ZOONOTIC AND PARASITIC DISEASES

PROCEEDINGS OF THE THIRD INTERNATIONAL AND PAN-ARAB SEMINAR
HELD IN AMMAN, JORDAN,
17–20 OCTOBER, 1989
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La présente série est réservée aux documents issus de colloques, aux rapports internes et aux documents techniques susceptibles d'être publiés plus tard dans une série de publications plus soignées. D'un tirage restreint, le rapport manuscrit est destiné à un public très spécialisé.

Esta serie incluye ponencias de reuniones, informes internos y documentos técnicos que pueden posteriormente conformar la base de una publicación formal. El informe recibe distribución limitada entre una audiencia altamente especializada.
ZOO NOTIC AND PARASITIC DISEASES
Proceedings of the Third International and Pan-Arab Seminar
held in Amman, Jordan, 17-20 October 1989

Edited by
Oumeish Youssef Oumeish and Panduka M. Wijeyaratne

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BRUCELLOSIS IN ANIMALS:  
CONTROL AND PREVENTATIVE MEASURES IN JORDAN  
Abdul Aziz, N.*, Schenkel, F.*

Introduction

Synonyms:

When occurring in humans:  
Undulant fever, Malta fever, Mediterranean fever.

When occurring in animals:  
Contagious abortion, abortus fever, infectious abortion,  
epizootic abortion (2).

Etiology:

The genus Brucella has six known species:  
B. melitensis, B. abortus, B. suis, B. neotomae, B. ovis and  
B. canis (2).

The first three are subdivided into biotypes, distinguishable  
by different biochemical characteristics, and by reactions to  
the monospecific A (Abortus) and M (Melitensis) sera.  
B. melitensis is subdivided into 3 biotypes, B. abortus into 8,  
and B. suis into 4.

At present Brucellosis is perhaps the most widespread and  
economically devastating of the zoonotic diseases (7). It occurs in  
all of man's domesticated and semi-domesticated animals as well as  
in the wild.

Adding to the problem of disease occurrence in man is the fact  
that the primary resource reservoirs are such common domestic  
animals as cattle, sheep, goats, and swine. As long as susceptible  
animals are present, there are no limits to the distribution of  
this organism in nature, and Brucellosis can be found in moderate  
climates, in the tropics, the deserts, and the arctic areas.

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The classical species of brucella bacteria are \textit{B. abortus}, \textit{B. melitensis}, and \textit{B. suis}. Several biotypes are identified but these are limited to specific host ranges. Brucella is characteristically localized in the reproductive tract of male and female hosts, but because of abortion, females are the main source of environmental contamination. Abortion leads to a massive exodus of the organism from its host. Subsequently infection occurs under conditions that do not necessitate host to host contact. Females that have aborted carry the organism in their lymph nodes, primarily those of the supra mammary region. This leads to a shedding of the organism, probably for the rest of their lives, via the mammary glands. This type of exodus leads to transfer under circumstances where there is close host to host contact, as during lactation of the young. In addition, brucellosis can be sexually transferred. This mode of transmission may be common among dogs and swine, and to a lesser extent among sheep and goats. Sexual transfer appears to be almost inexistent as a mode of infection in cattle (7).

Brucella has a multitude of entrances to the body. It can penetrate through the mucus membranes, the eye, the mouth and the stomach, as well as through unbroken skin, and of course through skin lesions. Infection can be dust borne, droplet borne or can be by inhalation.

Viability of Brucella Bacteria

Brucella organisms have excellent survival mechanisms under a variety of environmental conditions. Upon excretion from infected animals they are able to survive in faeces, urine, soil, water, bedding and food for long periods of time.

For example, \textit{B. melitensis} survived in:

<table>
<thead>
<tr>
<th>Environment</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>urine</td>
<td>49 days</td>
</tr>
<tr>
<td>contaminated water</td>
<td>38 days</td>
</tr>
<tr>
<td>potable water</td>
<td>72 days</td>
</tr>
<tr>
<td>urine dried onto a textile sack</td>
<td>80 days</td>
</tr>
<tr>
<td>dried organic material</td>
<td>± 9 months</td>
</tr>
<tr>
<td>such as faeces</td>
<td></td>
</tr>
</tbody>
</table>

It can live almost indefinitely in damp soils, and freezing is the best method to preserve viability (7). At low pH (pH4) survival rates decline to about 1 week to 10 days. Brucella is very susceptible to heat. Temperatures of 100°C are immediately lethal, 90°C lethal after 1 minute, 62°C after 10. Disinfectants are efficient as well: Lysol (1%) or Formalin (2%) destroy the bacteria after 15 minutes, and sunlight after a few hours. More details and findings from different sources are listed in Tables IV and V.
The Disease Transmitted to Humans

Human brucellosis exists only as a function of brucellosis in animals. In Jordan 43 isolates of *B. melitensis* from humans were documented (5) and pointed to small ruminants as the source of infection, confirming earlier results (3). Humans become infected by contact with infected animals (Graph II) by consuming food of animal origin, such as soft cheese or non-pasteurized/non-boiled milk, or crops contaminated with infected animal wastes. Meat from infected animals contains only small numbers of brucellae, and the meat must be eaten raw to result in infection. Cases of brucellosis from meat ingestion are rare (1). The most pathogenic species are *B. melitensis*, *B. abortus*, *B. suis* and *B. canis*. The incubation period is from 1 to 3 weeks, but sometimes can be as long as several months. Since sick persons are considered as non-productive members of the community, the disease is termed a socio-economic illness. The disease may be debilitating if not correctly cared for in the early stages.

The Disease in Animals

The incubation period is from 1 to 36 weeks. The predominant symptoms in pregnant females are abortion and either premature or full term birth of dead or weakened animals. All species may cause abortion in their natural hosts.

Generally abortion occurs during the second half of pregnancy, often with retention of the placenta and metritis. Other serious diseases from *Brucella* infection are mastitis, arthritis and orchitis.

Control of Brucellosis in Sheep and Goats

In any country the prerequisite of efficient brucellosis control is a knowledge of the extent of the problem. Two avenues are available.

1. **Eradication by Test-and-Slaughter**

   On a national scale, eradication has so far been achieved only by identifying infected herds and slaughtering all the animals of the herd.

2. **Control of Immunization**

   Where *B. melitensis* infection is endemic and widespread in a population of small ruminants, control by immunization is recommended, in most situations, at least as a preliminary step (6, 11).
Immunizing agents prevent abortion because there is an almost tissue specific immunity in the reproductive tract. However, immunization does not prevent infection. Even under the most favourable circumstances, and with choice vaccines, immunization is at best 80% effective. However, it increases the level of herd immunity, and this is important in both control and eradication programs. Since immunization prevents abortion, it eliminates the main avenue the organism has to contaminate the environment through a mass exit from the host. Infection of new animals through environmental contact is substantially lowered.

When used alone immunization is a control measure, but cannot eradicate the disease. Immunization pushes the Brucellosis incidence to a level that leads both to reduced infection in man, and increased numbers of offspring in animals.

Since this disease affects adult animals, the normal course of events is to vaccinate the young before they reach good. For sheep and goats aged less than 6 months, the live ("Rev1") agent should be used. The live agent will be completely eliminated upon sexual maturity.

Alternatively all animals can be vaccinated using the regular dose in young animals and a reduced dose in adult animals. The vaccination of adult animals produces a titer.

It is not possible to differentiate between a vaccination titer and an infection titer, because the antibodies are similar.

For sheep and goats the vaccine in use is "Rev1". It is a live vaccine with reduced virulence. It is pathogenic to man, as is the "S19" vaccine used to immunize cattle. Accidental inoculation or spraying on the face can lead to the disease in man.

**Flock Disease Survey in Jordan, Emphasizing Brucellosis**

Currently the main livestock populations are as follows: sheep 1 million; goats, 500,000; cattle, 30,000; camels, 10,000; horses, 3,000; poultry, 1 million parent stock, and 3 million layers.
In 1971-72 a limited investigation was done using tube agglutination and CFT. All sheep and cattle showed negative results in serological tests, except for two flocks of imported "Shami" goats (315 animals). Seven per cent of the animals examined in these two flocks had a positive titer. They were condemned (1).

In 1977-78, 6,000 sheep and goats from 211 randomly selected flocks were screened using "Brucellin" (9). Thirteen goats tested positive for brucellosis, most of them belonging to the "Shami" breed. These were slaughtered. Sheep did not show positive results. Within this investigation, 1,000 cattle were also examined. One animal had a positive titer for brucellosis and was condemned. Since 1983 considerably higher rates of brucellosis occurrence have been documented in sheep and goats, as well as in humans. Increased occurrences mostly in the northern governorates, may very likely be the result of animal trade with neighbouring countries that passed on the disease.

Brucellosis and Other Important Sheep and Goat Diseases

Besides Brucellosis, Q. Fever, Chlamydiosis, Leptospirosis, Blue tongue and Toxoplasmosis are diseases that affect the production and maintenance of livestock. Most of them are of special concern to public health. In 1987, therefore, a survey to detect their occurrence was implemented through a German technical cooperation project.

In each governorate flocks were selected at random. They were visited by a team of department staff, consisting usually of one veterinarian, one livestock production specialist, and one stock assistant. For each flock a questionnaire was completed. It was intended to record information about general farm aspects and practices, health of the small ruminant flocks, and flock structure and dynamics.

A limited number of animals, usually about 20 per flock, was selected and specific health-related observations were made. From these animals, blood samples were taken and were submitted for laboratory examination.

During 1987/88 serum samples from 471 randomly selected flocks were analyzed (Table II and III). Forty-four per cent of the non-vaccinated flocks tested positive. The highest percentage of positive flocks was in Mafraq, with 65%; the lowest in Ma'an with 23%. This reveals the fact that Brucellosis is widespread (Graph I).
Furthermore, results from serum samples collected in 1989 show that there is an increase in Brucellosis prevalence in sheep and goats. Out of 800 samples tested (Jan. - Aug.) for Brucellosis, 12% were positive, against 9% from 4,669 samples in 1987, and 7% from 2,711 samples in 1988.

**Brucellosis in Cattle**

In testing 3,815 cattle for Brucellosis, a prevalence of 1.8% was found in the 1988 survey using CFT and RBT. Positives were slaughtered, with farmers compensated for the loss.

Table II illustrates Brucella prevalence by governorate in 1987/1988, and Table III shows the prevalence of Brucellosis as well as of other infections during this time.

**Control Program**

Because of the seriousness of Brucellosis, its control is of national concern, and calls for the cooperation in Jordan of the Department of Public Health, the Municipal Leadership and the Veterinary Services.

Vaccination of livestock appears to be the only available method to control the disease, and to break the chain of infection. Vaccination will eliminate abortion, the leading cause of environmental contamination and new infection. Furthermore, immunity is considered as life-long (1, 8), but revaccination is possible without harm (6). As with "S 19", "Rev 1" occasionally is shed in the milk of vaccinated animals, but this is not of public health significance (8, 10).

A successful vaccination program will ultimately lead to disease eradication measures. This is the goal of the 5-year plan established in 1986 by the Department of Animal Health and Production. It mandates control of Brucellosis through vaccination, and recommends the use of "Rev 1" vaccine for sheep and goats, and "S 19" vaccine for cattle.

Besides vaccination, other control measures are envisaged. They aim to control the sale of dairy products, the imposition of appropriate quarantine regulations when there is need of importation from abroad, improved farm and dairy hygiene, and public education. Public education addresses the boiling of milk, and milk products before use.
Literature


Table I. Summary of Brucellosis Prevalence in Jordan 1987 and 1988

<table>
<thead>
<tr>
<th>Year</th>
<th>Sheep</th>
<th>Goats</th>
<th>Sheep/Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>3,397</td>
<td>1,272</td>
<td>4,669</td>
</tr>
<tr>
<td></td>
<td>11%</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>1988</td>
<td>1,516</td>
<td>1,195</td>
<td>2,711</td>
</tr>
<tr>
<td></td>
<td>9%</td>
<td>5%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Table II. Prevalence of Brucella Antibodies in Sheep and Goats 1987-1988* (7,380 Serum Samples. Test method: CFT)

Results by Agricultural Directorates

<table>
<thead>
<tr>
<th>Agricultural Directorates</th>
<th>Negative Samples</th>
<th>Positive Samples</th>
<th>Total No. of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ajlun</td>
<td>285</td>
<td>18</td>
<td>303</td>
</tr>
<tr>
<td>Amman</td>
<td>706</td>
<td>78</td>
<td>804</td>
</tr>
<tr>
<td>Balqa</td>
<td>830</td>
<td>56</td>
<td>886</td>
</tr>
<tr>
<td>Irbid</td>
<td>307</td>
<td>35</td>
<td>342</td>
</tr>
<tr>
<td>J. Valley</td>
<td>680</td>
<td>42</td>
<td>722</td>
</tr>
<tr>
<td>Jerash</td>
<td>117</td>
<td>11</td>
<td>128</td>
</tr>
<tr>
<td>Karak</td>
<td>889</td>
<td>78</td>
<td>967</td>
</tr>
<tr>
<td>Ma'an</td>
<td>478</td>
<td>21</td>
<td>499</td>
</tr>
<tr>
<td>Madab</td>
<td>487</td>
<td>69</td>
<td>556</td>
</tr>
<tr>
<td>Mafraq</td>
<td>340</td>
<td>88</td>
<td>428</td>
</tr>
<tr>
<td>Tafila</td>
<td>1,039</td>
<td>52</td>
<td>1,091</td>
</tr>
<tr>
<td>Zarka</td>
<td>589</td>
<td>65</td>
<td>654</td>
</tr>
</tbody>
</table>

Column Totals

<table>
<thead>
<tr>
<th></th>
<th>6,747</th>
<th>633</th>
<th>7,380</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>91.4%</td>
<td>8.6%</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Evidence from non-vaccinated flocks
Table III. Sheep and Goat Disease Data 1987/88

<table>
<thead>
<tr>
<th>Disease</th>
<th>Total of Sera</th>
<th>Number positive</th>
<th>Per cent positive</th>
<th>Diagnostic test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brucellosis</td>
<td>7,380 *</td>
<td>633</td>
<td>8.6%</td>
<td>CFT, SAT, RBT</td>
</tr>
<tr>
<td>Q. Fever</td>
<td>8,534</td>
<td>256</td>
<td>3.0%</td>
<td>CFT</td>
</tr>
<tr>
<td>Chlamydiosis</td>
<td>8,534</td>
<td>682</td>
<td>8.0%</td>
<td>CFT</td>
</tr>
<tr>
<td>Leptospirosis</td>
<td>4,395</td>
<td>44</td>
<td>1.0%</td>
<td>CFT</td>
</tr>
<tr>
<td>Toxoplasmosis</td>
<td>279</td>
<td>47</td>
<td>17.0%</td>
<td>IFAT</td>
</tr>
<tr>
<td>Blue Tongue</td>
<td>801 **</td>
<td>152</td>
<td>19.0%</td>
<td>IGIDT</td>
</tr>
<tr>
<td>CAE</td>
<td>801 **</td>
<td>0</td>
<td>0.0%</td>
<td>IGIDT</td>
</tr>
<tr>
<td>Mycopl. agal.</td>
<td>3,647</td>
<td>5</td>
<td>0.14%</td>
<td>CFT</td>
</tr>
<tr>
<td>Mycopl. mycoid</td>
<td>2,081</td>
<td>2</td>
<td>0.10%</td>
<td>CFT</td>
</tr>
<tr>
<td>Mycopl. capri</td>
<td>1,352</td>
<td>0</td>
<td>CFT (strain F38)</td>
<td></td>
</tr>
<tr>
<td>Babesiosis</td>
<td>8,161</td>
<td>2,040</td>
<td>25.0%</td>
<td>ELISA</td>
</tr>
</tbody>
</table>

* Rev1 unvaccinated animals  
** Belonging to 81 flocks
Table IV. Viability of Brucella Bacteria in Milk and Dairy Products (12)

<table>
<thead>
<tr>
<th>Storage Temp. °C</th>
<th>Drescher and Hopfengartner Days</th>
<th>Lerche Days</th>
<th>Transmissability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk artificial inoculation with <em>B. abortus</em></td>
<td>8</td>
<td>-</td>
<td>8-10</td>
</tr>
<tr>
<td>Milk</td>
<td>8-10</td>
<td>21</td>
<td>-</td>
</tr>
<tr>
<td>Whipped Cream</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Cream (sweet)</td>
<td>4-5</td>
<td>37</td>
<td>-</td>
</tr>
<tr>
<td>Sweet Cream Butter from inoculated Milk</td>
<td>45</td>
<td>-</td>
<td>yes</td>
</tr>
<tr>
<td>Butter from separating the cream by centrifugation</td>
<td>40</td>
<td>-</td>
<td>yes</td>
</tr>
<tr>
<td>Sweet Cream Buttermilk</td>
<td>4-5</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Sour Cream Buttermilk</td>
<td>4-5</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>White Cheese cottage type from inoculated Milk</td>
<td>24</td>
<td>-</td>
<td>yes</td>
</tr>
<tr>
<td>Soft Cheese (Delicatessen) 35-day ferment</td>
<td>18</td>
<td>35</td>
<td>-</td>
</tr>
<tr>
<td>Semi-soft Cheese (Tilsiter) 92-day ferment from start of ferm. 31-90</td>
<td>-</td>
<td>-</td>
<td>no</td>
</tr>
<tr>
<td>Hard Cheese (Emmenthaler)</td>
<td>-</td>
<td>49</td>
<td>-</td>
</tr>
</tbody>
</table>
Table V. Summary of Results of Selected Trials on Survival of *B. abortus* (13)

<table>
<thead>
<tr>
<th>Medium</th>
<th>Temperature/environment</th>
<th>Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunlight</td>
<td>&lt; 31°C petri dish</td>
<td>4.5 Hours</td>
</tr>
<tr>
<td>Water</td>
<td>- 4°C</td>
<td>114 Days</td>
</tr>
<tr>
<td>Water</td>
<td>Room</td>
<td>77 Days</td>
</tr>
<tr>
<td>Water, lake</td>
<td>37°C pH 7.5</td>
<td>&lt; 1 Day</td>
</tr>
<tr>
<td>Water, lake</td>
<td>8°C pH 6.5</td>
<td>&gt; 57 Days</td>
</tr>
<tr>
<td>Soil</td>
<td>Room dried</td>
<td>&lt; 4 Days</td>
</tr>
<tr>
<td>Soil</td>
<td>Cellar wet</td>
<td>66 Days</td>
</tr>
<tr>
<td>Soil</td>
<td>Autumn 90% humidity</td>
<td>48-73 Days</td>
</tr>
<tr>
<td>Manure</td>
<td>Summer</td>
<td>1 Day</td>
</tr>
<tr>
<td>Manure</td>
<td>Winter</td>
<td>53 Days</td>
</tr>
<tr>
<td>Manure</td>
<td>158-170°F pit</td>
<td>&lt; 4 Months</td>
</tr>
<tr>
<td>Manure, liquid</td>
<td>Summer</td>
<td>108 Days</td>
</tr>
<tr>
<td>Manure, liquid</td>
<td>Winter</td>
<td>174 Days</td>
</tr>
<tr>
<td>Slurry</td>
<td>Tank</td>
<td>7 Weeks</td>
</tr>
<tr>
<td>Slurry</td>
<td>12°C tank</td>
<td>&gt; 8 Months</td>
</tr>
<tr>
<td>Slurry</td>
<td>12°C tank + 1000 ppm xylene</td>
<td>&lt; 1 Month</td>
</tr>
<tr>
<td>Saliva, sheep</td>
<td></td>
<td>20-24 Hours</td>
</tr>
<tr>
<td>Abdominal fluid, sheep</td>
<td></td>
<td>(Strain 19)</td>
</tr>
<tr>
<td>Wool</td>
<td>Warehouse</td>
<td>110 Days</td>
</tr>
</tbody>
</table>

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GRAPH I

SEREA PREVALENCE OF BRUCELLOSIS
in 385 Non-Vaccinated SHOAT Flocks 87/88
(7380 Serum Samples Examined by CFT)
GRAPH II

Caprine and ovine brucellosis (Brucella melitensis). Mode of transmission. (2)