Treatment of *Brucella melitensis* infection in sheep and goats with oxytetracycline combined with streptomycin

A.I. RADWAN, S.I. BEKAIRI and A.A. MUKAYEL *

Summary: Six treatment regimens using oxytetracycline (OTC) combined with streptomycin (ST) were evaluated for eliminating *Brucella melitensis* from 480 naturally infected sheep and goats. Cessation of shedding *Brucella* from udder secretions and absence of *Brucella* in selected tissues at autopsy were considered criteria for successful treatment.

Four regimens were equally effective in eliminating *Brucella* in the treated groups of sheep and goats regardless of the source of antibiotics used. These were regimen A (OTC 20 mg/kg intravenously daily for 6 weeks, combined with ST 20 mg/kg intramuscularly [i.m.] daily for 3 weeks), regimen B (long-acting [LA] OTC 20 mg/kg i.m. every 3 days for 6 weeks, with ST 20 mg/kg i.m. every 3 days for 3 weeks), regimens D and E (LA OTC 28 mg/kg i.m. every 3 days for 6 weeks, with ST 20 mg/kg i.m. every 3 days for 3 weeks). However, regimen C (LA-OTC 20 mg/kg i.m. every 3 days for 6 weeks, with ST 20 mg/kg i.m. every 3 days for 3 weeks) eliminated *Brucella* in only 75 of 80 (94%) sheep and goats.

Regimen F (LA-OTC 25 mg/kg i.m. every 2 days for 4 weeks, combined with ST 20 mg/kg i.m. every 2 days for 2 weeks) was the most practical, effective and least expensive regimen for eliminating *Brucella* in the 80 treated sheep and goats.

*Brucella melitensis* biovar 2 was repeatedly isolated from the mammary secretions of all sheep and goats before treatment. It was also isolated repeatedly from the udder secretions of all non-treated control animals and from selected tissue specimens collected from the controls at necropsy.

KEYWORDS: *Brucella melitensis* - Brucellosis - Goat diseases - Oxytetracycline - Sheep diseases - Streptomycin - Therapy.

INTRODUCTION

For many years, various chemotherapeutic measures have been employed in the treatment of animal brucellosis, but the results have not been entirely satisfactory. For bovine brucellosis several chemical antimicrobials, minerals, trace elements and vitamins have been tried unsuccessfully (7, 8, 10, 11, 14, 16, 20). In addition, the

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use of penicillin or sulfonamides failed to cause cessation of the shedding of *Brucella abortus* from the udders of infected cows (2, 4, 9, 28). However, aureomycin, terramycin, streptomycin (ST) or tetracyclines administered in cows infected with *B. abortus* resulted in the reduction of abortions (18, 19, 26). Moreover, the recent use of oxytetracycline (OTC), long-acting (LA)-OTC with or without accompanying injection of ST caused disappearance of the symptoms of bovine brucellosis and reduction in the shedding of *B. abortus* in udder secretions. However, these treatments were not successful in curing all infected cows (5, 13, 21, 22, 23).

In sheep, a limited trial has been performed, in which nine sheep infected experimentally with *B. abortus* were injected daily for 6 days with 1 g chlortetracycline, then 20 days later with 1.4 g daily for 3 days (together with immune serum). Only one sheep was found to be bacteriologically positive at slaughter 46 days after infection (24). The treatment regimens in previous trials had involved small doses and few injections of the antibiotics used. In 1989, Radwan and colleagues (25) carried out a long-term treatment trial using different doses of OTC alone or in combination with ST on 118 sheep naturally infected with *B. melitensis*. Groups of infected Najdi sheep were given 250, 500 or 1,000 mg OTC daily for 6 weeks by the intraperitoneal (i.p.) route. In the respective groups 52%, 69% and 100% of the sheep were found to the Brucella-free at the end of the trial. Furthermore, the treatment with OTC (250 mg i.p. daily for 6 weeks) combined with ST (1 g i.m. daily for 3 weeks) showed a synergistic effect and increased the percentage of Brucella-free sheep to 82%. In addition, when eight Najdi sheep were inoculated with LA-OTC (1,000 mg i.m. every 3 days for 6 weeks) six animals were Brucella-free at necropsy. Unfortunately, the majority of treated sheep developed subcutaneous sterile abscesses in the flank at the site of repeated i.p. inoculation with OTC. Other investigators (17) reported serious local reactions in cows repeatedly inoculated i.p. with tetracycline.

The purpose of this study was to evaluate the efficacy of various therapeutic regimens using OTC or LA-OTC combined with ST in eliminating *B. melitensis* from naturally-infected sheep and goats. The study was directed towards obtaining a therapeutic regimen which is practical, effective, without side-effects and relatively inexpensive, to make treatment of infected sheep and goats with superior genes a viable alternative to slaughter.

**MATERIALS AND METHODS**

**Animals**

Only sheep and goats which proved to be brucellosis positive both serologically and bacteriologically were selected in order to obtain a more conclusive evaluation. The selected animals had already aborted or lambed two to six months before initiation of the treatment regimens. The study was carried out on 240 sheep of pure Najdi and Naimi breeds (161 and 79 ewes respectively) and 240 goats of pure Syrian, Masry and Balady breeds (132, 51 and 57 respectively). All animals were between three and five years old and weighed between 40 and 50 kg. The infected animals were donated by several breeding farms in Al-Kharj, Dirab, Dawadmi, Haradh, Heremla, Mozahmia, Riyadh and Sahna in Saudi Arabia. The animals were randomly divided into six treatment groups (the distribution of the sheep and goat breeds is shown in Table I) and one control group. The non-treated control group included 20 sheep...
**TABLE I**

*Efficacy of six treatment regimens in eliminating Brucella melitensis from naturally-infected sheep and goats*

<table>
<thead>
<tr>
<th>Regimen, animal group and breed</th>
<th>Antibiotics</th>
<th>Route</th>
<th>Dosage mg/kg (ml or g per animal)</th>
<th>No. of inoculations</th>
<th>Periodicity (days)</th>
<th>Tissues(^{(a)})</th>
<th>Success/treated Udder secretions(^{(b)}) % of total</th>
<th>Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 40 sheep (N) 40 goats (S)</td>
<td>OTC (^{(c)}) &amp; ST (^{(d)})</td>
<td>i.v.</td>
<td>20 (12 ml)</td>
<td>42 &amp; 42</td>
<td>1</td>
<td>4/4</td>
<td>36/36</td>
<td>100</td>
</tr>
<tr>
<td>B 40 sheep (N,A) 40 goats (S,B)</td>
<td>LA-OTC (^{(e)}) &amp; ST (^{(d)})</td>
<td>i.m.</td>
<td>20 (1 g)</td>
<td>21</td>
<td>1</td>
<td>4/4</td>
<td>36/36</td>
<td>100</td>
</tr>
<tr>
<td>C 40 sheep (N,A) 40 goats (S,M)</td>
<td>LA-OTC (^{(e)}) &amp; ST (^{(f)})</td>
<td>i.m.</td>
<td>20 (1 g)</td>
<td>14</td>
<td>3</td>
<td>4/4</td>
<td>33/36</td>
<td>94</td>
</tr>
<tr>
<td>D 40 sheep (N) 40 goats (S,M,B)</td>
<td>LA-OTC (^{(e)}) &amp; ST (^{(f)})</td>
<td>i.m.</td>
<td>28 (7 ml)</td>
<td>14</td>
<td>3</td>
<td>4/4</td>
<td>36/36</td>
<td>100</td>
</tr>
<tr>
<td>E 40 sheep (N,A) 40 goats (M,B)</td>
<td>LA-OTC (^{(g)}) &amp; ST (^{(f)})</td>
<td>i.m.</td>
<td>28 (1 g)</td>
<td>7</td>
<td>3</td>
<td>3/4</td>
<td>35/36</td>
<td>35/36</td>
</tr>
<tr>
<td>F 40 sheep (N,A) 40 goats (S,M,B)</td>
<td>LA-OTC (^{(g)}) &amp; ST (^{(h)})</td>
<td>i.m.</td>
<td>25 (6 ml)</td>
<td>14</td>
<td>2</td>
<td>4/4</td>
<td>36/36</td>
<td>100</td>
</tr>
</tbody>
</table>

(a) number of sacrificed animals from which selected tissues were cultured for Brucella
(b) number of animals from which udder secretions were repeatedly cultured for Brucella
(c) oxytetracycline i.v. solution (from the United States of America) 250 mg per 3 ml ampoule (i.v. solution), 6 ml inoculated in the morning and 6 ml in the afternoon
(d) streptomycin (from Germany)
(e) long-acting oxytetracycline injectable solution (from the United Kingdom) 200 mg/ml
(f) streptomycin (from France)
(g) long-acting oxytetracycline injectable solution (from France) 200 mg/ml
(h) streptomycin (from Egypt)

Animal breeds:
N: Najdi
A: Naimi
S: Syrian
M: Masry
B: Balady
(10 Najdi and 10 Naimi ewes) and 20 goats (10 Syrian, 5 Masry and 5 Balady). The control animals were kept without mating to avoid further spread of infection. The treated and control groups were each housed in isolation from other animals.

Immediately after completion of the treatment regimens (Table I), the treated ewes and goats were mated with Brucella-free males. About three months later (at about mid-pregnancy), four ewes and four goats from each treatment group were sacrificed for bacteriological examination, together with all non-treated control animals.

**Therapeutic agents**

The pharmaceutical products employed in this study were:

- OTC i.v. solution (from the United States of America [USA]) at 250 mg per 3 ml ampoule
- ST sulphate (from France, Germany and Egypt) supplied in 1 g vials, dissolved in 3 ml distilled water immediately before use
- LA OTC injectable solution (from the United Kingdom) containing 200 mg OTC base per millilitre
- LA OTC injectable solution (from France) containing 200 mg OTC base per millilitre.

**Treatment protocols**

The treatment regimens of the six groups of infected sheep and goats are shown in Table I. ST was administered at the onset of therapy with OTC or LA-OTC. In group A, the daily dose of OTC (12 ml) was divided into two equal amounts (6 ml inoculated in the morning and 6 ml in the afternoon). The LA-OTC was administered i.m. in the cervical and the thigh regions.

**Serological tests**

Sera from all sheep and goats on the farms involved in the trial were initially screened for the presence of Brucella agglutinins by the Rose Bengal test (1). The Rose Bengal test antigen was obtained from the Central Veterinary Laboratory, New Haw, Weybridge, United Kingdom. Sheep and goats found to be positive by the Rose Bengal test were retested by the standard US plate agglutination procedure (1) for the determination of Brucella antibody titres. In this procedure 0.08, 0.04, 0.02, 0.01 and 0.005 ml of serum were mixed with 0.03 ml of the standard Brucella plate antigen (made from B. abortus strain 1119-3 and obtained from the United States Department of Agriculture in Ames, Iowa, USA) and examined. When mixed with the antigen, these amounts of serum resulted in dilutions of 1:25, 1:50, 1:100, 1:200 and 1:400 respectively. Agglutinations at 1:50 or greater were considered positive.

Sera from the selected positive (serologically and bacteriologically) sheep and goats were tested before treatment and at bi-weekly intervals during and after treatment. Parallel serum samples were also collected and tested from the non-treated control animals until slaughter. In addition, sera from all lambs and kids born from treated animals were also tested.
Bacteriological examinations

In this study, the medium for *Brucella* culture was prepared from brain heart infusion agar to which 5% defibrinated sheep blood, 1% sterile dextrose and *Brucella*-selective supplement were added (12). The supplement was supplied in vials, each containing:

- Polymyxin B (as SO₄) 2,500 international units (IU)
  - Bacitracin 12,500 IU
  - Cycloheximide 50 mg
- Nalidixic acid 2.5 mg
- Nystatin 50,000 IU
- Vancomycin (as HCl) 10 mg.

The contents of each vial were dissolved in 10 ml of 50:50 mixture of methanol and sterile distilled water and added to each 500 ml of autoclaved medium (cooled at 50°C). The medium was then mixed well and poured into sterile Petri dishes.

Pre treatment cultures were prepared from udder secretions of all the treated and non-treated control animals to confirm shedding of *B. melitensis* from the selected serologically positive sheep and goats. Separate quarter samples (30 ml each) of the udder secretions were also cultured every week during treatment, every month from completion of treatments until lambing or kidding, and again every week after lambing or kidding until weaning time (about ten weeks later). In addition, repeated udder secretion samples from the 40 non-treated control animals were cultured every two weeks until sacrificed.

From the sacrificed treated and non-treated control animals, the following specimens were aseptically collected for bacteriological examination: udder secretions and/or udder tissues, supramammary, prescapular, iliac, precrural, mediastinal, mesenteric and head lymph nodes, sections of brain, uterus, ovary, liver and spleen, and bone marrow from the long bones of the front and hind limbs. In addition, samples of the stomach contents, liver, lung and spleen of foetuses from the sacrificed treated group of animals were cultured.

Each tissue specimen was individually homogenised in a tissue grinder and aliquots were spread with sterile cotton swabs on several (four to six) freshly prepared plates of culture medium. The plates were incubated at 37°C in the presence and absence of 5% CO₂ atmosphere for seven days. The isolated *Brucella* cultures were identified morphologically, microscopically, biochemically and serologically (1). The biotyping of the identified isolates was carried out at the Central Veterinary Laboratory, New Haw, Weybridge, United Kingdom.

Sheep and goats in which *B. melitensis* could no longer be recovered from udder secretions nor from any of the selected tissue specimens collected at necropsy were considered cured (successful treatment). Animals which continued or resumed shedding *B. melitensis* in udder secretions, or in which *Brucella* organisms were isolated from any of the tissue specimens obtained at necropsy, were considered treatment failures.

In this study, aborted foetuses from the breeding farms involved were cultured for *Brucella* isolation in addition to the routine bacteriological examination for listeriosis, salmonellosis, mycoplasmosis and mycotic abortion.
RESULTS

Breeding performance

A comparison was made between the breeding performance in the breeding flocks involved before identification of the infected animals and in the treated animals in the breeding season following treatment. Before identification of the *Brucella*-infected animals, abortion rates in the breeding flocks involved ranged between 20% and 30%, and the infertility rate was approximately 35%. However, in the breeding season following treatment, about 96% of the treated animals were pregnant and had normal lambing or kidding with a high percentage of twins (the average number of offspring increased from 0.8 to 1.3). There were no premature parturitions among the treated animals. Data on the breeding performance of the infected non-treated control group of sheep and goats could not be obtained because these animals were not kept for breeding purposes.

Serological findings

All lambs and kids born from the treated ewes and female goats were found to be serologically negative for brucellosis. Before treatment, in both the treated and non-treated control animals, the agglutinin antibody titres ranged between 100 and 400 in the US plate agglutination test (218, 173 and 129 animals had titres of 100, 200 and 400 respectively).

At three months post-treatment, there was only a decrease of titre from 400 to 200 and from 200 to 100 in 80% of the 48 treated animals sacrificed. However, in the 40 non-treated control animals sacrificed there was an increase of titre from 100 to 200 and from 200 to 400 in 10% and 4% of the animals, respectively.

At eight months post-treatment, there was a further decrease of titres from 400 to 200, 200 to 100, 100 to 50 and from 50 to 25 in 38%, 31%, 22% and 9% of the remaining treated animals, respectively.

Cost of drugs and animals

The cost of antibiotics used was calculated according to prices on the Saudi market at the time of conducting the experiment (US$1 = SR3.75). The cost of the antibiotics used to treat each individual animal in groups A, B, C, D, E and F was $447, $45, $18, $22, $17 and $13 respectively. This did not include the cost of interventions, because all laboratory examinations were made free of charge by governmental staff and the breeding farms involved had their own veterinary staff and supplies. Under different circumstances, the cost of interventions would have to be considered.

The treatment regimens used in this study did not show any harmful local or systemic side-effects on the health of the treated animals. In addition, meat inspection of the 48 treated animals slaughtered approximately three months after treatment revealed no detectable abnormalities in the muscles at the sites of repeated i.m. inoculation. Furthermore, since the studied animals were dried before initiation of treatment, no harmful effects were expected on human beings from antibiotic residues in the milk during and after treatment.

The price of a healthy adult Najdi ewe is between $160 and $320, and the price of a pure Syrian female goat ranges between $533 and $1,067 (or even higher, as they are a very valuable breed which is imported to Saudi Arabia at high cost).
Bacteriological examinations

In the present study, no listerias, salmonellas, mycoplasmas or pathogenic fungi were isolated from aborted foetuses on the breeding farms involved. Only *B. melitensis* biovar 2 was isolated. The efficacy of the six treatment regimens in eliminating *B. melitensis* in the 480 treated sheep and goats is shown in Table I.

The results of bacteriological examination for *Brucella* in the selected tissue specimens of the sacrificed treated animals (four sheep and four goats from each treatment group) and the non-treated control animals (20 sheep and 20 goats) are shown in Table II. All repeated udder secretion samples from the 72 non-sacrificed treated animals in each of groups A, B, D, E and F were free from *Brucella* (Table II).

However, in group C, *B. melitensis* was isolated from udder tissues and secretions, supramammary lymph nodes and liver in one of the four sacrificed goats. In addition, the repeated udder secretion samples from three ewes and one goat of the 72 treated non-sacrificed animals were culture positive for *B. melitensis*. When these four positive animals (of regimen C) were treated again with the same regimen, they ceased shedding *Brucella* and their tissues were culture negative at necropsy three months after this second treatment.

All sacrificed non-treated control animals (20 ewes and 20 goats) were found to be culture positive. The rate of recovery of *B. melitensis* from the selected tissue specimens is shown in Table II. The average number of *Brucella* colonies recovered per plate from the specimens of control animals was about fifty times higher than from the udder secretions of the culture positive sheep and goats of group C (which ranged between one and three colonies per plate).

In all the successful treatments, shedding of *Brucella* in udder secretions ceased after one week from the initiation of therapy. However, in failed treatments (in group C) the amount of shedding declined after the onset of treatment and remained at a lower level until after termination of therapy.

**DISCUSSION**

In general, the treatment of animal brucellosis has not been fully successful because of the intercellular localisation of brucellas within phagocytic cells of the reticuloendothelial system in lymph nodes, liver, spleen, mammary glands and reproductive organs. Therefore, the brucellas are protected from antibodies, complement and antibiotics (6). Other explanations for treatment failures include incorrect choice and dose of antibiotics or insufficient duration of treatment and/or improper routes of administration. In addition, the high cost of therapy, long duration of treatment, antibiotic residues in milk and meat and, in many cases, failure to cure udder infections have led to the general conclusion that treatment has no role in the control of animal brucellosis.

The recent use of OTC combined with ST gave promising results in curing cows infected with *B. abortus* (5, 13, 21, 22, 23) and sheep with *B. melitensis* (25). OTC is a broad-spectrum antibiotic which is capable of intracellular penetration and inhibits bacterial protein synthesis at the level of the ribosomes. ST is also known to inhibit protein synthesis of Gram-negative bacteria. Furthermore, a synergistic effect has
### TABLE II

*Results of bacteriological examinations for *Brucella* in selected tissues of sacrificed treated and non-treated sheep and goats*

<table>
<thead>
<tr>
<th>Regimen</th>
<th>Treatment</th>
<th>No. of specimens with <em>Brucella</em> positive culture</th>
<th>Success/treated&lt;sup&gt;(a)&lt;/sup&gt; (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>OTC (b) (20mg/kg/day/6 weeks, i.v.) &amp; ST (c) (20mg/kg/day/3 weeks, i.m.)</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>8/8 (100)</td>
</tr>
<tr>
<td>B</td>
<td>LA-OTC (d) (20mg/kg/3 days/6 weeks, i.m.)</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>8/8 (100)</td>
</tr>
<tr>
<td>C</td>
<td>LA-OTC (d) (20mg/kg/3 days/6 weeks, i.m.) &amp; ST (20mg/kg/3 days/3 weeks, i.m.)</td>
<td>1 1 0 0 0 0 0 0 0 0 1 0 0 0 0</td>
<td>7/8 (88)</td>
</tr>
<tr>
<td>D</td>
<td>LA-OTC (d) (28mg/kg/3 days/6 weeks, i.m.) &amp; ST (20mg/kg/3 days/3 weeks, i.m.)</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>8/8 (100)</td>
</tr>
<tr>
<td>E</td>
<td>LA-OTC (e) (28mg/kg/3 days/6 weeks, i.m.) &amp; ST (20mg/kg/3 days/3 weeks, i.m.)</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>8/8 (100)</td>
</tr>
<tr>
<td>F</td>
<td>LA-OTC (e) (25mg/kg/2 days/4 weeks, i.m.) &amp; ST (20mg/kg/2 days/2 weeks, i.m.)</td>
<td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td>
<td>8/8 (100)</td>
</tr>
<tr>
<td>Control</td>
<td>Non treated</td>
<td>20 sheep and goats: No. (%)</td>
<td>40 40 0 24 15 0 24 0 0 20 0 24 24 24 5</td>
</tr>
</tbody>
</table>

<sup>(a)</sup> number of sacrificed animals *Brucella* free/total treated or untreated controls  
<sup>(b)</sup> oxytetracycline i.v. solution (from the United States of America)  
<sup>(c)</sup> streptomycin sulphate  
<sup>(d)</sup> long acting oxytetracycline (from the United Kingdom) 200 mg/ml  
<sup>(e)</sup> long-acting oxytetracycline (from France) 200 mg/ml.
been demonstrated with OTC and ST in vivo and in vitro (22, 25, 27). The LA-OTC was used to provide long-lasting OTC concentration in plasma. One injection of LA OTC gave effective OTC plasma concentration (0.6 µg/ml) for three days (3). For these reasons, OTC or LA OTC combined with ST were selected for the treatment of sheep and goats naturally-infected with *B. melitensis*.

The present study indicates that long-term therapy and the combination of drugs resulted in a high level of efficacy among different regimens. This is in agreement with other studies on cows infected with *B. abortus* (21, 22). In the present study, the inoculation of OTC (i.v.), LA OTC and ST (i.m.) did not give rise to local reactions or other harmful effects on the health of the treated sheep and goats.

The treated animals were considered cured when they remained asymptomatic and when no *Brucella* was isolated from the tissues or repeated udder secretion samples after termination of treatment. Cure by the combined action of OTC and ST as measured by the above parameters was clear. In humans, OTC has been considered the most effective antibiotic for treatment of brucellosis, although occasional relapses do occur. There have also been relapses in cows (15, 21, 22). In the present study, the majority of the treated sheep and goats (90%) were retained for extended periods after termination of therapy and no relapse occurred in animals of groups A, B, D, E and F. However, relapses occurred in 6% of the treated animals in group C.

Although the treatment regimen in group A was safe and effective in eliminating *B. melitensis*, it was the most laborious and expensive. This was because highly purified, expensive OTC (intended for humans) was used, the number of i.v. injections was high and the method of administration required experienced staff.

The cost of antibiotics used for successful treatment of brucellosis in ewes and goats of group B was relatively high because the total dose of ST was high and required daily inoculation. Although the cost of antibiotics used in animals of group C was low and the regimen was practical, it was less effective in eliminating *B. melitensis*.

Regardless of the source of antibiotics used in groups D and E, they were equally effective and successful in eliminating *B. melitensis* infection in 160 ewes and goats. On the other hand, the duration of treatment in groups D and E was relatively long (six weeks), and the dose of LA-OTC (28 mg/kg) and consequently the cost of drugs ($22 and $17 respectively) was fairly high.

The most practical, successful and least expensive regimen for eliminating *B. melitensis* from 80 naturally-infected sheep and goats was that used in group F. This regimen involved the administration of 25 mg/kg LA-OTC i.m. every 2 days for 4 weeks combined with 20 mg/kg ST i.m. every 2 days for 2 weeks.

Serology was of limited value in evaluating the effectiveness of the therapeutic regimens when monitored over a limited period of time (three and eight months). Other investigations revealed no reduction in agglutinating or complement fixing antibodies in treated cows from which *Brucella* was not isolated (13).

Brucellosis in goats and sheep caused by *B. melitensis* is widespread in many areas of the world. The disease is responsible for serious economic losses in infected flocks and constitutes a great hazard to public health. In campaigning against brucellosis, it is impossible to use a single method which would suit every country. A control campaign through slaughter and compensation is rarely within the financial capabilities of developing countries, especially where it is difficult to change agricultural customs.
or social habits. On the other hand, mass vaccination of infected flocks protects only non-infected animals without altering the course of infection, and the infected vaccinated animals remain a great hazard to public health.

Livestock producers in Saudi Arabia and many other developing countries cannot afford the traditional "test and slaughter" approach used in developed countries. In addition, slaughter of infected animals with superior genetic potential has serious economic and genetic consequences. Consequently, a practical and effective treatment regimen such as that used in group F in the present study would be a very useful alternative to slaughter of valuable infected animals.

In Saudi Arabia, the majority of breeding sheep and goats are imported at very high cost. The average wholesale prices per head of local and imported sheep and goats on the Saudi market are as follows (source given in brackets):

- $61 (New Zealand)
- $62 (Somalia)
- $72 (Australia)
- $110 (Turkey)
- $1,067 (Syria)
- $300 (local pure Najdi ewe).

The average cost of antibiotics used in regimen F for treating a sheep or goat was $13, which represents between 1% and 21% of the original price of the animal. Such treatment costs are considered economically acceptable.

At the present time, treatment of brucellosis in sheep or goats using regimen F is recommended for valuable breeding animals. However, treatment at the flock level remains to be evaluated from the economic point of view. Furthermore, the treatment of seropositive animals should be accompanied by vaccination of all seronegative animals in the flock to achieve effective control and minimise the public health risk.

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Appreciation is also extended to the owners and staff of the sheep and goat farms involved in this study for their cooperation and support.

TRAITEMENT DES INFECTIONS A BRUCELLA MELITENESIS CHEZ LES OVINS ET LES CAPRINS PAR UNE ASSOCIATION D'OXYTÉTRACYCLINE ET DE STREPTOMYCINE. A.I. Radwan, S.I. Bekairi et A.A. Mukaye.

Résumé : Six protocoles thérapeutiques associant l’oxytétracycline (OTC) et la streptomycine (ST) ont été évalués sur l’infection naturelle par Brucella melitensis, chez 480 ovins et caprins. La réponse au traitement a été considérée comme positive lorsque le germe n’était plus présent dans les sécrétions mammaires ni dans certains tissus choisis à l’autopsie.
Quatre protocoles se sont révélés également efficaces pour éliminer le germe dans les groupes d’ovins et de caprins traités, quelle qu’ait été la source des antibiotiques utilisés. Il s’agissait du protocole A (20 mg/kg/jour d’OTC par voie veineuse pendant 6 semaines + 20 mg/kg/jour de ST par voie musculaire [i.m.] pendant 3 semaines), du protocole B (20 mg/kg d’OTC i.m. retard tous les 3 jours pendant 6 semaines + 20 mg/kg de ST i.m. tous les 3 jours pendant 3 semaines) ainsi que des protocoles D et E (28 mg/kg d’OTC i.m. retard tous les 3 jours pendant 6 semaines + 20 mg/kg de ST i.m. tous les 3 jours pendant 3 semaines). Mais le protocole C (20 mg/kg d’OTC i.m. retard tous les 3 jours pendant 6 semaines + 20 mg/kg de ST i.m. tous les 3 jours pendant 3 semaines) n’a permis d’éliminer Brucella que chez 75 des 80 ovins et caprins traités (94%).

Le protocole F (25 mg/kg d’OTC i.m. retard tous les 2 jours pendant 4 semaines + 20 mg/kg de ST i.m. tous les 2 jours pendant 2 semaines) s’est avéré la solution la plus commode, la plus efficace et la moins onéreuse pour éliminer Brucella chez les 80 ovins et caprins traités.

B. melitensis du biotype 2 a été isolée à plusieurs reprises des sécrétions mammaires de tous les ovins et caprins avant le traitement. Elle a également été isolée plusieurs fois chez tous les animaux non traités dans ces mêmes sécrétions, ainsi que dans certains tissus choisis à l’autopsie.


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Resumen: Se evaluaron seis tratamientos utilizando oxitetraciclina (OTC) combinada con estreptomicina (ST) para la eliminación de Brucella melitensis en 480 ovejas y cabras infectadas naturalmente. La desaparición de Brucella de las secreciones de la ubre y la ausencia de Brucella en tejidos seleccionados en la autopsia fueron los criterios considerados para un tratamiento exitoso.

Cuatro de los tratamientos resultaron igualmente eficaces en la eliminación de Brucella en los grupos de ovejas y cabras tratados, independientemente de la fuente de antibióticos utilizada. Dichos tratamientos fueron el tratamiento A (20 mg/kg de OTC en administración diaria por vía intravenosa durante 6 semanas, combinada con 20 mg/kg de ST diarios por vía intramuscular [i.m.] durante 3 semanas), el tratamiento D (20 mg/kg de OTC de larga actuación [LA] por vía i.m. cada 3 días, durante 6 semanas, con 20 mg/kg de ST por vía i.m. cada 3 días durante 3 semanas), los tratamientos D y E (28 mg/kg de OTC-LA por vía i.m. cada 3 días durante 6 semanas, con 20 mg/kg de ST por vía i.m. cada 3 días durante 3 semanas). Sin embargo, el tratamiento C (20 mg/kg de OTC LA por vía i.m. cada 3 días durante 3 semanas) eliminó Brucella en sólo 75 de las 80 ovejas y cabras (94%).

El tratamiento F (25 mg/kg de OTC LA por i.m. cada 2 días durante 4 semanas, combinada con 20 mg/kg de ST por i.m. cada 2 días durante 2 semanas) resultó ser el más práctico, eficaz y barato para la eliminación de Brucella en las 80 ovejas y cabras tratadas.
El biotipo 2 de B. melitensis se aisló repetidas veces de las secreciones mamentales de todas las ovejas y cabras antes del tratamiento, así como de las secreciones de la ubre de todos los animales de control no tratados y de las muestras de tejidos seleccionados extraídos en la necropsia.


REFERENCES


