

Epidemiological survey of brucellosis in sheep and goats in selected pastoral and agro-pastoral lowlands of Ethiopia

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Summary

An epidemiological survey was conducted in pastoral regions of Ethiopia to investigate the distribution of brucellosis in sheep and goats. Between November 2004 and December 2007, a total of 6,201 serum samples were collected from 67 randomly selected peasant associations, 25 districts and eight pastoral zones of Ethiopia. The Rose Bengal plate test (RBPT) and complement fixation test were used in series. Samples for bacteriology were collected from three export abattoirs, where 285 goats were randomly selected and tested by RBPT three days before slaughter. Tissue samples were collected from 14 strongly positive goats and cultured in dextrose agar and *Brucella* agar base. To confirm and subtype the isolates, staining, biochemical tests and polymerase chain reaction were used. The overall standardised seroprevalence of brucellosis was 1.9%, ranging from 0.07% in Jijiga zone to 3.3% in Borena zone. There was statistically significant variation among the studied regions, zones, districts and peasant associations ($p < 0.05$).

Male goats and sheep were twice as likely to test positive as females (relative risk [RR]: 2.04; 95% confidence interval [CI]: 1.7–3.4; $\chi^2 = 21.05$, $p < 0.05$). Adults (older than 1.5 years) were three times more likely to test positive than younger animals (RR: 2.76; 95% CI: 1.14–6.73; $\chi^2 = 5.18$, $p < 0.05$). Goats were around four times more likely to be infected than sheep (RR: 3.8; 95% CI: 2.4–6.1; $\chi^2 = 36.99$, $p < 0.05$).

Brucella melitensis was isolated from 2 of the 14 samples analysed. The widespread distribution of brucellosis in goats and sheep in these areas justifies the use of control measures to minimise the economic losses and public health hazards.

Keywords

Brucellosis – Complement fixation test – Ethiopia – Goat – Identification – Isolation – Prevalence – Rose Bengal test – Sheep.

Introduction

Brucellae are Gram-negative, facultative intracellular bacteria that can infect many species of animals, including humans. Ten species are recognised within the genus *Brucella*. There are six 'classical' species: *B. abortus*, *B. melitensis*, *B. suis*, *B. ovis*, *B. canis* and *B. neotomae* (1, 2), and another four species have been recognised more recently (3). The principal manifestation of brucellosis is reproductive failure, including abortion, birth of unthrifty neonates and infertility (4, 5). *Brucella melitensis* (biovars 1, 2 or 3) is the main causative agent of caprine and ovine brucellosis (5).

Brucellosis is a worldwide re-emerging zoonosis that causes severe disease in humans, with non-specific clinical signs affecting numerous organs (6). Contact with infected animals, ingestion of contaminated animal products and handling of *Brucella* isolates in laboratories are risk factors.

Brucellosis in livestock and humans is still common in the Middle East, Asia, Africa, South and Central America, the Mediterranean Basin and the Caribbean. *Brucella melitensis* is particularly common in the Mediterranean Basin, and it has also been reported from Africa, India and Mexico (7).

In sub-Saharan Africa, little is known about the prevalence of brucellosis, and most data are derived from small sero-epidemiological studies (8), although human cases have been reported in most of the countries in the region (9). The prevalence in small ruminants ranges from 3.6% in Uganda (10) to 17% in the Sudanese region of Khartoum (11).

In Ethiopia, most research work on brucellosis has been focused on intensive dairy cattle herds in urban and peri-urban areas. In 1987, the World Organisation for Animal Health (OIE) reported a prevalence of 20%; the prevalence was higher around large towns than in rural areas (12). In zebu cattle of the central highlands, Tekleye *et al.* (13) reported a prevalence of 4.2%. Eshetu *et al.* (14) found a prevalence of 10% in Addis Ababa, and in a study conducted on smallholder farms of central Ethiopia (the Wuchale-Jida district), Kebede *et al.* (15) reported a prevalence of 11%.

In cattle under extensive management systems, studies conducted in different regions of Ethiopia between 2003 and 2005 reported individual-level prevalence values of 0.8% and 3.2% and herd-level prevalences of 2.9% and 42.3% (16, 17). In other areas of the country, studies conducted between 2003 and 2004 reported an individual-level prevalence of 1.6% and a herd prevalence of 13.7% (18).

In small ruminants, a prevalence of 1.5% in sheep and 1.3% in goats was found in the central highlands by Tekleye

and Kasali (19). However, prevalence values of 5.6% in sheep and 13.2% in goats were reported by Teshale *et al.* (20) in the Afar and Somali regions respectively, and 3.2% of sheep and 5.8% of goats in the Afar region were reported to be positive by Ashenafi *et al.* (21).

When brucellosis is detected in a herd, flock, region, or country, international veterinary regulations impose restrictions on animal movements and trade, which result in huge economic losses. The economic losses as well as its zoonotic importance are the reasons why programmes to control or eradicate brucellosis in cattle, small ruminants and pigs have been implemented worldwide (22).

In many African countries, limited financial resources, political instability, lack of commitment by local and regional governments and the presence of other serious livestock diseases (i.e. peste des petits ruminants, Rift Valley fever, foot and mouth disease, contagious caprine pleuropneumonia, lumpy skin disease and African swine fever) have diverted attention from important zoonotic diseases such as tuberculosis and brucellosis (8, 11, 23). There is no strategic control and eradication plan against brucellosis in Ethiopia under implementation (17, 18). Therefore, this study was designed to investigate the spread of this neglected zoonotic disease in the country. Its objectives were to determine the prevalence and to identify the species of *Brucella* circulating in the small ruminant population in the pastoral areas of Ethiopia.

Materials and methods

Description of study areas

Ethiopia's economy is mainly based on agriculture, which accounts for 46% of the national gross domestic product (GDP) and 85% of total employment (24). In Ethiopia, the pastoralist and agro-pastoralist areas such as Borena, Afar and Somali are considered the traditional source of livestock, supplying 95% of livestock destined for the export market (25).

Since 2003, exportation of both live animals and meat has been increasing rapidly. The annual export potential of Ethiopian export abattoirs is estimated at 72,000 tonnes of meat, valued at US\$136 million (26). The small ruminant population of the country is estimated to be 29.64 million sheep and 25.85 million goats (27); 25% of the sheep and 73% of the national goat population inhabit the lowlands, mostly in pastoral areas.

The pastoral human population of Ethiopia makes up approximately 13.7% of the country's total population of 93.8 million (24, 28). The pastoral population is heterogeneous in its ethnic composition and social

structure. Livestock production, trading and ‘take-a-chance’ crop farming (subsistence rain-fed farming) are the pastoral livelihood systems (28).

The administrative regions and study area are shown in Figure 1. These areas were selected for this study because:

- pastoral areas have a large population of small ruminants and supply more than 90% of the export animals
- seasonal mixing of flocks/herds of different origins may spread infectious diseases throughout these regions.

The traditional husbandry systems involve close contact between domestic animals and humans, and the dependence on livestock and livestock products for nutrition predisposes pastoral communities to brucellosis.

The sheep and goats are of the local indigenous Ethiopian breeds: Afar, Somali, Borana and South Omo. No *Brucella* vaccine has been used in the study area. The livestock population of the study area, according to the Central Statistics Agency of Ethiopia (CSA) (29), is shown in Table I.

Study design

A cross-sectional survey of small ruminants was carried out between November 2004 and December 2007 in selected pastoral zones (Afar 1–5, Jijiga, Borena and South Omo) of Ethiopia. For sample size calculations Win Episcope 2.0 software was used (30). The study was initially designed to estimate 5% prevalence with an accepted error of 0.75% and a confidence interval (CI) of 95% (3,245 animals). In the end, the sample size was increased to 6,201 (3,694 sheep and 2,507 goats). Two-stage cluster sampling at different



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Fig. 1
Pastoral zones of Ethiopia included in the study

Table I
Livestock population of the study area

| Region | No. of sheep (× 1,000) | No. of goats (× 1,000) |
|-----------|------------------------|------------------------|
| Afar | 403.3 | 801.5 |
| Somali | 1,162.7 | 1,374.5 |
| Borena | 1,274.1 | 669.1 |
| South Omo | 323.8 | 505.1 |

Source: Central Statistical Agency (29)

hierarchical levels was used. Peasant associations (PAs) and villages/flocks were designated as primary and secondary sampling units, respectively. The sampling frame consisted of 51 districts and 513 PAs, from which 25 districts and 67 PAs were randomly selected by lottery. In the Somali region, because of security problems, sampling was restricted to the districts and PAs of the Jijiga zone. Villages and/or flocks within PAs were considered as cluster units and animals were selected on the basis of their availability at the time of sampling.

Given the absence of a livestock identification system in the pastoral regions it was difficult to trace seropositive animals for further bacteriological sampling. Therefore, it was decided that tissue samples would be collected from three export slaughterhouses where livestock from pastoral areas are slaughtered for the export market. Initially, 285 goats were randomly selected three days before slaughter and screened for brucellosis with the Rose Bengal plate test (RBPT). Tissue samples (inguinal lymph nodes, testes, spleen and lungs) from 14 positive goats were used for attempted bacterial isolation.

Serum sample collection and submission

Approximately 10 ml of blood was collected from each animal using a Vacutainer and needle. The samples were stored, tilted horizontally, overnight at room temperature to allow clotting. The serum from each animal was decanted into a single sterile cryogenic vial, labelled and transported to the National Animal Health Diagnostic and Investigation Center (NAHRC), maintaining the cold chain. The sera were stored at -20°C until tested.

Serological tests

The antigen used in the RBPT was a suspension of *Brucella abortus* coloured with Rose Bengal (Institut Pourquier, France). For the complement fixation test (CFT), standard *Brucella abortus* antigen and control sera were obtained from the Federal Institute for Consumer Health Protection and Veterinary Medicine (BgVV) (Berlin, Germany), complement from Biomerieux (France), and haemolysin or amboceptor from Institut Pourquier.

The RBPT was used as a screening test. To increase the sensitivity of the test, the modified procedure recommended for sheep and goats by Blasco *et al.* (31) and the Joint Food and Agriculture Organization of the United Nations (FAO)/World Health Organization (WHO) Expert Committee on Brucellosis (23) was followed. Briefly, 75 μl of test serum was dispensed on each of the circles of the plate and 25 μl of antigen (Institut Pourquier) was placed alongside the serum. Antigen and serum were mixed thoroughly and the plate was rocked by hand for about 4 min at room temperature. A magnifying glass was used to read the result and interpret it; the results were recorded as 0, +, ++, +++ according to the degree of agglutination.

All RBPT-positive and approximately 50% of the negative samples were retested with the CFT for confirmatory diagnosis at the National Veterinary Institute (NVI) laboratory, Debre Zeit, Ethiopia, according to the protocols recommended by the OIE (22).

Bacteriology

Tissue samples (inguinal lymph nodes, testes, spleen and lungs) from 14 goats positive on the RBPT were used for attempted bacterial isolation. Samples were cultured on Sabouraud dextrose agar and *Brucella* agar base (BAB) containing antibiotics, and incubated at 37°C supplemented with 5–10% CO_2 for 5–8 days. Identification of *Brucella* organisms was carried out by a combination of assessment of colonial characteristics, morphology and biochemical tests. Positive cultures were stained with Gram's and modified Ziehl–Neelsen stains to determine the morphology, and basic biochemical tests (catalase, oxidase and urease tests) were conducted (32, 33).

Polymerase chain reaction

The isolates were further tested with polymerase chain reaction (PCR) using forward primers specific for *B. abortus* and *B. melitensis* and a genus-specific reverse primer to confirm and subtype the *Brucella* isolates.

Extraction of genomic DNA from bacterial culture

Bacterial cultures (one to three colonies) were suspended in 50 μl of water (Molecular Biology Reagent, W4502, Sigma, Mannheim, Germany), heated to 99°C for 20 min, and centrifuged at 14,000 rpm for 1 min. The supernatant was used as the DNA template for PCR reactions.

DNA amplification by polymerase chain reaction

The primer sequences used were: genus-specific reverse primer/universal primer IS711R: 5'-TGC CGA TCA CTT AAG GGC CTT CAT-3'; species-specific forward primers *Brucella abortus* F: 5'-GAC GAA CGG AAT TTT TCC AAT

CCC-3' and *Brucella melitensis* F: 5'-AAATCGCGTCTGCTGG TCT GA-3' (Amersham Pharmacia Biotech, Barcelona, Spain). Both sets of primers were designed to amplify a PCR product that included a region of chromosome I from nucleotide (nt) position 963,334 to nt 964,065 (relative to the 5' extreme). The PCR was performed in a 50 µl mixture containing: 5 µl template DNA; PCR buffer (10 mM Tris HCl [pH 8.4], 50 mM KCl, 1.5 mM MgCl₂); 200 nM of each of the PCR primers; 200 µM (each) of dATP, dCTP, and dGTP; 190 µM dTTP; 10 µM digoxigenin-11-dUTP (Roche Diagnostics, Barcelona, Spain); and 1.25 U of *Taq* polymerase (Roche Diagnostics). The PCR cycling conditions consisted of preheating at 93°C for 5 min; 35 cycles of 90°C for 1 min, 60°C for 30 s, and 72°C for 1 min; and final extension at 72°C for 7 min.

Data treatment and analysis

The data collected from the field were stored in an Excel spreadsheet. Prevalence values were standardised for the sheep and goat populations. The chi-square test was performed and relative risks (RRs) were calculated with Epi-Info (www.cdc.gov/epiinfo); *p*-values less than 0.05 were taken to be significant. Confidence intervals (CI) for prevalence were calculated using EpiCalc 2000 (www.brixtonhealth.com/epicalc.html) and the standardised prevalence with EpiSheet (<http://krothman.org/episheet.xls>). Maps were created with Quantum GIS version 1.6. (www.qgis.org).

Results

A total of 6,201 serum samples (from 3,694 sheep and 2,507 goats) were collected and tested; 4,882 (78.7%) of the animals sampled were female and 1,319 (21.3%) were male. Of the 6,201 sera tested, 320 (5.2%; 95% CI: 4.6–5.8) and 134 (2.2%; 95% CI: 1.8–2.6) were positive for brucellosis by RBPT and CFT, respectively. All administrative zones, 84% of the districts and 58% of the PAs surveyed were found to be affected with brucellosis, but the distribution was not uniform. The Borena zone and the Afar zones had higher standardised prevalence values (3.3%; 95% CI: 1.7–4.9 and 2.8%; 95% CI: 2.2–3.4, respectively) than Jijiga and South Omo, where the prevalence values were 0.07% (95% CI: 0.0–0.17) and 0.26% (95% CI: 0.0–0.56). There was statistically significant variation in disease prevalence among the studied zones, districts and peasant associations (*p* < 0.05). The seroprevalence of brucellosis in each zone and district is summarised in Table II and Table III. Figure 2 and Figure 3 show the spatial distribution of brucellosis in districts and zones.

Table IV shows the variation of prevalence with species, sex and age group. Male goats and sheep were twice as likely to test positive as females (RR: 2.04; 95% CI: 1.7–3.4; χ^2 : 21.05, *p* < 0.05). Adults (animals older than 1.5 years) were three times more likely to test positive than younger animals (RR: 2.76; 95% CI: 1.14–6.73; χ^2 : 5.18, *p* < 0.05),

Table II
Seroprevalence of small ruminant brucellosis in the study zones, obtained using the complement fixation test

| Region | Zone | Goats | | | Sheep | | | Standardised prevalence (95% CI) |
|------------------------|--------|----------------------|------------------|-----------------------|----------------------|-----------------|-----------------------|----------------------------------|
| | | Population (× 1,000) | Pos./N | Prevalence (95% CI) | Population (× 1,000) | Pos./N | Prevalence (95% CI) | |
| Afar | 1 | | 42/1,245 | 3.4% (2.5–4.6) | | 3/215 | 1.4% (0.4–4.4) | 2.4% (1.4–3.3) |
| | 2 | | 2/79 | 2.5% (0.4–9.7) | | 0/8 | 0.0% (0.0–40.2) | 1.2% (0–2.9) |
| | 3 | | 25/331 | 7.6% (5.0–11.1) | | 5/144 | 3.5% (1.3–8.3) | 5.5% (3.4–7.5) |
| | 4 | | 6/156 | 3.8% (1.5–8.6) | | 1/53 | 1.9% (0.1–11.4) | 2.8% (0.4–5.2) |
| | 5 | | 15/483 | 3.1% (1.8–5.2) | | 6/405 | 1.5% (0.6–3.4) | 2.3% (1.3–3.2) |
| Sub-total: Afar | | 403.3 | 90/2,294 | 3.9% (3.2–4.8) | 801.5 | 15/825 | 1.8% (1.1–3.1) | 2.8% (2.2–3.4) |
| Oromia | Borena | 1,274.1 | 21/474 | 4.4% (2.8–6.8) | 669.1 | 3/135 | 2.2% (0.6–6.9) | 3.3% (1.7–4.9) |
| Somali | Jijiga | 1,162.7 | 0/371 | 0.0% (0.0–1.3) | 1,374.5 | 2/1,483 | 0.1% (0.02–0.5) | 0.07% (0–0.17) |
| SNNPR | S. Omo | 323.8 | 3/555 | 0.5% (0.1–1.7) | 505.1 | 0/64 | 0.0% (0.0–7.1) | 0.26% (0–0.56) |
| Total | | 3,163.9 | 114/3,694 | 3.1% (2.6–3.7) | 3,350.2 | 20/2,507 | 0.8% (0.5–1.3) | 1.9% (1.6–2.2) |

CI: confidence interval
N: number sampled
Pos.: positive

S: South
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Table III
Seroprevalence of small ruminant brucellosis at regional, zonal and district levels, by complement fixation test

| Region | Zone | District | Tested | Positive | Prevalence (%) | 95% CI | |
|---------------------------|------------------|------------------|--------------|--------------|----------------|------------------|------------------|
| Afar | Zone 1 | Chefira | 280 | 16 | 5.7 | 3.41–9.29 | |
| | | Dubti | 134 | 9 | 6.7 | 3.32–12.74 | |
| | | Mille | 1,043 | 20 | 1.9 | 1.21–3.00 | |
| | | Sub-total | | 1,457 | 45 | 3.1 | 2.29–4.15 |
| | Zone 2 | Afdera | 58 | 1 | 1.7 | 0.09–10.46 | |
| | | Koneba | 29 | 1 | 3.5 | 0.18–19.63 | |
| | | Sub-total | | 87 | 2 | 2.3 | 0.40–8.84 |
| | Zone 3 | Amibarah | 60 | 7 | 11.7 | 5.21–23.18 | |
| | | Awash Fentale | 58 | 6 | 10.3 | 4.27–21.83 | |
| | | Bure Mudaitu | 87 | 1 | 1.2 | 0.06–7.13 | |
| | | Gewane | 270 | 16 | 5.9 | 3.54–9.63 | |
| | | Sub-total | | 475 | 30 | 6.3 | 4.38–9.00 |
| | Zone 4 | Ewa | 129 | 3 | 2.3 | 0.33–4.03 | |
| | | Golina | 58 | 2 | 3.5 | 0.60–12.95 | |
| | | Yalo | 28 | 2 | 7.1 | 1.25–24.96 | |
| | | Sub-total | | 215 | 7 | 3.3 | 1.44–6.87 |
| | Zone 5 | Artuma | 29 | 0 | 0 | 0.31–14.56 | |
| | | Daliphage | 566 | 10 | 1.8 | 0.86–3.17 | |
| | | Dewey | 58 | 1 | 1.7 | 0.09–10.46 | |
| | | Fursi | 57 | 1 | 1.8 | 0.09–10.63 | |
| Semurobi | | 88 | 7 | 7.9 | 3.53–16.22 | | |
| Telalak | | 87 | 2 | 2.3 | 0.40–8.84 | | |
| | Sub-total | | 885 | 21 | 2.4 | 1.51–3.66 | |
| Sub-total (region) | | | 3,119 | 105 | 3.3 | 2.78–4.08 | |
| Oromia | Borena | Yabello | 609 | 24 | 3.9 | 2.60–5.89 | |
| SNNPR | South Omo | Benatsemay | 619 | 3 | 0.5 | 0.12–1.53 | |
| Somali | Jijiga | Awabere | 236 | 1 | 0.4 | 0.02–2.70 | |
| | | Harshin | 79 | 0 | 0 | 0.12–5.78 | |
| | | Jijiga | 1,249 | 1 | 0.1 | 0.00–0.52 | |
| | | Medele | 60 | 0 | 0 | 0.15–7.50 | |
| | | Obre | 230 | 0 | 0 | | |
| Sub-total (region) | | | 1,854 | 2 | 0.1 | 0.02–0.44 | |
| Total | | | 6,201 | 134 | 2.2 | 1.86–2.60 | |

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and goats were approximately four times more likely to be infected than sheep (RR: 3.8; 95% CI: 2.4–6.1; χ^2 : 36.99, $p < 0.05$).

Bacterial growth was seen on only 2 of the 14 cultured plates. The PCR results for these two isolates were positive for *B. melitensis*, showing a band of amplified DNA of 731 bp, similar to the positive control containing *B. melitensis* DNA (Fig. 4).

Discussion

The prevalence of brucellosis observed in small ruminants in the Ethiopian pastoral areas was lower than most values reported in other African countries. This may be attributed to the low level of intensification, breed differences, flock size and composition, or the tests used to make the diagnosis. In the Somali region, the authors were unable

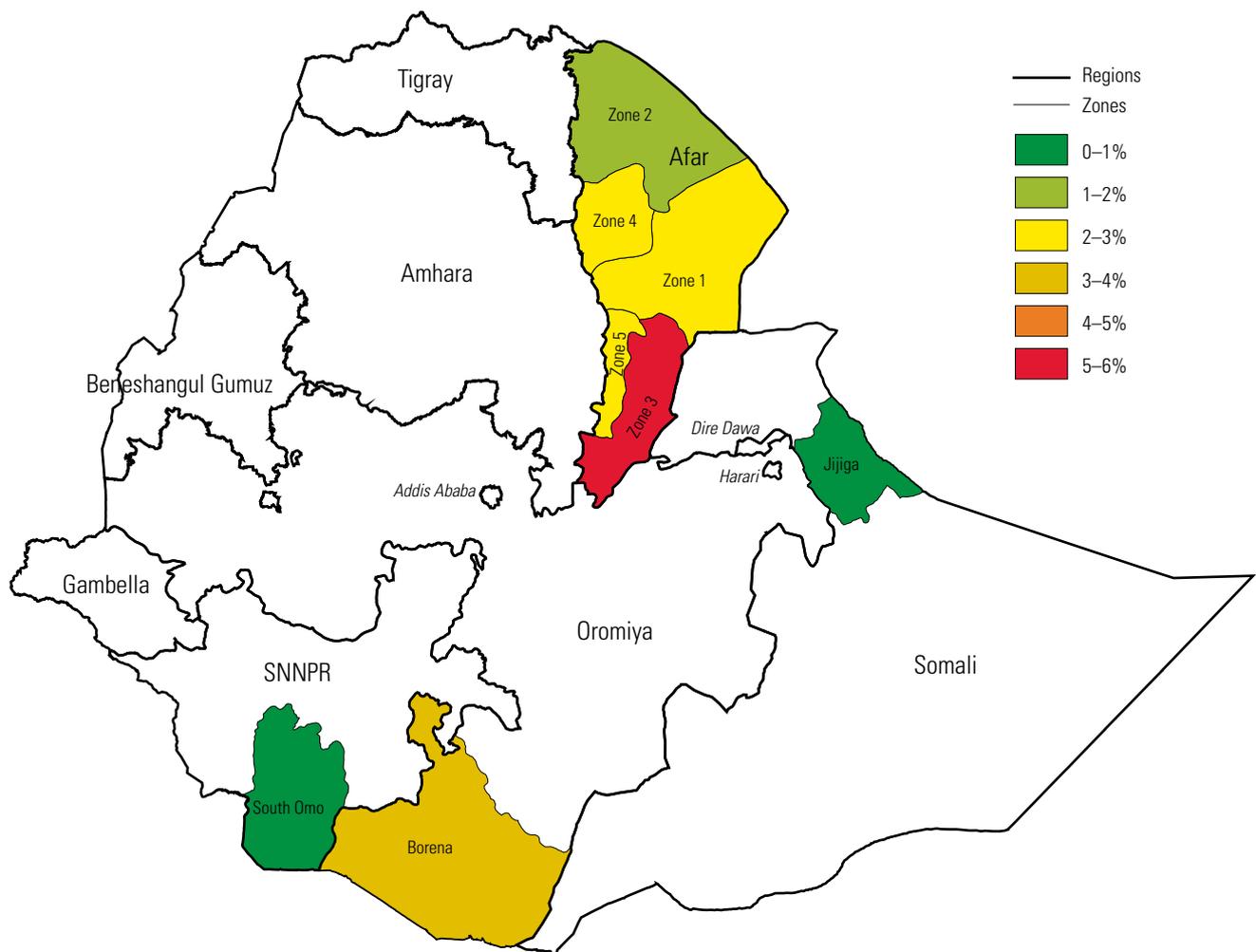
to include as many zones in the study as selected in the Afar region, because of security problems. However, the authors sampled five districts and 12 PAs, from which they collected 1,854 sera for the study. Therefore, they believe that the sampling was representative and did not affect the overall result of the study.

A higher seroprevalence in goats than in sheep has also been described by other authors. Prevalence values between two- and four-fold higher in goats have been described in Eritrea (34), East Morocco, Tunisia and Egypt (11) and Nigeria (35), and between one- and two-fold higher in Sudan and the United Arab Emirates (11) and in Kenya (36). In other countries a higher prevalence has been detected in sheep, for example Somalia (37), Jordan (11) and Oman (38). Generally, goats are more susceptible to *Brucella* infection than sheep, and this could be partly due to the fact that

sheep excrete the organism for shorter periods than goats. This may reduce the potential for spread of the disease within and between sheep flocks (4).

The observation that prevalence was higher in male animals than in female animals was not in accordance with the findings of other authors. Hirsh and Zee (39) and Alton (40) reported lower susceptibility to *Brucella* infection in males, and Teshale *et al.* (20) and Ashenafi *et al.* (21) found no observable sex variation in the prevalence of brucellosis. A possible reason for the findings of the current study is the sharing of male animals between villages, which could have led to an increased likelihood of infection and may explain the higher prevalence.

Differences among regions may be related to husbandry practices. The higher prevalence in Afar and Borena flocks



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Fig. 2
Prevalence of brucellosis in small ruminants in the zones selected for the study

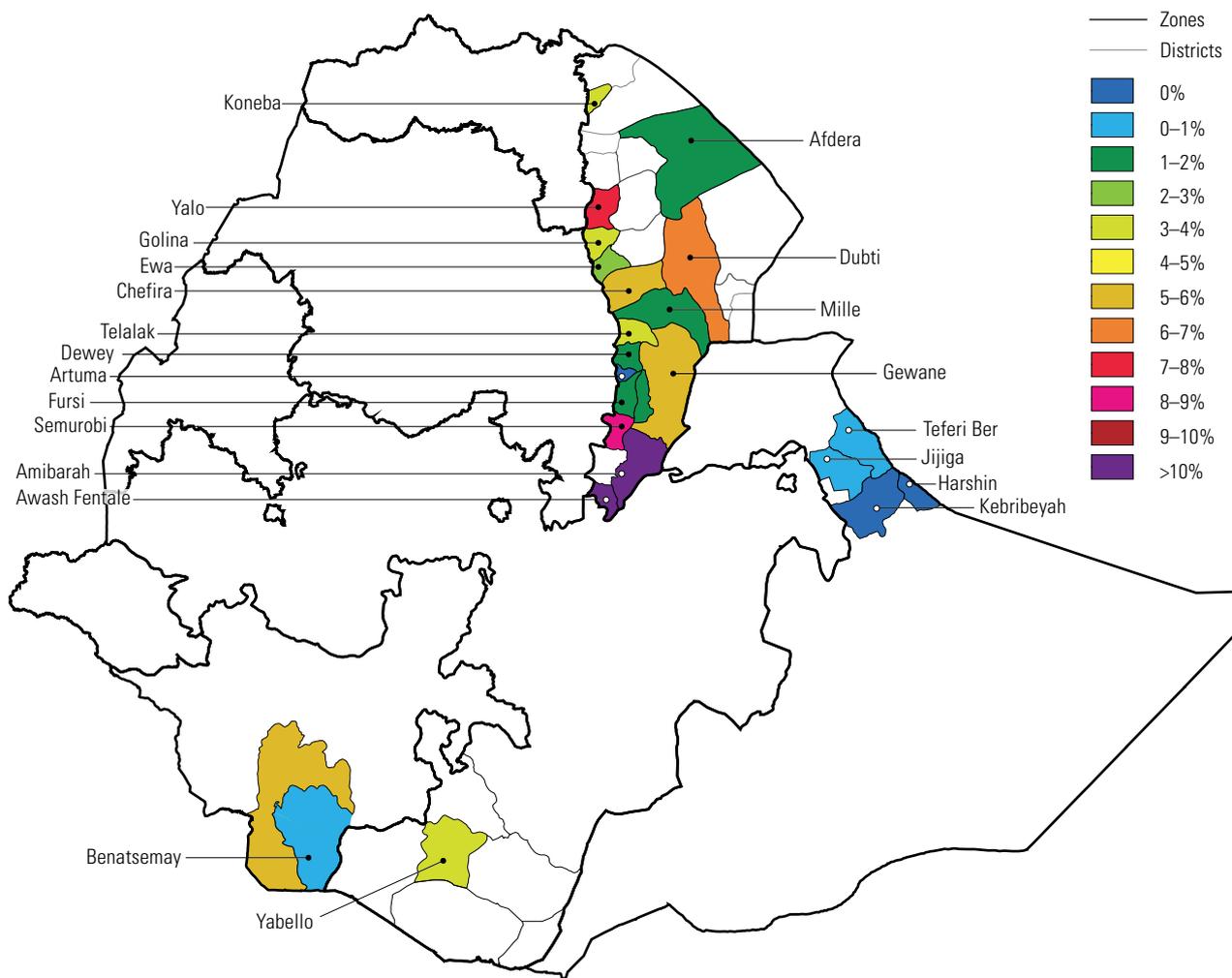


Fig. 3
Prevalence of brucellosis in small ruminants in selected districts ('Woredas')

can be explained by the greater contact between flocks that use communal grazing and watering points, in contrast to Jijiga and South Omo, where the level of contact between flocks is lower.

In this ecosystem, people and animals move seasonally in search of pasture and water, and detailed herd information (i.e. animal identification, local herd census by sex, age and species) is not available for analysis. Therefore it is not possible to determine whether bias was introduced by the sampling procedure. In this study the available animals over six months of age were sampled in each PA. However, more females than males, more adults than young animals and more goats than

sheep were sampled. This is partly because more females are kept in the herds/flocks than males. Male animals are sent for live animal export or slaughtered for the local and export markets. Furthermore, there is a regional variation in the preference for the species of small ruminant kept.

Conclusion

The overall standardised prevalence of brucellosis found in this survey was 1.9%, which appears low, but 58% of the PAs, 84% of the districts and 100% of the zones surveyed

Table IV
Prevalence of small ruminant brucellosis by species, sex and age group

| Category | No. tested | Positive | Prevalence (%) | 95% CI | χ^2 | p-value | Relative risk |
|----------------|--------------|------------|----------------|------------------|----------|---------|--|
| Species | | | | | | | |
| Goat | 3,694 | 114 | 3.1 | 2.69–3.57 | 36.99 | <0.05 | Goats in relation to sheep RR = 3.8; 95% CI: 2.4–6.1 |
| Sheep | 2,507 | 20 | 0.8 | 0.60–1.06 | | | |
| Sex | | | | | | | |
| Male | 1,319 | 50 | 3.8 | 3.34–4.31 | 21.05 | <0.05 | Male in relation to female RR = 2.04; 95% CI: 1.7–3.4 |
| Female | 4,882 | 84 | 1.7 | 1.40–2.06 | | | |
| Age | | | | | | | |
| Adult* | 5,592 | 129 | 2.3 | 1.95–2.71 | 5.18 | <0.05 | Adult in relation to young RR = 2.76; 95% CI: 1.14–6.73 |
| Young** | 608 | 5 | 0.8 | 0.60–1.06 | | | |
| Total | 6,201 | 134 | 2.2 | 1.86–2.60 | | | |

* >1.5 years

** ≤1.5 years

CI: confidence interval

χ^2 : chi-square

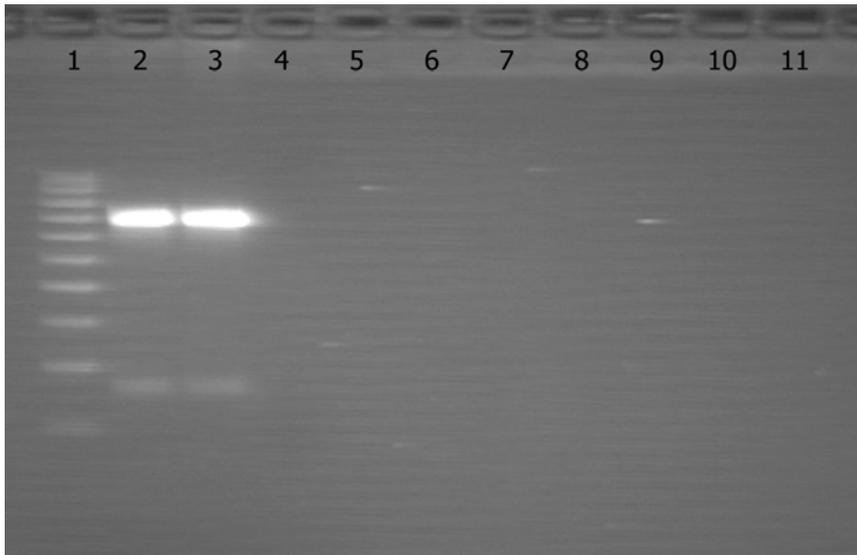


Fig. 4
Result of polymerase chain reaction on the isolate tested using *Brucella melitensis*-specific primers

A positive band was formed at 731 base pairs (bp), the same size as the band from a known isolate used as a positive control (National Animal Health Diagnostic and Investigation Center, Ethiopia, October, 2006)

Lane 1: Molecular ladder

Lane 2: *B. melitensis* positive control with band at 731 bp

Lane 3: The isolate coincides with the positive control, with a band at 731 bp

Lane 4: Negative control

Lane 5–11: Empty

contained animals seropositive for brucellosis. The bacterial isolation was successful, which indicates that it is possible to isolate circulating *Brucella* species from livestock in arid and semi-arid pastoral areas and other regions of Ethiopia. The results of the study show that most regions and herds/flocks in the pastoral areas of Ethiopia are affected by brucellosis. There is clear evidence that control measures are required in order to minimise further economic losses and public health hazards.

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Enquête épidémiologique sur la brucellose ovine et caprine dans certaines zones des plaines pastorales et agropastorales éthiopiennes

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Résumé

Les auteurs présentent les résultats d'une enquête épidémiologique visant à décrire la distribution de la brucellose dans les populations ovine et caprine des régions d'élevage pastoral en Éthiopie. Au total, 6 201 prélèvements de sérum ont été obtenus à partir d'animaux provenant de 67 élevages communautaires, répartis dans 25 districts et huit zones pastorales d'Éthiopie. La période de collecte a duré de novembre 2004 à décembre 2007. Les échantillons ont été soumis à l'épreuve au rose Bengale sur plaque (RBPT) et à l'épreuve de fixation du complément, utilisées en séries. Les échantillons destinés à l'analyse bactériologique ont été collectés dans trois abattoirs opérant à des fins d'exportation, où 285 chèvres ont été sélectionnées au hasard et soumises à la RBPT trois jours avant l'abattage. Des échantillons tissulaires prélevés de 14 chèvres ayant donné des résultats fortement positifs ont été cultivés sur gélose dextrose ou gélose de base pour *Brucella*. La confirmation des isolats identifiés et leur caractérisation en sous-types ont été réalisées par coloration, tests biochimiques et amplification en chaîne par polymérase.

D'après ces résultats, la prévalence sérologique globale standardisée de la brucellose est de 1,9 %, allant de 0,07 % dans la zone de Jijiga à 3,3 % dans la zone de Borena. Des variations significatives au plan statistique ($p < 0,05$) ont été constatées entre les districts, les régions, les zones et les élevages communautaires étudiés.

La probabilité de donner un résultat positif était deux fois plus élevée chez les caprins et ovins mâles que chez les femelles (risque relatif [RR] : 2,04 ; intervalle de confiance [IC] à 95 % compris entre 1,7 et 3,4 ; $\chi^2 = 21,05$; $p < 0,05$). Les animaux adultes (âgés de plus d'un an et demi) avaient trois fois plus de probabilités de donner des résultats positifs que les animaux plus jeunes (RR : 2,76 ; IC à 95 % compris entre 1,14 et 6,73 ; $\chi^2 = 5,18$; $p < 0,05$). La probabilité d'être infecté était quatre fois plus élevée chez les caprins que chez des ovins (RR : 3,8 ; IC à 95 % compris entre 2,4 et 6,1 ; $\chi^2 = 36,99$; $p < 0,05$).

Brucella melitensis a été isolée dans 2 des 14 échantillons analysés. La distribution très importante de la brucellose chez les chèvres et les moutons de ces régions justifie le recours à des mesures de contrôle visant à minimiser les pertes économiques dues à cette maladie ainsi que les risques pour la santé publique.

Mots-clés

Brucellose – Chèvre – Épreuve au rose Bengale – Épreuve de fixation du complément – Éthiopie – Identification – Isolement – Mouton – Prévalence.



Estudio epidemiológico de la brucelosis ovina y caprina en una serie de llanuras pastorales y agropastorales de Etiopía

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Resumen

Los autores describen una investigación epidemiológica que se llevó a cabo en regiones pastorales de Etiopía con el fin de estudiar la distribución de la brucelosis en ovinos y caprinos. De noviembre de 2004 a diciembre de 2007 se obtuvieron un total de 6.201 muestras séricas procedentes de 67 organizaciones campesinas seleccionadas aleatoriamente, 25 distritos y ocho zonas pastorales de Etiopía. Se aplicaron en serie la prueba de aglutinación en placa de rosa de Bengala (RB) y la prueba de fijación del complemento (FdC). Para el examen bacteriológico se obtuvieron muestras de tres mataderos que sacrifican animales destinados a la exportación, donde se seleccionaron aleatoriamente 285 cabras que fueron sometidas a la prueba de RB tres días antes del sacrificio. Después se extrajeron muestras histológicas de 14 cabras que habían arrojado resultado claramente positivo y se cultivaron estas muestras en un medio de agar de dextrosa y agar *Brucella*. Para confirmar los resultados y determinar el subtipo de las cepas aisladas se utilizaron técnicas de tinción y bioquímicas y la prueba de reacción en cadena de la polimerasa (PCR).

La seroprevalencia total normalizada de brucelosis resultó del 1,9%, con resultados que iban de un 0,07% en la zona Jijiga a un 3,3% en la zona Borena. Entre las regiones, zonas, distritos y organizaciones campesinas objeto de estudio se observó una variación estadísticamente significativa ($p < 0,05$).

La probabilidad de resultado positivo en los machos de cabra y oveja era dos veces mayor que en las hembras (riesgo relativo [RR]: 2,04; intervalo de confianza [IC] del 95%: 1,7–3,4; $\chi^2 = 21,05$, $p < 0,05$). La probabilidad de resultado positivo en los ejemplares adultos (de más de un año y medio de edad) era tres veces mayor que en los animales más jóvenes (RR: 2,76; IC 95%: 1,14–6,73; $\chi^2 = 5,18$, $p < 0,05$). Asimismo, la probabilidad de infección en cabras resultaba cuatro veces mayor que en ovejas (RR: 3,8; IC 95%: 2,4–6,1; $\chi^2 = 36,99$, $p < 0,05$).

En 2 de las 14 muestras analizadas se aisló *Brucella melitensis*. La presencia generalizada de brucelosis en los caprinos y ovinos de esas zonas justifica el uso de medidas de lucha para reducir al mínimo las pérdidas económicas y el riesgo para la salud pública que ello supone.

Palabras clave

Aislamiento – Brucelosis – Cabra – Etiopía – Oveja – Prevalencia – Prueba de fijación del complemento – Prueba de rosa de Bengala – Tipificación.



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