conjunctival sac of one eye.

The six controls were of the same age and breeding as the above. After breeding they were exposed exactly as were the experimentals.

All of the controls aborted after this treatment. They all showed immediate high agglutination titers that persisted for long periods of time or indefinitely. Thus the controls were 100% susceptible when judged by abortion, 100% susceptible when judged by high titers, and 100% susceptible when judged by persisutent titeds.

Three of the 12 vaccinated animals behaved exactly as did the controls. The other nine gave birth to normal litters. The challenge dose of brucella did not produce appreciable agglutinin formation in eight of these animals and only a low titer that lasted a short time in the ninth—1:50 for 20 days, and 1:25 for 40 days longer. Further more the offspring of these nine gilts were repeatedly examined and no evidence of exposure to brucella was ever detected. This is in contrast to the "non immune" aborting animals, some of which were rebred and their offspring then showed evidence of exposure to brucella. Thus the vaccinates were 75% immune when judged by abortion, 75% immune when judged by freedom of infection in offspring

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and in absence of persistent titer, and 66% immune in absence of agglutination titer. Only one positive blood culture was obtained from the above animals. Thus blood cultures, as a test for immunity, were unsatisfactory in these animals.

In addition to the above 18 animals, three other vaccinated hogs were re-exposed—without breeding—and compared to two unbred controls. The re-exposure of the experimentals and the initial exposure of the controls were made on June 18, 1945, when all were about eight months old. Repeated blood cultures were made from all. Following re-exposure, two of the vaccinates showed high agglutination titers for about 20 days. The remaining vaccinate showed very little. None of the blood cultures from the vaccinates was positive for brucella. Both controls showed immediate high titers that still persist, and blood cultures from them were repeatedly positive for about three weeks. When the experimentals are compared to the controls, it is obvious that they, the experimentals, are 100% immune on blood culture and 100% immune on persistent titer but only 33% immune on absence of titer. Again the controls were 100% susceptible by all tests employed.

Disapearance of agglutination titer usually means recovery from brucellosis. Thus, as a general rule, the agglutination test can be employed to determine how long animals remain infected. During the above vaccination experiment, 29 pigs from 83 to 161 days of age were exposed to virulent Br. suis. All showed significant agglutination titers shortly after exposure. One pig ceased to react in 29 days and two were still reacting in 486 days when they were sold. The 27 that ceased to react did so in an average time of about 90 days.

In a second vaccination experiment now under way, a mucoid form of Br. suis has been used as vaccine, Huddleson(1). This organism spreads from pig to pig, produces a bactermia in pigs, and can be isolated for at least 50 days from exposed guinea pigs. It appears to be more pathogenic than "Strain 19". It produces agglutinins in low titer for itself. Because of this fact, accidental infection with the smooth type can be detected in animals vaccinated with the mucoid form.

Holm, Ardrey and Beeson(2). employed "Strain 19" in the vaccination of swine. Pigs were vaccinated shortly after weaning. Such pigs ceased to react to the agglutination test before breeding time. The vaccine gave sufficient protection so that infection was readily eradicated from the herd under study. It had been impossible to effect eradication in this herd until the vaccine was employed. When the authors compared vaccinated animals to unvaccinated controls, they also demonstrated a definite immunity or resistance. About 88% of the vaccinates were resistant when compared to the controls.

In natural infection it has been repeatedly observed that sows do not abort if exposed sometime previous to breeding, Hadley and

Beach(3), McNutt and Leith(4). Such previous infection produces sufficient immunity to prevent tbortion.

Hutchings, Delez and Donham(5) showed that recovered animals may becomc reinfected and also spreaders of infection although possessing immunity sufficient to prevent abortion. These authors state that "hogs previously exposed to Br. suis—were not as responsive to a second exposure as unexposed swine—to their first exposure". In the light of the findings of Holm and his co-workers and the results reported in this paper, the resistance demonstrated by Hutchings, Delez and Donham may prove to be of prime importance in immunity of swine to brucellosis and the control of swine brucellosis.

If vaccines are to be employed in swine for the production of immunity against brucellosis it is desirable to know how animals react at different ages.

Hutchings, Delez and Donham(6) state that pigs of weaning age are readily infected. McNutt(7) reported the death of animals that became infected at about a year of age whereas death due to brucellosis was not observed in the sexually immature. Holm et al(2) observed that when Strain 19 was injected into immature pigs the agglutination titer was not higher than 1:25 in the very young—less than 70 days old—but gradually became higher as the pigs were exposed at older ages. They also observed that young pigs might be rather seriously affected in herds where the infection was very active. This same observation was made by Groth(8). As already noted in the above vaccination experiment, 29 immature pigs were exposed to fully virulent strains of Br. suis, yet serious evidence of disease was not encountered in any. Twenty-seven of these animals readily overcame the disease in an average time of about 90 days. In contrast to this, Holm, Audrey and Beeson reported that their sows, infected as mature animals, continued to react for about six months. In our experience, infected aged animals continue to show evidence of infection, react, for much longer periods. Many react for 11 to 12 months, some never cease to react during the time they are kept. For example, the two control sows reported above still reacted at 486 days when they were sold. The table shows what one may often expect in naturally infected animals. It shows the results of retests on 170 naturally infected animals. It is generally agreed that a reactor is usually free of infection when it ceases to react. The animals that remained positive in this table were still positive when sold. It is not known how much longer they continued to react. It will be noted that a considerable number continued to react for six months or more, that one animal kept for 19 months was still reacting when sold.

TABLE

Persistence of agglutination reaction (infection) in naturally infected swine.

Number of animals retested	Number of months after the first positive test	Number positive	Number negative
23	2	16	7*
24	1	18	6*
30	3	26	4*
22	4	22	
33	5	33	
15	6	12	3
9	7	7	2
4	8	1	3
2	9	1	1
2	11	1	1
2	12	2	
1	13		1
1	16	1	
1	18	1	
1	19	1	

* All of these were young pigs that never reacted higher than 1:25.

Our unpublished data on agglutination tests of young pigs from naturally infected reactor sows show that such pigs are apt not to be infected, and the above vaccination experiment indicates that should sexually immature pigs become infected they are apt to rid themselves of such infection within three months of exposure. Thus the plan of eradication advocated by Cameron(9), tlso by Hutchings, and by McNutt and Leith is based on this knowledge of swine brucellosis. Of course in those rather unusual cases where the infection is extremely active and large numbers of immature pigs are infected, the plan will be unsatisfactory. Hadley and Beach noted sterility in sows caused by brucellosis. Such sterility is more apt to result when sexually mature females are infected than is the case with the sexually immature females.

Thus it becomes evident that younger animals, the sexually immature, are more resistent to brucella infection than are older animals, at least they overcome the disease more quickly, are not usually so seriously affected, and sterility is less apt to result. For these reasons it would appear that live culture vaccines, if employed at all, will be used mainly in the sexually immature.

In 1934 McNutt(7) reported limited experiments wherein Br. abortus did not produce a serious disease when injected into swine, but that suis and melitensis were of about equal pathogenicity for these animals. The work of Borts, McNutt, and Jordan(10) shows that natural infection with Br. melitensis occurs in Iowa hogs. Continued study of this disease in swine by these authors strongly indicates that Br. melitensis is able to maintain itself in swine herds for long periods of time, perhaps years.

Holm and his co-workers found Strain 19 relatively non-pathogenic for swine. Mucoid strains and suis strains of reduced pathogenicity are now being tested as live vaccines. Just what species of brucella or what type of strain will prove most satisfactory for vaccination of swine remains to be seen.

In conclusion it can be said that the results reported in this paper strongly indicate that a very definite resistance was established in 75% of the vaccinated pigs. The total lack of immunity in some vaccinated pigs indicates that it might be possible to develop a strain of hogs, genetically highly susceptible to brucellosis.

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