Distribution of Antibody against *Erysipelothrix rhusiopathiae* in Cattle

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Received 14 July 2000/Returned for modification 9 November 2000/Accepted 24 January 2001

Serum samples collected from 854 cattle in nine prefectures of Japan, from Hokkaido to Okinawa, between 1988 and 1992 were examined for presence of antibodies against *Erysipelothrix rhusiopathiae* by growth agglutination test. Most of the sera showed positive reactions, and the antibody titers ranged from below 4 to above 128. Seventy-six percent of the sera showed titers of 32 or above, and 34% showed titers of 128 or above. The titers had a tendency to be higher in the south and lower in the north and were clearly low in sera from areas with no swine industry. These results indicated that Japanese cattle had been infected with *E. rhusiopathiae* and that clinical cases of the disease were possible.

*Erysipelothrix rhusiopathiae* is most commonly associated with disease in swine, turkeys, and sheep and infrequently in dogs, horses, and humans. The organism rarely causes disease in cattle. However, it has been isolated from the tonsils of healthy adult cattle and from endocardial lesions (7), as well as from cattle slurry (9). A few cases of bovine disease conditions caused by *E. rhusiopathiae*, including septicemia (4, 10), encephalomyelitis (17), and arthritis (2, 6), have been reported. In Japan, no clinical cases of the disease have been reported, in spite of bacterial isolation from the tonsils by Murase et al. (7) in 1959. Thus, the present study was undertaken to clarify serologically the infection of cattle in Japan.

**Serum samples.** A total of 854 serum samples collected from dairy or beef cattle at livestock hygiene service stations in the prefectures of Hokkaido, Iwate, Saitama, Shizuoka, Ishikawa, Shimane, Tokushima, Nagasaki, and Okinawa, Japan (Fig. 1), between 1988 and 1992 were provided. Ages of the cattle ranged from 1 to 15 years. The number of samples was 50 to 125 in each prefecture.

**Growth agglutination test.** The growth agglutination test was conducted to determine the agglutinating antibody titers of the sera, as described previously (13). Briefly, twofold dilutions (1:4 to 1:128) of serum were prepared with tryptose phosphate broth (pH 7.6) in small test tubes. One drop (0.02 to 0.05 ml) of an 18-h tryptose phosphate broth culture of *E. rhusiopathiae* strain Marienfelde (serovar 1a) (15) was added to 1 ml of each serum dilution. The agglutination was read after incubation at 37°C for 18 to 24 h. The titers were expressed as the reciprocal of the number of the highest dilution of serum that showed agglutination.

**Results of growth agglutination testing.** Antibody titers of all sera ranged from below 4 to above 128, and the geometric mean (GM) titer was 41.44. Seventy-six percent (619 of 854) of the sera showed titers of 32 or above, and 34% (286 of 854) showed titers of 128 or above. The GM titers of examined serum samples from Hokkaido, Iwate, Saitama, Shizuoka, Ishikawa, Shimane, Tokushima, Nagasaki, and Okinawa were 32.00, 15.22, 37.16, 94.16, 47.50, 41.35, 70.03, 57.48, and 81.00, respectively (Table 1). The titers of the sera collected from the southern prefectures of Shizuoka, Tokushima, and Okinawa were significantly higher than those of the sera from the northern prefectures of Hokkaido and Iwate. These results indicated that Japanese cattle had been infected with *E. rhusiopathiae* and that clinical cases of the disease were possible.

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FIG. 1. Map of Japan showing the nine prefectures (shaded) where bovine sera were collected.
were higher than the titers from the northern prefectures of Hokkaido and Iwate.

The GM titers of examined serum samples obtained from two districts of Hokkaido were 32.44 in Shiribeshi and 31.55 in Hiyama (Fig. 2). Although there had been outbreaks of erysipelas among swine in Shiribeshi and no outbreaks in Hiyama over the previous 5 years, there was no significant difference in the titers between the two districts.

The titers were clearly low (GM titer of 7.62 for 45 samples) in the sera from three islands of the Shimane prefecture (Fig. 3), where there is no swine industry. In contrast, the GM titer of sera from the mainland of Shimane, where there is a swine industry, was 122.78 for 70 samples. There were no significant differences in the GM titers of bovine antibody in sera from the islands (74.13) and the mainland (45.25) of the Nagasaki prefecture (Fig. 4), where the swine industry has been active. No correlation between the age or breed of the cattle and the antibody titers was observed.

**Conclusions.** A few clinical cases of *E. rhusiopathiae* infection in cattle have been reported in the United States (4, 6, 10, 17); however, no reports on levels of bovine antibody against the organism are available. Our study demonstrated the presence of antibody against *E. rhusiopathiae* in Japanese cattle even though no clinical cases of bovine disease have been reported in the country. This finding indicates that the cattle having antibodies with higher titers might have been infected with *E. rhusiopathiae*.

The growth agglutination test (Wachstumsprobe) has been developed by several researchers (3, 5, 8, 15) and commonly used in Europe and Japan. The specificity of the test in cross-reaction with antibodies against organisms other than *E. rhusiopathiae* has not been reported in detail even for swine. However, good correlation between the antibody titers and immune status of pigs has been recognized (1, 8, 11, 14, 16), and a titer of 32 or above is considered positive, indicating complete protection against challenge with virulent organisms.

### Table 1. Distribution of growth agglutinating antibody against *E. rhusiopathiae* in sera of cattle in Japan

<table>
<thead>
<tr>
<th>Prefecture</th>
<th>No. of serum samples</th>
<th>No. of samples with growth agglutination titer of:</th>
<th>GM titer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hokkaido</td>
<td>100</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>32.00</td>
</tr>
<tr>
<td>Iwate</td>
<td>70</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>15.22</td>
</tr>
<tr>
<td>Saitama</td>
<td>125</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>37.16</td>
</tr>
<tr>
<td>Shizuoka</td>
<td>50</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>94.16</td>
</tr>
<tr>
<td>Ishikawa</td>
<td>100</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>47.50</td>
</tr>
<tr>
<td>Shimane</td>
<td>115</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>41.35</td>
</tr>
<tr>
<td>Tokushima</td>
<td>100</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>70.03</td>
</tr>
<tr>
<td>Nagasaki</td>
<td>97</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>57.48</td>
</tr>
<tr>
<td>Okinawa</td>
<td>97</td>
<td>&lt;4 4 8 16 32 64 ≥128</td>
<td>81.00</td>
</tr>
<tr>
<td>Total (%)</td>
<td>854</td>
<td>14 (1.6) 17 (2.0) 46 (5.4) 127 (14.9) 158 (18.5) 201 (23.5) 291 (34.1)</td>
<td>41.44</td>
</tr>
</tbody>
</table>

**Fig. 2.** Distribution of growth agglutinating antibody against *E. rhusiopathiae* in sera of cattle from two areas of Hokkaido prefecture.
Although we did not determine passive protectivity of the bovine sera in mice, bovine sera showing a higher antibody titer may be protective in mice, as shown for porcine sera (12). The organism can survive in feces and feces-contaminated soil for several months and is resistant to most environmental influences (18). It has been isolated from fecal slurry in 49% of the cattle herds in which no swine are present (9) and from tonsils of healthy cattle (7). These sites may be a source of infective organisms. However, we found low antibody titers of the sera collected from cattle on the islands with few swine and higher antibody titers of the bovine sera collected on mainland Shimane, where swine production is greater, indicating that the organism is transmitted mainly by swine.

### FIG. 3
Distribution of growth agglutinating antibody against *E. rhusiopathiae* in sera of cattle from two areas of Shimane prefecture.

- **Islands**
  - No swine
  - n=45
  - GM titer=7.62

- **Mainland**
  - n=70
  - GM titer=122.78

### FIG. 4
Distribution of growth agglutinating antibody against *E. rhusiopathiae* in sera of cattle from two areas of Nagasaki Prefecture.

- **Islands**
  - Swine erysipelas was recorded
  - n=47
  - GM titer=74.13

- **Mainland**
  - Swine erysipelas was recorded
  - n=50
  - GM titer=45.25
healthy swine (18) and from pig slurry (9). Our results, however, indicate that cattle might also be important carriers of the organism.

Cattle appear to be more resistant than swine to *E. rhusiopathiae*. However, care must be taken by handlers of cattle, because the organism may cause erysipeloid in humans. Detection of the organism and lesions in cattle at slaughterhouses, in addition to the detection of clinical cases of bovine disease in the field, may be helpful in demonstrating *E. rhusiopathiae* infection.

We are grateful to the veterinarians of the livestock hygiene service stations in each prefecture for kindly providing the bovine serum samples.

REFERENCES