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DEPARTMENT OF THE ARMY
Fort Detrick
Frederick, Maryland

Experimental Anthrax Infection of Rats on Different Diets,

by Professor Feser.

Wochenschrift fuer Thierheilkunde und Viehzucht, 23:197-201 (1879).

I started raising white rats in 1877 in order to obtain inexpensive material for inoculations. They multiply readily and are easily maintained. I had intended them primarily for control inoculations in order to confirm questionable cases of anthrax. I noted during this application that they would remain healthy at times despite injections of active anthracic material, but would prove highly susceptible to the anthrax toxin at other times, when very small quantities of inoculum sufficed to kill the animals.

I was unable to explain this odd situation save by the changing nourishment of the rats. For weeks they would receive primarily meat and only a little bread, and for certain periods they would get only bread. I found that the bread rats invariably succumbed to anthrax injections, whereas the meat rats died only when subjected to large quantities of anthracic blood.

After my attention was attracted to this condition, I attempted to establish this fact in more detail by special tests. I fed part of my rats only meat, another part only bread, and after this manner of feeding had lasted for several weeks or months I started inoculating the two groups with the same inoculum at the same time, and indeed found that the meat rats who had become distinctly stronger and heavier were immune, while the bread rats, in spite of equal age, without exception succumbed to the anthrax injection, and this due to genuine anthrax.

The following summation of all of my experience gained to date will show this clearly:

1) A white rat, received from Munich on 22 August, had been kept on bread and had escaped from its cage, was greatly emaciated due to lack of food. It was given meat and bread on 22 and 23 August. At 1015 hours on 23 August it was injected with about 3-4 drops of anthracic blood subcutaneously inside the right hind leg. The blood came from a cow that had died the previous day on the Schoenberg meadows near Langgries. This rat remained in healthy appetite and vitality up to 30 August, but a large swelling developed on the second day along the whole leg, impeding movement. The rat was found dead in its cage on 31 August.

Section revealed numerous anthrax bacilli in the blood, the spleen and in the tissues. A rabbit inoculated at 1700 hours on 31 August with the carbuncular infiltrate of this rat died of anthrax in the night from 3 to 4 September.

The long duration of the disease is conspicuous; death occurred on the 7-8th day after inoculation. It is noteworthy that meat was the principal feed during the test period; the meat diet thus could have been effective only after inoculation.

2) Four white rats, having been fed predominantly on meat since the beginning of August (more meat than bread), received subcutaneous injections of blood and anthracic particles from a goat that had died of anthrax the day before. Injections were given at 0845 hours on 26 August partly into the tail, partly at the inner side of the left hind leg. All four rats remained healthy and were used for other experiments after 29 September. A simultaneous injection of the same anthracic material into a rabbit caused the animal's death by anthrax on 31 August.

3) A white rat, inoculated without success with active splenic particles on 26 August (see below), received 1 drop of heart blood from a cow that had died of anthrax at 1200 hours the day before in Untersteinbach near Langgries (*). The injection was made subcutaneously at 1000 hours on 29 September at the right hind leg. The rat remained healthy. Its diet before and during the test period consisted predominantly of meat.

Left over from the tests in Langgries, the rat was taken to Munich and fed exclusively with bread during November and December. At 1115 hours on 10 December it was injected subcutaneously at the leg with one drop of heart blood from a rabbit that had succumbed to anthrax on the evening of 9 December. This action caused the rat's death at 1900 hours, 11 December, i.e. in a remarkably short time. Section confirmed anthrax as the cause of death.

4) Two of those rats that had been inoculated without success on 26 August (see above) were given several particles of fresh anthracic spleen subcutaneously into the tail at 1700 hours on 1 October. The material came from sheep that had died of anthrax two days before in salicylic acid experiments. Both animals remained healthy, although the same inoculum, injected simultaneously and in the same amount into a rabbit and a goose, caused anthrax with fatal outcome. Both rats were on a diet consisting principally of meat.

After these two rats had shown themselves quite well, vigorous and in good appetite up to 9 October, without the slightest sign of local swelling at the site of injection, both rats were inoculated simultaneously with $\frac{1}{2}$ and $\frac{1}{4}$ cc of anthracic blood, respectively, at 1000 hours, 9 October. The material, originating with a goat that had died in the night from 8 to 9 October, was diluted with equal amounts of water and instilled subcutaneously in the right hind leg. Both rats showed lassitude, sadness, little movement, inappetence and strong local swellings even on the first day. The rat with $\frac{1}{4}$ cc of blood died 25 hours after inoculation, the other one 26 hours p.i. Section yielded strong sanguineous-serous infiltration at the site of injection; the infiltrate revealed only isolated short and long bacilli, but strikingly numerous free, shiny, oval spherules (spores); the spleen was uniformly enlarged, bluish-black, softened, and contained distinctly demonstrable short bacilli in one case and many sporular bodies in both cases. The hearts, filled with dark blood resembling tea, showed only isolated spores, but no bacilli.

(*) The same material was injected simultaneously into a goat and a rabbit and proved lethal within a short time. The goat died of anthrax on 1 October at 0500 hours, the rabbit in the night of 2-3 October.

It is noteworthy that the diet of these dead rats had not been changed since the first experiment.

5) A white rat which had already been used in tests described under 2) and which had been kept on a constant meat diet, having given birth to nine young in the meantime, was offered, on 29 September, 30 g of fresh meat from a cow that had died of anthrax in Untersteinbach the day before. The meat was consumed with great relish; all young partook of the meal. On 2 October and again on 4 October the old rat and its offspring were repeatedly fed with fresh, active anthracic substances. They received pieces of fresh ovine spleens and bread dipped in anthracic blood. All rats remained healthy.

Starting with 1 November, the old rat was placed on a bread diet and on 17 and 18 December it received fresh meat from recently killed rabbits. On the morning of 21 December it was found lying dead in its cage. Section revealed a markedly swollen spleen, dark brownish-red, slightly softened, without bacilli but containing many sporular bodies; the heart blood showed a few short anthrax bacilli. The rat therefore had died of anthrax.

Of the 9 young of this rat which had survived repeated feedings of fresh anthracic substances without injury, 3 were placed on an exclusive meat diet starting in mid-November, together with 3 other rats of equal age from another litter; they received only boiled horse meat and beef with water; the remaining 6 animals were segregated and fed only bread and water. Thus I had 6 young, half-grown rats on an extended diet of pure meat, and 6 others on a pure bread diet. The meat rats were larger and more vigorous and looked stronger than the bread rats.

At 1100 hours on 10 December, I inoculated all 12 rats with the same quantity (i.e. hypodermic measure) of heart blood from a rabbit that had died of anthrax the evening of 9 December. Injection was made into the tail. As a result, all bread rats died on 11 December (one already at 0900, one at 1100, one at 1200, one at 1500, one at 1600 and one at 1900 hours), i.e. very rapidly within 22-23 hours, whereas all meat rats remained healthy.

The section of the 6 dead rats fed on bread gave fairly consistent results. The sites of injection showed only a low-grade swelling; the blood and spleen contained numerous short (1-6 red blood cells long), stationary, glass-clear bacilli; the rats undoubtedly had died of anthrax.

(To be concluded.)