

# Epidemiological study of bovine brucellosis in three agro-ecological areas of central Oromiya, Ethiopia

T. Jergefa<sup>(1)</sup>, B. Kelay<sup>(2)</sup>, M. Bekana<sup>(2)</sup>, S. Teshale<sup>(2)\*</sup>,  
H. Gustafson<sup>(3)</sup> & H. Kindahl<sup>(3)</sup>

(1) Oromiya Agricultural Development Bureau, Addis Ababa, Ethiopia

(2) Addis Ababa University, Faculty of Veterinary Medicine, P.O. Box 34, Debre Zeit, Ethiopia

(3) Department of Clinical Sciences, Swedish University of Agricultural Sciences (SLU),  
Box 7054, SE-750 07 Uppsala, Sweden

\*Corresponding author: teshalesori2002@yahoo.com

Submitted for publication: 30 January 2007

Accepted for publication: 2 December 2008

## Summary

A cross-sectional sero-epidemiological study of bovine brucellosis was conducted between September 2005 and March 2006 in three separate agro-ecological areas of central Oromiya, Ethiopia. In this study, a total of 176 clusters (farms) and 1,238 animals were selected, using the one-stage cluster sampling method. Fifty-nine clusters and 423 animals were selected from the lowland areas; 58 clusters and 385 animals from the midland areas and 59 clusters and 430 animals from the highlands. Serum samples were collected from a total of 1,238 animals older than six months. The rose bengal plate test and complement fixation test were used as screening and confirmatory tests, respectively, to detect *Brucella* seropositivity. Questionnaires were also administered to 176 households to gather information on the farm and livestock.

Results showed that the overall seroprevalence of bovine brucellosis at the individual animal level was 2.9% (low). The seroprevalence was 4.2% in the lowlands, 1.0% in the midlands and 3.4% in the highlands. The overall seroprevalence at the herd level was 13.6% (moderate). At the herd level, seroprevalence in the lowlands was 17%; in the midlands: 5.1%; and in highland areas: 18.6%.

Logistic regression analysis revealed that the breed of cattle and the method of disposing of aborted fetuses and foetal membranes had a statistically significant effect on individual animal seroprevalence ( $p < 0.05$ ). In lowland areas, the breed ( $p < 0.05$ ), animal management system ( $p < 0.05$ ), mating method ( $p < 0.05$ ), herd size ( $p < 0.05$ ) and source of replacement stock ( $p < 0.05$ ) all had significant effects on individual animal seroprevalence.

## Keywords

Agro-ecological systems – Bovine brucellosis – Bovines – Brucellosis – Ethiopia – Oromiya – Seroprevalence.

## Introduction

Brucellosis is an important livestock and human disease in many developing countries (4, 24, 31, 35). It is primarily a reproductive disease, characterised by abortion, retained foetal membranes and impaired fertility. Bovine brucellosis is caused principally by *Brucella abortus*, which comprises nine serotypes and a number of variant strains (9, 26, 27).

The disease is important because of its widespread distribution, multiplicity of hosts and the public health hazard that it causes (4, 9, 35, 46).

Bovine brucellosis is distributed throughout the world, but has been eradicated from the livestock populations of most European countries, Japan, Canada and the United States of America (USA) (25, 30, 33). However, it remains widely

distributed in developing countries. Its occurrence and prevalence has been studied in various countries in Africa, Asia and South America. A high prevalence has been reported from Uganda (11), Egypt, Sudan and Senegal (7); moderate prevalence rates were recorded in Nigeria, Tanzania, Zambia, Ghana and Botswana (8); while a low prevalence was encountered in Kenya (17), Djibouti (6) and Eritrea (28). Similar studies have been conducted on the occurrence and distribution of bovine brucellosis in Asian and South American countries (3, 21, 32, 36, 37, 39), showing low to moderate prevalences.

In Ethiopia, bovine brucellosis was first reported in 1970 by the veterinary section of the US Navy Medical Research Unit (10). Since then, several studies have been carried out to determine its prevalence in different parts of the country (2, 12, 13, 14, 18, 19, 22, 23, 42). Generally, the prevalence of bovine brucellosis was found to range from 0.2% in south-western Ethiopia (41) to 38% in western Ethiopia (34). In Ethiopia, the dairy industry in central Oromiya (one of Ethiopia's nine regions), has been growing to meet an ever-increasing demand for milk and milk products. Crossbreeding indigenous cattle with high-yield exotic cattle is the main policy favoured by the Ethiopian government to bridge the gap between supply and demand for dairy products. Owners of dairy cattle and institutions promoting the dairy industry require current, reliable scientific data on such important diseases as brucellosis. However, previous studies on brucellosis have been limited in coverage and scope. As a result, there is insufficient information on this disease, despite its relevance to the potential development of the dairy industry in Ethiopia. The objectives of the present study are, thus:

- to determine the seroprevalence of bovine brucellosis
- to identify potential risk factors for the spread and distribution of bovine brucellosis in different agro-ecological zones of central Oromiya.

## Materials and methods

### Study areas

The study was conducted in three selected agro-ecological areas of central Oromiya:

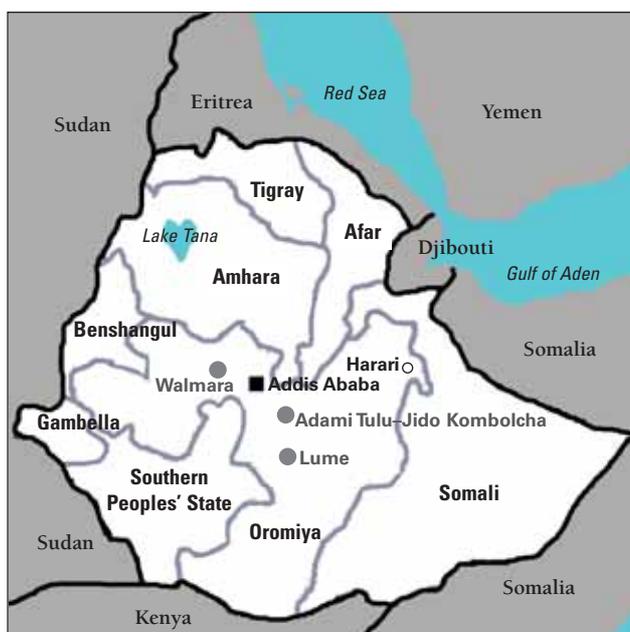
- the Walmara district in West Shewa Zone (one of twelve zones in the Oromiya region)
- the Lume and Adami Tulu–Jido Kombolcha districts of East Shewa Zone.

Walmara district is geographically located at 9° 3' N latitude and 38° 3' E longitude, at an altitude of 2,400 m above sea level. The minimum and maximum

temperatures range from 2°C to 9°C and 20°C to 27°C, respectively. The average annual rainfall of the district is 1,000 to 2,200 mm. Walmara is typically a highland district characterised by cool weather conditions. The major livestock production systems in the area include: mixed crop-livestock farming, where animals are managed under extensive traditional grazing systems; market-oriented, peri-urban dairy production and urban dairy production systems.

Lume district is situated between 8° 12' to 8° 5' N latitude and 39° 01' to 39° 17' E longitude. Approximately 50% of the district has a midland climate (1,500 to 2,000 m above sea level). The predominant livestock production system is mixed crop-livestock farming. Crossbred dairy animals are raised by smallholder farmers who supply milk to the milk marketing cooperatives. Some of the households engaged in dairy production manage their animals intensively, while others use extensive grazing systems.

Adami Tulu–Jido Kombolcha district is found in the mid-Rift Valley at 7° 9' N latitude and 38° 7' E longitude. The average altitude of the district is about 1,650 m above sea level. The average annual rainfall of the area is 760.9 mm. The main climate type is semi-arid. Livestock production is the dominant farming system, and crop production is not common. Dairy cattle are mostly reared in small-scale dairy operations, in which animals are managed both intensively and extensively. Figure 1 shows the geographical locations of the study area. The three study districts are among the main dairy sources for the capital, Addis Ababa.



**Fig. 1**  
Map showing locations of study areas in central Oromiya, Ethiopia

## Study population and design

The target population for the serological survey was cattle aged over six months, whereas the study population for the questionnaire was composed of all households which keep cattle, for whatever purpose. The study design was a cross-sectional, sero-epidemiological survey and questionnaire, which was conducted between October 2005 and April 2006. Screening of sera was performed using the rose bengal plate test (RBPT), while the complement fixation test (CFT) was used for confirmation. Information on individual animal and herd attributes was collected in the questionnaire.

## Sample size determination

Sample size was determined using a one-stage, cluster sampling method. A herd was considered to be a cluster and the average herd size was considered to be six, in accord with figures supplied by the Oromiya Agricultural Development Bureau (OADB) (29). The number of clusters to be sampled from each district was determined according to Thrusfield (44). The between-cluster variance was calculated at 12.3%, based on a previous prevalence report (29). Accordingly, the number of clusters (herds) to be sampled from each district was 29 and the total number of clusters was 87. To increase precision, a total of 176 clusters (with a total of 1,238 animals) were randomly selected, of which 59 clusters (423 animals) came from a lowland area (Adami Tulu-Jido Kombolcha district); 58 clusters (385 animals) came from the midlands (Lume district) and 59 (430 animals) came from the highlands (Walmara district).

## Blood sample collection

A sample of approximately 10 ml of blood was collected from the jugular vein of each of the selected animals, using plain vacutainer tubes. The samples were left at room temperature overnight to allow clotting for serum separation. The serum was collected into cryovials with plastic pipettes and stored at  $-20^{\circ}\text{C}$  until serological testing could be performed.

## Serological analysis

### Rose bengal plate test

All serum samples were screened using the RBPT, according to the procedures described by Alton *et al.* (1) and the *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* of the World Organisation for Animal Health (OIE) (46). The rose bengal antigen constituted a suspension of *B. abortus* (obtained from the Institut Pourquier, 326 rue de la Galéra, Parc Euromédecine, 34090 Montpellier,

France). Thirty  $\mu\text{l}$  of serum was mixed with an equal volume of antigen suspension on a glass plate and agitated. After four minutes of rocking, any visible agglutination was considered a positive result.

### Complement fixation test

All sera which tested positive to the RBPT were further tested using CFT for confirmation. The CFT was performed at the National Veterinary Institute, Debre Zeit, Ethiopia. A standard *B. abortus* antigen for CFT (Veterinary Laboratories Agency, United Kingdom) was employed to detect the presence of antibodies against *Brucella* in the sera. The control sera and complement were both obtained from the Federal Institute for Health Protection of Consumers and Veterinary Medicine, Germany. Sera with a strong reaction – more than 75% fixation of the complement (3+) at a dilution of 1:5 and with at least 50% fixation of the complement (2+) at dilutions of 1:10 and 1:20 – were classified as positive (+), according to the guidelines of the OIE *Manual* (46).

### Sensitivity and specificity of the tests

The results of the tests lacked values for the sensitivity and specificity of these serological tests in tropical settings. Values that have been proposed elsewhere are as follows:

- for the RBPT: sensitivity from 91% to 100% in affected areas (11), and from 96.7% to 100% on *Brucella*-free farms (20); specificity from 95% to 99% in affected areas (11), and from 79% to 91.9% on virus-free farms (20)
- for the CFT: sensitivity from 96.7% to 100% and specificity from 88.8% to 97.7% (20).

## Questionnaire

A structured questionnaire was prepared and used to collect information about:

- a) animal attributes, such as age and breed
- b) farm attributes, such as:
  - management system
  - herd size and composition
  - system of housing livestock
  - hygienic practices on the farm
  - the level of awareness of the farmer about brucellosis
  - sources of replacement stock.

During the survey, study animals were identified by giving codes to each animal in the cluster. The coding system included the study area, household, sex and age of the animal. The animals were given serial numbers, beginning with older animals and ending with the youngest.

## Data analysis

Data were entered into the Microsoft Excel programme and descriptive statistics were used to summarise the results. Analysing the effects of different potential risk factors on the seroprevalence of brucellosis at both the individual animal level and the herd level was performed by logistic regression, adjusted for cluster samples. For statistical inference, the level of significance was taken as 0.05.

## Results

### The seroprevalence of bovine brucellosis

Table I presents the seroprevalence of bovine brucellosis at both the individual animal level and the herd level in the three selected agro-ecological systems, and the overall study area. The overall seroprevalence in individual animals in the selected areas was 2.9%. The highest seroprevalence (4.2%) was recorded in lowland areas, followed by the highlands (3.4%) and midlands (1.0%). Generally, 13.6% ( $n = 24$ ) of the herds tested included at least one seropositive animal. The highest seroprevalence at the herd level (18.6%) was found in the highland areas, followed by the lowlands (17.0%). The lowest prevalence was recorded in the midlands (5.1%).

### Factors affecting the overall seroprevalence of bovine brucellosis

Table II shows the results of logistic regression analysis for the overall study areas. The results reveal that

**Table I**  
The overall prevalence of bovine brucellosis, at the individual animal level and at the herd level, in three agro-ecological areas of central Oromiya, Ethiopia

Agro-ecological area	No. of animals tested	No. of positive animals (prevalence)	
		RBPT	CFT
Lowland	423	24 (5.7%)	18 (4.2%)
Midland	385	10 (2.6%)	4 (1.0%)
Highland	430	27 (6.3%)	15 (3.4%)
Total	1,238	61 (4.9%)	37 (2.9%)

Agro-ecological area	No. of herds tested	No. of positive herds (prevalence)	
		RBPT	CFT
Lowland	59	14 (23.7%)	10 (17.0%)
Midland	58	6 (10.3%)	3 (5.1%)
Highland	59	8 (13.6%)	11 (18.6%)
Total	176	28 (16.0%)	24 (13.6%)

RBPT: Rose Bengal plate test  
CFT: complement fixation test

both the breed of cattle ( $p < 0.05$ ) and the methods of disposal used for aborted materials ( $p < 0.05$ ) had a significant effect on the overall seroprevalence in individual animals. This prevalence was higher (4.9%) in crossbred animals than in indigenous cattle (2.2%). It was also higher in animals kept under intensive management systems (4.8%) than those in semi-intensive (2.8%) and extensive (2.4%) management systems. All other factors considered (age, herd size, agro-ecological system, mating method and sources of replacement stock) had no effect on the serological prevalence of bovine brucellosis at the individual animal level. In addition, none of the potential risk factors had a significant effect on the prevalence of brucellosis at the herd level ( $p > 0.05$ ).

### Factors affecting the seroprevalence of brucellosis in the study regions

The results of logistic regression analysis for the lowland areas are presented in Table III. Among the potential risk factors considered in the lowland area, breed ( $p < 0.05$ ), herd size ( $p < 0.05$ ), management system ( $p < 0.05$ ), mating methods ( $p < 0.05$ ) and sources of replacement stock ( $p < 0.05$ ) each had a significant effect on the seroprevalence of brucellosis. The prevalence was higher in crossbred animals (10.3%) than in indigenous ones (2.7%). A higher prevalence was found in animals from smaller herds (10.2%) than in animals from medium (2.8%) and large (2.2%) herds. More positive test results were recorded in animals raised under intensive production systems (10.3%) than in those raised in extensive systems (2.7%). Similarly, a higher seroprevalence of brucellosis was observed on farms that used artificial insemination (10.3%), as opposed to those that used natural mating (2.7%).

When these risk factors were considered separately for the three agro-ecological areas, the source of replacement stock was found to affect the prevalence of brucellosis in lowland areas. In these regions, dairy cattle owners obtained their replacement stock from village breeders, with a high risk of purchasing unproductive or problematic animals. As a matter of fact, the reproductive and health status of these replacement animals were, in most cases, not known. This is because of the absence of organised ranches and government breeding centres in the lowlands. Most lowland areas are far from veterinary services and practise extensive husbandry systems. The prevalence of brucellosis was higher on farms that obtained replacement stock from village breeders (10.3%), rather than other sources, such as regional markets (2.7%) (Table III). However, this factor had no effect on the seroprevalence of brucellosis in midland and highland areas ( $p > 0.05$ ).

**Table II**  
**Factors affecting the overall seroprevalence of brucellosis in individual animals in the study areas of central Oromiya, Ethiopia**  
 (logistic regression analysis adjusted for clustering)

Risk factor	Group	Number	Prevalence (rate %)		95% CI	p-value	OR
Breed	Indigenous	892	20	(2.2%)	1.0-4.7	0.04	2.2
	Crossbred	346	17	(4.9%)			
Age	0.5-3 years	412	17	(4.1%)	0.3-1.0	0.07	0.6
	3-10 years	729	18	(2.5%)			
	> 10 years	97	2	(2.1%)			
Herd size	1-6	296	16	(5.4%)	0.7-2.4	0.37	
	7-16	537	9	(1.7%)			
	> 16	405	12	(3.0%)			
Management system	Intensive	266	13	(4.8%)	0.9-2.1	0.09	1.4
	Semi-intensive	70	2	(2.8%)			
	Extensive	902	22	(2.4%)			
Agro-ecological area	Lowland	423	18	(4.3%)	0.5-1.4	0.60	0.8
	Midland	385	4	(1.0%)			
	Highland	430	15	(3.5%)			
Mating method	Natural	894	20	(2.2%)	0.8-1.8	0.20	1.2
	Artificial	116	11	(9.5%)			
	Both	228	6	(2.6%)			
Source of replacement stock	Regional market	891	20	(2.2%)	0.8-1.7	0.20	1.2
	Village breeders	236	13	(5.5%)			
	Government farms	6	1	(16.7%)			
	Urban dairy farms	105	3	(2.9%)			

CI: confidence interval  
 OR: odds ratio

**Table III**  
**Factors affecting the seroprevalence of *Brucella* in individual animals in the lowland areas of central Oromiya, Ethiopia**  
 (logistic regression analysis adjusted for cluster samples)

Risk factor	Group	Number	Prevalence (rate %)		95% CI	p-value	OR
Breed	Indigenous	336	9	(2.7%)	1.3-12.6	0.01	4.1
	Crossbred	87	9	(10.3%)			
Age	0.5-3 years	143	7	(4.9%)	0.3-1.5	0.47	0.7
	3-10 years	237	10	(4.2%)			
	> 10 years	43	1	(2.3%)			
Herd size	1-6	98	10	(10.2%)	0.1-0.9	0.04	0.41
	7-16	143	4	(2.8%)			
	> 16	182	4	(2.2%)			
Management system	Intensive	87	9	(10.3%)	1.1-3.5	0.01	2.0
	Extensive	336	9	(2.7%)			
Mating method	Natural	335	9	(2.7%)	1.3-12.4	0.01	4.1
	Artificial	88	9	(10.3%)			
Source of replacement stock	Regional markets	335	9	(2.7%)	1.3-12.4	0.01	4.1
	Village breeders	88	9	(10.2%)			

CI: confidence interval  
 OR: odds ratio

## Questionnaire survey

### Description of farm characteristics

The questionnaire revealed that most of the intensive farms (85.7%) in the lowland area had a herd size of six animals or fewer, while most of the extensive farms (71%) had a herd size greater than or equal to seven. In midland areas, nearly all the intensive farms had a herd size of six or fewer, while the majority of extensive farms (86.2%) had seven animals or more. In the highlands, the majority of the intensive farms (54.6%) and extensive farms (72.1%) had a herd size of seven or more animals, while the majority of semi-intensive farms (64.3%) had six or fewer.

In all of the study areas, most farmers (84.7% to 89.8%) were not aware of bovine brucellosis. More than half of the farmers in the highlands (50.9%) disposed of aborted materials properly. However, farmers in other areas were less likely to use proper disposal methods (only 32.2% to 43.1%). Nearly all the farmers in all agro-ecological systems (81.3% to 91.5%) had no separate parturition pen. The practice of regularly cleaning the barn was performed on 50.8% to 69.4% of the farms in the study areas. As can be seen from Table IV, occurrences of abortion, stillbirth and retained foetal membranes were also less than 10.3%, 6.8% and 6.8% in the lowland, midland and highland areas, respectively.

## Discussion

### Overall prevalence

The 2.9% overall seroprevalence of brucellosis found in individual animals, and the seroprevalence found in

highland areas (3.4%), midland areas (1.0%) and the lowlands (4.2%), are lower than those reported in most previous studies (3, 22, 23).

In 1970, the Ethiopian Ministry of Agriculture (10) reported the prevalence of bovine brucellosis in different parts of Ethiopia, ranging from 2% for Wollo to 5% for Illubabor, 7% for Kaffa, 8% for Harar and Shewa and 21% for Sidamo. Similarly, higher prevalence rates have been recorded by Molla in Arsi (22), Asfaw around and about Addis Ababa (2), Zewdu in Sidamo (47) and Gebremariam (12) in the Addis Ababa region. Prevalence rates as high as 38.7% and 22% have been reported from western and north-eastern parts of Ethiopia by Rashid (34) and Sintaro (40), respectively.

Slightly higher, individual serological prevalence rates of 5.6%, 5.9%, 6.5%, 9.9% and 15.8% have been recorded in Eritrea, Tanzania, Sudan, Kenya and Uganda, respectively (11, 15, 17, 28). The (individual) prevalence rate observed in the present study was very close to those rates reported from other parts of Ethiopia and elsewhere (6, 13, 23, 38). The individual serological prevalence rate recorded in the present study was higher than that recorded by:

- Taddele (41) for Jimma
- Kebede (19) for the Amhara region
- Kassahun (18) for Sidama
- Gebretsadik (13) for the region of Tigray.

The serological prevalence of 13.6% encountered at the herd level in this present study was consistent with previous findings, which ranged between 13.7% and 14.9% (18, 23, 41).

**Table IV**  
**Farm characteristics in three agro-ecological areas of central Oromiya, Ethiopia**

Variables	Category	Proportion of respondents (No.)		
		Lowlands (59)	Midlands (58)	Highlands (59)
Awareness of brucellosis	Yes	15.3% (9)	10.3% (6)	10.3% (6)
	No	84.7% (50)	89.7% (52)	89.8% (53)
Proper disposal of aborted materials	Yes	32.2% (19)	43.1% (25)	50.9% (30)
	No	67.8% (40)	56.9% (33)	49.2% (29)
Presence of parturition pen	Yes	8.5% (5)	17.2% (10)	18.6% (11)
	No	91.5% (54)	82.8% (48)	81.4% (48)
Regular cleaning of barn	Yes	50.8% (30)	60.3% (35)	69.5% (41)
	No	49.2% (29)	39.7% (23)	30.5% (18)
Occurrence of abortion	Yes	6.8% (4)	10.3% (6)	8.5% (5)
	No	93.2% (55)	89.7% (52)	91.5% (54)
Occurrence of stillbirth	Yes	6.8% (4)	3.4% (2)	3.4% (2)
	No	93.2% (55)	96.6% (56)	96.6% (57)
Occurrence of retained foetal membrane	Yes	6.8% (4)	3.4% (2)	8.5% (5)
	No	93.2% (55)	96.6% (56)	91.5% (54)

Differences in the seroprevalence rates observed in this study, as opposed to those recorded by previous researchers, may be due to several factors:

- differences in herd size
- different management systems
- the presence or absence of infectious foci, such as *Brucella*-infected dairy farms or ranches in the surrounding areas, which are used as sources of replacement stock.

Differences in sample size and the serological tests employed would further accentuate these variations. The fact that the source of replacement stock was found to be associated with *Brucella* infection adds substance to the above hypothesis (33).

### Risk factors

Among the potential risk factors considered in the present study, the breed of cattle was shown to have a significant effect on the serological prevalence rate of bovine brucellosis ( $p < 0.05$ ), for both the overall study area and in lowland agro-ecological systems. In both cases, the serological prevalence was higher in crossbred animals than in indigenous ones, a finding in accord with those of Bukanzi *et al.* (5) in Bophuthatswana but not with those of Faye *et al.* (11) in Uganda. This significant difference could be due to the compounded effects of management and mating methods. In the three areas observed in the present study, farmers who owned crossbred cattle tended to follow intensive management methods and prefer artificial insemination to natural mating for breeding. However, in contrast to the findings of the authors, Radostits *et al.* (33) reported no association between the breed of cattle and the seroprevalence of bovine brucellosis.

Another important risk factor with a significant effect in the overall study area ( $p < 0.05$ ), and in lowland agro-ecological areas ( $p < 0.05$ ), was the animal management system. In this study, a higher prevalence was observed in cattle under intensive production systems than in those under extensive farming. This finding agreed with previous reports of Tekelye *et al.* (42) in central Ethiopia in 1989 and Jiwa *et al.* (16) in Tanzania in 1969. However, it was not in accord with a 2005 study by Gebretsadik (13), in northern Ethiopia. This study reported a higher prevalence rate in cattle under extensive management systems.

The higher prevalence in intensive production systems could be explained by the fact that there is a greater chance of contact between infected and healthy animals in these systems, or between healthy animals and infectious materials, since most farmers do not follow hygienic practices. This increased risk of contact was described by Thimm and Wundt (43). The higher prevalence in

extensive management systems reported by Gebretsadik (13) could be due to the transhumant nature of cattle herding in northern Ethiopia, which can enhance the spread and distribution of infection.

A statistically significant difference was also observed in the seroprevalence of bovine brucellosis among different herd sizes in lowland areas. Animals from smaller herds were at greater risk of acquiring brucellosis ( $p < 0.05$ ), contradicting previous reports by Asfaw (2) and Taddele (41). This could be related to the typical herd size found in the lowlands, where extensive farms hold larger numbers of animals than intensive farms.

The type of mating method used by farmers ( $p < 0.05$ ) and sources of replacement stock ( $p < 0.05$ ) were shown to significantly affect the prevalence of bovine brucellosis in lowland areas. A higher prevalence was encountered on farms that used artificial insemination, and which obtained replacement stock from village breeders (rather than government ranches). This may be due to a lack of awareness about brucellosis on the part of village breeders. In the questionnaire, farmers in the lowlands reported that they had been purchasing replacement stock from farms that were closed, because of a variety of problems, and unprofitable urban dairy farms. Most of the farms that were selling dairy cows had gone out of business and the animals were partially culled stock which the owners had decided not to keep. Farmers in the other study sites obtained their replacement stock from government farms.

Artificial insemination was also shown to be an important risk factor for brucellosis in lowland agro-ecological zones. This could be the result of poor hygiene practices before and after insemination and inappropriate techniques. The inseminators had only a few months of training and there is no regular monitoring or upgrading of their skills. However, this area needs more detailed investigation.

The results of the questionnaire showed that there is a lack of awareness about brucellosis and an absence of hygienic practices, such as the use of a separate parturition pen, proper disposal of aborted materials, etc. Similar findings have been documented by Asfaw and others (2, 13, 41), suggesting that little attention has been given to preventing brucellosis and that this, in turn, contributes to the spread and transmission of the infection in the area.

## Conclusions

This study of central Oromiya has shown that the prevalence of brucellosis observed in cattle at the individual animal level is low, while the prevalence observed at the herd level is moderate. Whether the cattle were indigenous or crossbred was found to be an

important risk factor, as was the disposal method for aborted fetuses and foetal membranes. Other significant risk factors in the lowlands were the size of the herd, whether natural mating or artificial insemination were used for breeding and the sources for replacement stock.

Artificial insemination and obtaining replacement stock from village breeders seem to be associated with the occurrence of brucellosis. Thus, improvements are needed in hygienic practices and artificial insemination techniques, to decrease the chances of iatrogenic disease spread. The technical skills of artificial inseminators should be monitored and improved. Awareness should be promoted among dairy farmers in the area as to the importance of the hygienic disposal of aborted materials and knowing the health status of the animals they are

considering for replacement. Since brucellosis is known to have a multiplicity of agents and hosts, it is crucial to learn more about the occurrence of the disease in other species, particularly small ruminants and camels, for effective control. Detailed bacteriological investigations are recommended to identify the *B. abortus* biotypes present in Ethiopia.

## Acknowledgements

This study was supported by a grant given by the Swedish International Development Cooperation Agency to the Faculty of Veterinary Medicine at Addis Ababa University.



# Étude épidémiologique de la brucellose bovine dans trois zones agro-écologiques de la région centrale d'Oromiya, Éthiopie

T. Jergefa, B. Kelay, M. Bekana, S. Teshale, H. Gustafson & H. Kindahl

## Résumé

La brucellose bovine a fait l'objet d'une étude séro-épidémiologique transversale, réalisée entre les mois de septembre 2005 et mars 2006 dans trois zones agro-écologiques distinctes de la région centrale d'Oromiya en Éthiopie. À cette fin, 176 grappes (exploitations) et 1 238 animaux ont été sélectionnés au moyen de la méthode d'échantillonnage en grappes à une étape. L'échantillon a consisté en 59 grappes et 423 animaux sélectionnés dans la région des plaines, 58 grappes et 385 animaux sélectionnés dans la région centrale et 59 grappes et 430 animaux sélectionnés dans la région des hauts plateaux. Des échantillons de sérum ont été prélevés sur un total de 1 238 animaux âgés de plus de six mois. Le dépistage et la confirmation de la présence d'anticorps dirigés contre *Brucella* ont été réalisés au moyen de l'épreuve au rose bengale sur plaque et de l'épreuve de fixation du complément, respectivement. En outre, des questionnaires ont été distribués dans 176 foyers afin de recueillir des informations sur les exploitations et les animaux d'élevage.

Les résultats ont révélé, à l'échelle individuelle, une prévalence sérologique globale de la brucellose bovine de 2,9 % (prévalence faible). Les prévalences par zone et à l'échelle individuelle étaient respectivement de 4,2 % dans la région des plaines, de 1,0 % dans la région centrale et de 3,4 % dans les hauts plateaux. À l'échelle des troupeaux, la prévalence sérologique globale était de 13,6 % (prévalence modérée). Les prévalences par zone et à l'échelle des troupeaux étaient respectivement de 17 % dans la région des plaines, de 5,1 % dans la région centrale et de 18,6 % dans les hauts plateaux.

Une analyse de régression logistique a révélé une corrélation significative au plan statistique ( $p < 0,05$ ) entre la race bovine, les méthodes habituelles d'élimination des fœtus avortés et des membranes fœtales et la prévalence sérologique à l'échelle individuelle. Dans la région des plaines, une corrélation significative a été relevée entre la race des animaux ( $p < 0,05$ ), le système de gestion animale ( $p < 0,05$ ), la méthode de reproduction ( $p < 0,05$ ), l'origine du bétail de remplacement ( $p < 0,05$ ) et la prévalence sérologique à l'échelle individuelle.

#### Mots-clés

Bovin – Brucellose – Brucellose bovine – Éthiopie – Oromiya – Prévalence sérologique – Système agro-écologique.



## Estudio epidemiológico de la brucelosis bovina en tres zonas agroecológicas de Oromia Central (Etiopía)

T. Jergefa, B. Kelay, M. Bekana, S. Teshale, H. Gustafson & H. Kindahl

#### Resumen

Los autores describen un estudio seroepidemiológico transversal de la brucelosis bovina que se llevó a cabo entre septiembre de 2005 y marzo de 2006 en tres zonas agroecológicas bien delimitadas de Oromia Central (Etiopía). Aplicando un método de muestreo por conglomerados en una sola etapa, se seleccionaron un total de 176 grupos (explotaciones agrícolas) y 1.238 animales: 59 grupos y 423 ejemplares de las tierras bajas; 58 grupos y 385 animales de zonas situadas a media altitud; y 59 grupos y 430 animales de las tierras altas. Se extrajeron muestras séricas a un total de 1.238 animales de más de seis meses de edad, muestras que fueron sometidas a las pruebas de aglutinación en placa de rosa de bengala, como método de detección, y de fijación del complemento, como técnica de confirmación de seropositividad por *Brucella*. Además, se pidió a las 176 familias que respondieran a un cuestionario para obtener información sobre la explotación y el ganado.

Los resultados ponen de manifiesto una tasa global de seroprevalencia en los animales del 2,9% (baja): un 4,2% en las tierras bajas, un 1,0% a media altitud y un 3,4% en las tierras altas. Cuantificada para los rebaños, la seroprevalencia global resultó del 13,6% (moderada), con la distribución siguiente: 17% en las tierras bajas, 5,1% a media altitud y 18,6% en las tierras altas.

El análisis de regresión logística reveló que tanto la raza de bovinos como los métodos utilizados normalmente para eliminar los fetos abortivos y las membranas fetales tenían una influencia estadísticamente significativa en la seroprevalencia de los animales ( $p < 0,05$ ). En las tierras bajas, la raza ( $p < 0,05$ ), los métodos zootécnicos ( $p < 0,05$ ) y de apareamiento ( $p < 0,05$ ), el tamaño del rebaño ( $p < 0,05$ ) y el origen de los bovinos de reemplazo ( $p < 0,05$ ) eran otros tantos factores que tenían efectos estadísticamente significativos sobre la seroprevalencia en los animales.

#### Palabras clave

Bovinos – Brucelosis – Brucelosis bovina – Etiopía – Oromia – Seroprevalencia – Sistemas agroecológicos.



## References

1. Alton G.G., Jones L.M. & Piezt D.E. (1975). – Laboratory techniques in brucellosis. World Health Organization (WHO), Geneva, 11-64.
2. Aslaw Y. (1998). – The epidemiological study of bovine brucellosis in intra and peri-urban dairy production systems in and around Addis Ababa, Ethiopia. *Trop. anim. Hlth Prod.*, **46**, 217-224.
3. Baumgarten D. (2002). – Brucellosis: a short review of the disease situation in Paraguay. *Vet. Microbiol.*, **90** (1-4), 63-69.
4. Boschioli M.L., Foulongne V. & O'Callaghan D. (2001). – Brucellosis: a worldwide zoonosis. *Curr. Op. Microbiol.*, **4** (1), 58-64.
5. Bukanzi FR., Zyambo G.C. & Morris S.D. (1993). – A serological survey of bovine brucellosis in the Molopo District of Bophuthatswana. *J. S. Afr. vet. Assoc.*, **64** (4), 154-155.
6. Chantal J., Dorchie Ph. & Legueno B. (1994). – A study on some zoonoses in Djibouti Republic. *Rev. Méd. vét.*, **145** (8-9), 633-640.
7. Chukwu C.C. (1985). – Brucellosis in Africa. Part I. The prevalence. *Bull. anim. Hlth Prod. Afr.*, **33**, 193-198.
8. Chukwu C.C. (1987). – Brucellosis in Africa. Part II. The importance. *Bull. anim. Hlth Prod. Afr.*, **35**, 92-98.
9. Dobrea V., Opris A. & Daraban S. (2002). – An epidemiological and surveillance overview of brucellosis in Romania. *Vet. Microbiol.*, **90** (1-4), 157-163.
10. Ethiopian Ministry of Agriculture (1970). – A review on animal health and production factors. Cited from Dinka (1995), Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
11. Faye B., Castel V., Lesnoff M., Rutabinda D. & Dhalwa S. (2005). – Tuberculosis and brucellosis prevalence survey on dairy cattle in Mbarara milk basin (Uganda). *Prev. vet. Med.*, **67** (4), 267-281. E-pub.: 4 January 2005.
12. Gebremariam K. (1985). – The prevalence of bovine brucellosis on four different farms. Doctor of Veterinary Medicine thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
13. Gebretsadik B. (2005). – Seroepidemiological study of bovine brucellosis in the Tigray Region, northern Ethiopia. Master of Science thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
14. Hadigo K. (1987). – A survey of bovine brucellosis around Bahir Dar. Doctor of Veterinary Medicine thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
15. Hellman E., Staak C. & Baumann M. (1984). – Bovine brucellosis among two different cattle populations in Bahr el Ghazal Province of Southern Sudan. *Trop. Med. Parasitol.*, **35** (2), 123-126.
16. Jiwa F.H., Kazwala R.R., Tungaraza R., Kimera S.I. & Kalaye W.J. (1996). – Bovine brucellosis serum agglutination test prevalence and breed disposition according to prevalent management systems in the Lake Victoria zone of Tanzania. *Prev. vet. Med.*, **26** (3-4), 341-346.
17. Kagumba M. & Nandokha E. (1978). – A survey of the prevalence of bovine brucellosis in East Africa. *Bull. anim. Hlth Prod. Afr.*, **26** (3), 224-229.
18. Kassahun A. (2004). – Epidemiology of bovine brucellosis in cattle and its seroprevalence in animal health professionals in Sidama Zone, Southern Ethiopia. Master of Science thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
19. Kebede F. (1999). – An epidemiological survey of bovine brucellosis in Amhara National Regional State. In Proc. 14th Annual Conference of the Ethiopian Veterinary Association (EVA), 8-9 June, Addis Ababa, Ethiopia. EVA, Addis Ababa.
20. Mainar-Jaime R.C., Muñoz P.M., de Miguel M.J., Grilló M.J., Marin C.M., Moriyón I. & Blasco J.M. (2005). – Specificity dependence between serological tests for diagnosing bovine brucellosis in *Brucella*-free farms showing false positive serological reactions due to *Yersinia enterocolitica* O:9. *Can. vet. J.*, **46** (10), 913-196.
21. Martinez E. & Meja-Terar C. (2002). – Brucellosis in Mexico: current status and trends. *Vet. Microbiol.*, **90**, 19-30.
22. Molla B. (1989). – Seroepidemiological survey of bovine brucellosis in the Arsi region. Doctor of Veterinary Medicine thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
23. Mussie H.M. (2005). – Seroprevalence study of bovine brucellosis in cattle and humans in Bahir Dar Milk shade. Master of Science thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
24. Nakouné E., Debaere O., Koumanda-Kotogne F., Selekon B., Samory F. & Talarmin A. (2004). – Serological surveillance of brucellosis and Q fever in cattle in the Central African Republic. *Acta trop.*, **92** (2), 147-151.
25. Nicoletti P. (1980). – The epidemiology of bovine brucellosis. *Adv. vet. Sci. comp. Med.*, **24**, 69-98.
26. Nicoletti P. (2002). – A short history of brucellosis. *Vet. Microbiol.*, **90** (1-4), 5-9.
27. Ocholi R.A., Kwaga J.K., Ajogi I. & Bale J.O. (2004). – Phenotypic characterization of *Brucella* strains isolated from livestock in Nigeria. *Vet. Microbiol.*, **103** (1-2), 47-53. Erratum: *Vet. Microbiol.*, **104** (3-4), 229-230.

28. Omer M.K., Skjerve E., Holstad G., Woldehiwot Z. & Macmillan A.P. (2000). – Prevalence of antibodies to *Brucella* spp. in cattle, sheep, goats, horses and camels in the State of Eritrea, influence of husbandry system. *Epidemiol. Infect.*, **125** (2), 447-453.
29. Oromiya Agricultural Development Bureau (OADB) (1996). – Herd size pattern and prevalence of brucellosis in central Oromiya, Addis Ababa, Ethiopia. OADB, Addis Ababa, Ethiopia.
30. Pan American Health Organization (PAHO), World Health Organization of the United Nations (WHO) (2001). – Zoonoses and communicable diseases common to man and animals, Vol. I: Bacterioses and mycoses, 3rd Ed. (P. Acha & B. Szyfres, eds) Scientific and technical publications No. 580. PAHO, WHO, Washington, DC.
31. Perry B.D., Randolph T.F., McDermott J.J., Sones K.R. & Thornton P.K. (2002). – Investing in animal health research to alleviate poverty. International Livestock Research Institute, Nairobi, Kenya.
32. Poester F.P., Gonçalves V.S. & Lage A.P. (2002). – Brucellosis in Brazil. *Vet. Microbiol.*, **90** (1-4), 55-62.
33. Radostits O.M., Gay C.C., Blood D.C. & Hinchcliff K.W. (2000). – Veterinary medicine: a textbook of the diseases of cattle, sheep, pigs, goats, and horses, 9th Ed. W.B. Saunders, New York, 867-882.
34. Rashid M. (1993). – Reproductive wastage in cattle due to bovine brucellosis. In Proc. 4th Livestock Improvement Conference, 13-15 November 1991, Addis Ababa. Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia, 270-272.
35. Refai M. (2002). – Incidence and control of brucellosis in the Near East region. *Vet. Microbiol.*, **90** (1-4), 81-110.
36. Renukaradhya G.J., Isloor S. & Rajasekhar M. (2002). – Epidemiology, zoonotic aspects, vaccination and control/eradication of brucellosis in India. *Vet. Microbiol.*, **90** (1-4), 183-195.
37. Rivera S.A., Ramírez M.C. & Lopetegui I.P. (2002). – Eradication of bovine brucellosis in the 10th region de Los Lagos, Chile. *Vet. Microbiol.*, **90** (1-4), 45-53.
38. Shiferaw A. (1987). – The prevalence of bovine brucellosis under different management systems around Shewa, based on serological tests. Doctor of Veterinary Medicine thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
39. Silva I., Dangolla A. & Kulachelvy K. (2000). – Seroepidemiology of *Brucella abortus* infection in bovinds in Sri Lanka. *Prev. vet. Med.*, **46** (1), 51-59.
40. Sintaro T. (1994). – The impact of brucellosis on productivity in an improved dairy herd of Chaffa state farm, Ethiopia. Master of Science thesis. Faculty of Veterinary Medicine, Free University of Berlin, Germany.
41. Taddele T. (2004). – Seroprevalence study of bovine brucellosis and its public health significance in selected sites of Jimma Zone, Western Ethiopia. Master of Science thesis. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.
42. Tekelye B., Kasali O.B., Mukasa-Mugerewa E., Sholtens R.G. & Tamirat Y. (1989). – The prevalence of brucellosis in indigenous cattle in Central Ethiopia. *Bull. anim. Hlth Prod. Afr.*, **37**, 97-98.
43. Thimm B. & Wundt W. (1976). – The epidemiological situation of brucellosis in Africa. *Dev. Biol. Standard.*, **31**, 201-217.
44. Thrusfield M. (1995). – Veterinary epidemiology, 2nd Ed. Blackwell Science, Oxford, 251-281.
45. Wondimu A. (1989). – The epidemiology and economics of bovine brucellosis in the central highlands of Ethiopia. Master of Science thesis. Reading University, Reading, United Kingdom.
46. World Organisation for Animal Health (OIE) (2004). – Bovine brucellosis. In Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, 5th Ed. OIE, Paris.
47. Zewdu E. (1989). – Seroprevalence study of bovine brucellosis in selected sites of Sidamo Region. Doctor of Veterinary Medicine thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

