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Full Length Research Paper

Brucellosis in extensive management system of Zebu cattle in Sidama Zone, Southern Ethiopia

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The study was conducted in six districts of Sidama Zone, Southern Ethiopia. During the study a total of 1627 indigenous zebu cattle in 124 herds were considered from extensive management system. Serum samples collected were screened using Rose Bengal Plate Test (RBPT) and positive reactors were further subjected to complement fixation test to maximize specifity and positive predictive value. In the study, an over all prevalence of 1.66% has been established and the herd level infection rate was 13.70 % (n = 124). Infected herds have been detected from all districts except Arroresa. Accordingly, the rate of seroreactor herds observed were, 33.3% (n = 6) for Awassa, 15.38% (n = 26) for Yirgalem, 13.15% (n = 38) for Aletawendo, 14.29% (n = 14) for Hagereselam and 18.18% (n = 22) for Arbegona in extensive management. Regarding herd size, 4.81% for small, 50% for medium and 70% infection rate was recorded for large herds. The variation between small and large herd size was statistically significant (P < 0.01). In general the study concluded that brucellosis is prevalent at low rate in individual level, while relatively high in herd level and wide in geographic distribution.

Key words: Brucellosis, complement fixation test, extensive management system, prevalence, Rose Bengal plate test, Zebu cattle.

INTRODUCTION

One of the infectious diseases, which is a major constraint for animal productivity, is brucellosis. Animal brucellosis is primarily a disease of ruminants (Cooper, 1991). Brucellosis is a wide spread disease of livestock and human beings resulting in reproductive inefficiency and abortion (Redkar et al., 2001). In dairy production, the disease is a major obstacle to the importation of high yielding breeds and represents a significant constraint to the improvement of milk production through cross-breeding (Mustefa and Nicoletti, 1993). The principal manifestations of brucellosis are reproductive failure such as abortion and birth of unthrifty new born in the female and orchitis and epididymitis with frequent sterility in the male (OIE, 2003).

Despite advances made in diagnosis and therapy, brucellosis is still widespread and prevalent in many developing countries (Mahajan and Kulshreshtha, 1991). Host preference is exhibited by the different *Brucella* species (Quinn et al., 1994). However, a broad host range has been demonstrated for some species. Survival time outside the host is variable and depends on the temperature and moisture. Cold weather extends survival time (Walker, 1999).

According to Nicoletti et al. (1980) and Staak (1990), brucellosis is perhaps one of the most widespread and economically important diseases in tropical and subtropical regions. The direct loss of meat (because of abortion, infertility and weight loss) in infected herds of cattle was estimated to be 15% and for milk (reduction in milk production) 20% per infected cow.

In Africa, bovine brucellosis was first recorded in Zimbabwe (1906), Kenya (1914) and in Orange Free State of South Africa in the year 1915 (Chukuwu, 1985). However, the surveillance and control of brucellosis in sub-Saharan Africa is rarely implemented outside South

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Africa (McDermot et al., 2002). Most surveys have been conducted on selected herds or areas and is therefore very difficult to asses national prevalence's for each country. Yet, it is apparent that bovine brucellosis is wide spread in Africa and in most countries; high prevalence is recorded (Madson, 1989).

The limited number of surveys done in Ethiopia on the prevalence of bovine brucellosis in intensive livestock management has already indicated how important the disease is in different parts of the country. The endemicity of bovine brucellosis in Ethiopia has been gradually established over the last two decades by various researchers; 8.86% in Arsi (Molla, 1989), 15.6% in Sidamo (Zewdu, 1989), 22% in Chafa state farm, Wello (Sintaro, 1994), 8.11% in and around Addis Ababa (Asfaw et al., 1998) and Bekele et al. (2000) had reported as high 19% in Abernossa ranch.

As the disease is hardly spectacular in its chronic stage and despite the losses and yield decrease, its causes often goes undetected. Its negative effect on profitability of cattle production is extremely underestimated particularly in tropical areas in extensive management system (Weidmann, 1991).

Most of the study conducted in Ethiopia concentrated on dairy farm with intensive management system. Therefore, such limited information in extensive farming constituted the rationale for this study, which is supposed to describe the current epidemiological status of the disease in cattle with extensive management system in Sidama Zone, Southern Ethiopia.

MATERIALS AND METHODS

Study area

The study was carried out in Sidama Zone of Southern Nations Nationalities and Peoples Region (SNNPRG). The zone is located in northern part of SNNPRG, with its capital at Awassa, which lies about 275 km south of Addis Ababa. Geographically the zone lies between 4^0 27' and 8^0 30' N latitude and 34^0 21' and 39^0 11' E longitude (SZPEDD, 2001).

Like most parts of Ethiopia, the relief configuration of Sidama ranges from very high mountains to lowland plains, where the altitude varies between 1001 to 3200 m above sea level. The mean annual temperature is 20.1^0C, with monthly means ranging 18.1^0C in November and December to 20.4^0C in March; however, the diurnal variation can be very wide reaching 30^0C in the dry season. The mean annual rainfall is 960 mm, with the rainfall having bimodal regime, that is, two rainy seasons in a year. The small rainy season Belg starts from February to May and the big rain starts from mid June to October.

Livestock population and economic activity

According to Sidama zone agricultural department statistical abstract, the total livestock population of Sidama zone is estimated to constitute 653,100 cattle, 316,620 goats, 404,130 sheep and 194,530 equines. As elsewhere in rural Ethiopia, the economic life of the people in the zone is mostly dependant on mixed farming in that 93% of the population is engaged in agriculture.

Livestock production occupies an enormous share in farm economy. The high and mid Landers are sedentary while transhumance is the style for lowlanders.

Study animal and study design

A seroepidemiological study was carried out in six districts of Sidama zone from September 2003 to April 2004. A standard questionnaire format was used to collect information relevant to the epidemiological investigation such as age, sex herd size and reproductive disorders. The study subjects included Zebu cattle reared in extensive management system. Blood samples were collected from breeding animals above six months of age. Screening of serum was done using Rose Bengal Plate Test (RBPT). Sera testing positive, were tested further by Complement Fixation Test (CFT). This serial testing maximizes specificity and predictive value of positive test result (Table 3).

A cross sectional epidemiological study was carried out to determine prevalence of bovine brucellosis and the role of risk factors like age, sex and herd size, under extensive management system. To this effect herd of cattle was categorized in the following groups based on herd size: small (1 - 15 animals), medium (16 - 30 animals) and large (>30 animals) herds. Based on this 104 small, 10 medium and 10 large herds were identified.

A total of 1627 indigenous animals found in 124 herds kept under extensive management were sampled randomly. 1602 were females while 25 were bulls and all animals sampled were above six months of age. The age stratification was made into 0.5 < 2 years, 2 - 4 years and >4 years.

Serological tests

Rose bengal plate test

Serum of 30 µl was mixed with an equal volume of antigen on a white tile or enamel plate to produce a zone approximately equal to 2 cm in diameter. The mixture was rocked gently for four minutes at ambient temperature and then observed for agglutination. Any visible reaction was graded positive and otherwise negative (OIE, 2003).

Complement fixation test

The test was conducted at the National Veterinary Institute-Debre Zeit and preparation of the reagents was made according to protocols of the procedure. Antigen, control sera and complement were obtained from the BgVV, Berlin, Germany.

Sera with strong reaction, more than 75% fixation of complement (3+) at a dilution of 1:5 and at least with 50% fixation of complement (2+) at a dilution of 1:10 and at dilution of 1:20 were classified as positive (OIE, 2003).

Data analysis

Data from the laboratory results and questionnaires were stored in personal computer micro soft excel spreadsheet program. Descriptive statistical analysis of various risk factors and dependant variables were done using Intercooled STATA 7.0 (Stata Corporetion, 2001). The chi-square test or Fisher's exact test were used to test *Brucella* seroprevalence rate and reproductive disorders association with incriminated categorical risk factors. Variables with substantial biological relevance were subjected to multiple logistic regression models to see whether there was a trend of association with the specified independent variable.

Table 1. Bovine brucellosis infection rate and attributed risk factors.

Variable	Category	Sample size	No. and (%) positive reactors	95% CI
Age	0.5 < 2	203	1 (0.49)	0.01-2.71
	2 - 4	302	4 (1.32)	0.36-3.35
	>4	1122	22 (1.96)	1.23-2.95
Sex	Male	25	1 (4.00)	0.10-20.35
	Female	1602	26 (1.62)	1.06-2.36
Herd size	1 - 15	696	7 (1.00)	0.40-2.06
	16 - 30	253	6 (2.37)	0.87-5.09
	>30	678	14 (2.06)	1.13-3.44
Area	Awassa	274	7 (2.55)	1.03-5.19
	Yirgalem	313	6 (1.92)	0.71-4.12
	Aletawendo	254	5 (1.96)	0.64 -4.55
	Hagere selam	242	4 (1.65)	0.45 -4.17
	Arbegona	310	5 (1.61)	0.52 -3.72
	Arroressa	234	0	0-1.56
Total		1627	27 (1.66)	1.09 -2.41

P > 0.05.

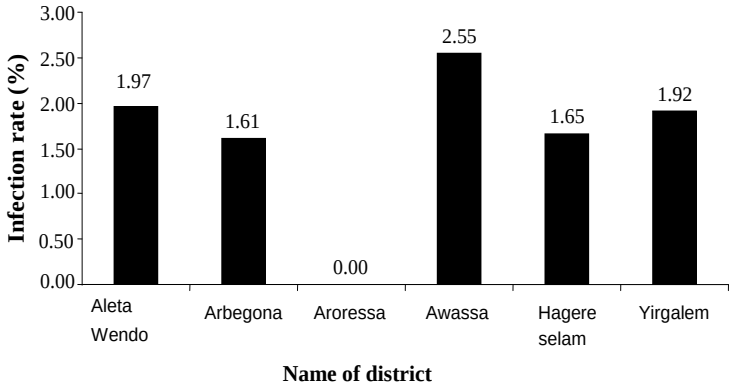

Figure 1. *Brucella* infection rate in the different districts.

RESULTS

Individual level seroprevalence

In individual seroprevalence, 1.66% (n = 1627) of the cattle were seropositive with their antibody titer ranged between 1:16 to 1:1024. The brucellosis infection rate was 2.55% (n = 274) for Awassa, 1.92% (n = 313) for Yirgalem, 1.96% (n = 254) for Aletawendo, 1.65% (n = 242) for Hagereselam and 1.61% (n = 310) for Arbegona. Reactors were not recovered from Arroresa district (n = 234) (Table 1 and Figure 1).

Risk factors and brucellosis status

Age

The seroprevalence rate was 0.49% for 0.5 < 2 years, 1.32% for 2 - 4 years and 1.96% for age group above 4 years (Table 1). The difference in infection rate among age groups was not significant (P > 0.05).

Sex

The seroreactor females were 1.62% (n = 1602) and one of the bulls (4% = 25) was positive. In extensive system most of the bulls were castrated, as part of traditional breeding management and sampling of more number was not made.

Herd size

The large herd (>30 animals) was found to have an infection rate of 2.06%. A prevalence rate of 2.37 and 1% were observed for medium (16 – 30 animals) and the

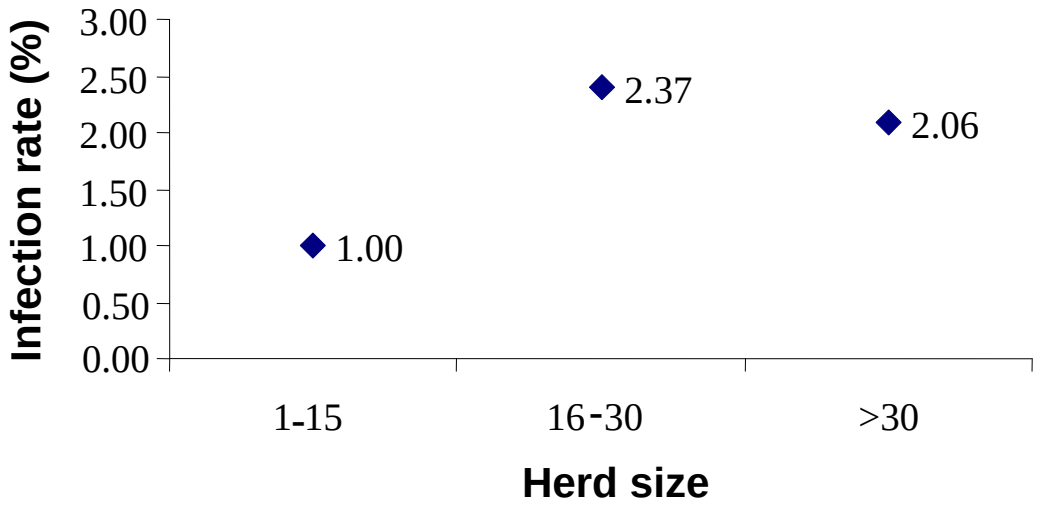

Figure 2. *Brucella* infection rate versus herd size in extensive management.

Table 2. Distribution of herd level infection in extensive management.

District	Herd size	No. of positive herds	Infection rate	95% CI
Awassa	6	2	33.33	4.32 - 77.72
Yirgalem	26	4	15.38	4.35 - 34.86
Aletawendo	38	5	13.15	4.41 - 28.08
Hagere selam	14	2	14.29	1.77 - 42.81
Arbegona	22	4	18.18	5.18 - 40.28
Arroresa	18	0	0	0 - 18.53
Total	124	17	13.70	8.19 - 21.04

small (1 - 15 animals) herd, respectively (Figure 2).

Herd (farm) level seroprevalence

Out of the 124 herds sampled, 13.7% were found to be positive. The herd infection rates on districts basis were 33.33% (n = 6) for Awassa, 15.38% (n = 26) for Yirgalem, 13.15% (n = 38) for Aletawendo, 14.29% (n = 14) for Hagereselam and 18.18% (n = 22) for Arbegona. In Arroresa (n = 18) all herds were negative (Table 2). A herd was defined as positive, if at least one animal is positive to both screening and confirmatory tests. Based on this, there was one herd with five reactors, four herds with two reactors, one herd with 3 reactors and 11 herds with one reactor.

In line with this, 4.81% (n = 104), 50% (n = 10) and 70% (n = 10) were the infection rates for small, medium and large herds, respectively. The variation here is apparently justified in univariate analysis between the small and large once ($P < 0.01$) and between medium and small ($P < 0.01$) but not between large and medium ($P > 0.05$) (Figure 3).

Questionnaire result

This aspect of the questionnaire evaluation was made both on individual and herd basis to produce an overview on the reproductive disorder. To this effect, data were collected on the presence of reproductive disorders (abortion, still birth and retention of fetal membranes).

Reproductive disorders and status of brucellosis

Since there was no farm with a record of health and reproductive parameters, it was hardly possible to evaluate all the reproductive performances. Therefore, the existing reality of the management system, limited the scope of the evaluation to major reproductive disorders that can be recalled. These were abortion, still birth and retained fetal membrane without abortion or still birth.

Reproductive disorders were reported from 20.96% (n = 124) herds. Among the herds that suffered any one of the specified disorders 79 animals in 13 herds were available for sampling. Of these animals 1.26% (1/79) was found to react positive for both RBPT and CFT in a

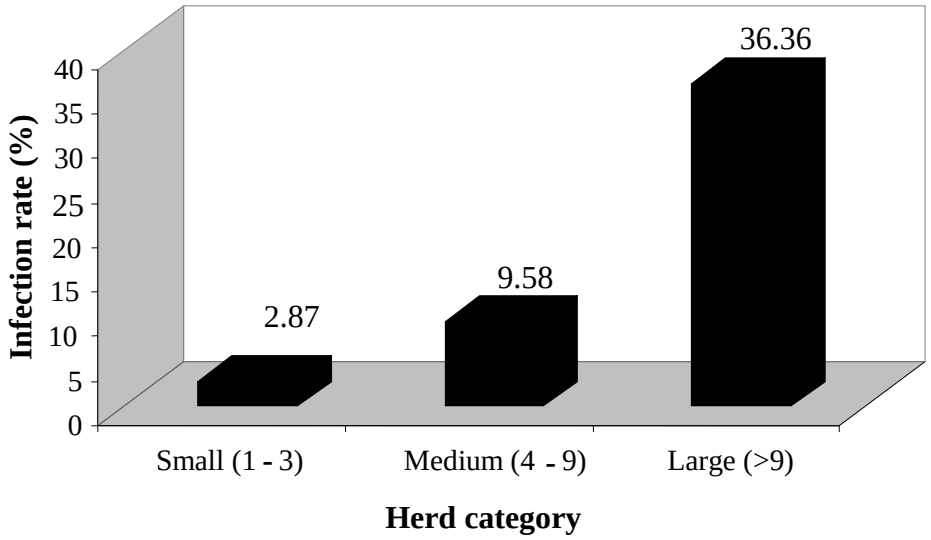

Figure 3. Relationship of herd category with *Brucella* infection.

Table 3. Reproductive disorders and seroreactors.

No	Reproductive disorders	No of animals sampled	No herds reported to have the disorders	Seroreactors	
				RBPT	CFT
1	Abortion	39	11	1	1
2	Still birth	8	6	3	-
3	Placental retention with out abortion /still birth	32	9	-	-
Total		79	26	3	1

herd. Sampling could not be made in the remaining herds, as animals that suffered reproductive disorders were not available for one or another reason.

DISCUSSION

Individual level brucellosis infection rate

The study discloses that, the prevalence of bovine brucellosis in extensive management system is found to be low. In a similar management system there are reports that agree with this finding. Shiferaw (1987) in Shoa, Wondimu (1989) in the central high lands of Ethiopia, Kebede (2000) in Eastern Amhara National Regional State observed infection rates of 1.5, 3 and 1.8%, respectively, in local breeds kept under extensive management. The lower prevalence report of tropical high land (2%) (Omer et al., 2000b) showed similarity among traditional management systems in this regard. In the area where sedentary livestock raising is predominant, the herd size and interaction among herds was limited to village level at most.

The low level infection rate found in this study was at variance with works of various investigators done in Ethiopia on intensive management involving Friesian and their crosses (Wondimu, 1989; Rashid, 1993; Sintaro, 1994; Asfaw et al., 1998 and Bekele et al., 2000). Wondimu (1989) reported a prevalence rate of 15% from central Ethiopia in crosses of Friesians. Rashid (1993) from IAR (Institute of Agricultural Research) and Sintaro (1994) from Chafa state farm reported 38.7 and 22% infection rates respectively in intensively managed Friesian crosses. A prevalence rate of 8.11% in and around Addis Ababa was observed by Asfaw et al. (1998) and infection rate of 10.8% at Agarfa state farm was reported by Bekele et al. (2000). The varation may be due to disparity in management and /or breed.

Risk factors

Age

The majority of the reactors (96.3%, n = 27) were detected in age strata above 2 years. This is a clear indication of age and sexual maturity being important determinants of the disease (Weidmann, 1991; Walker, 1999). The rise of infection exhibited as age advances

agree with reports of Bekele et al. (2000), Omer et al. (2000a), Asfaw et al. (1998) and Hellman et al. (1984). Bekele et al. *(*2000) could detect no reactor in animals less than 2 years. However, the prevalence rose from 1.7% in 2 - 4 years to 11.5% above 6 years, in Southeast Ethiopia. In and around Addis Ababa, Asfaw et al. (1998) had also reported 1.3 and 4% infection rate in the age range below 2 years and above four years, respectively. The recent 8.5% infection rate report of Omer et al. (2000a*)* in Eritrea disclosed similar phenomenon in age between 2 - 4 years and no reactor below. The highest infection rate in Dinka cattle (10.4%) and Felata cattle (26.2%) lie in the age range 4 to 8 years and the lowest rate in age less than two years (Hellman et al., 1984).

Sex

The infection rate for females was found to be lower (1.62%, n = 1602) compared to male (4%, n = 25) reactors. The finding here differ from the general agreement (Nicoletti, 1980; Asfaw et al., 1998). The presence of wide castration practice limited the number of male sample size. The tendency of keeping low number of bulls has also been observed in extensive management (Omer et al., 2000a). The reason could be cost and/or additional husbandry practices in traditional breeding practices in extensive system. In this study, bulls were considered not to miss important information. In this regard, Lema et al. (2001) emphasized the high frequency of disease conditions in bulls that requires cautious consideration. However, due to very small number of animals involved, the finding here regarding sex is not conclusive.

Brucellosis infection rate on herd level

In this study much of the herds (70.59%) were considered positive on the presence of at least one reactor. In case of brucellosis, without any control measures, the intra herd rate of infections is more likely to increase with time, either with an exponential epizootic shape or with slow enzootic shape depending on the prevailing epidemiological situations (Nicolleti, 1980).

Herd (farm) level infection rate is high. Analysis made on herd level infection rate however, came up with a different scenario. To this effect, a positive herd was defined as any herd with at least one seropositive animal, and categorization of farms into small, medium and large is similar to individual analysis but the units here are herds not individual animals.

The association of infection rate in this study with the large, medium and small herds has statistical support ($P < 0.01$). In general, the herd level infection rate rise in parallel with the farm size increment was in agreement with reports of past studies. Asfaw et al. (1998) had reported infection rates of 17.6, 100 and 100% for small, medium and large farms, respectively. The report of Bekele et al. (2000) in southeast Ethiopia was holding similar fact with 16.7, 35.7 and 75% for small, medium and large farms, respectively. The situation in extensive management is similar, high infection rate for large followed by medium and small herds was observed. The difference observed between categories was strong enough to predict the hypothesized association of herd size to infection rate statistically.

This relationship is rationalized by the intense animal contact within the herd and especially following abortion (Nicoletti, 1980; Walker, 1999). Despite the variability what a large herd is, it is generally accepted that an increase in herd size is usually accompanied by increase in stoking size (Omer et al., 2000a). Hellman et al. (1984), too, indicated that a high level of infection rate of bovine brucellosis was usually found in large herds compared to small herds.

Regarding reproductive disorders, there is an indication (20.96% of herds (n = 124)) for the presence of reproductive disorders being an important problem of the livestock raising practice in the area. However, the lack of record keeping made the investigation uncertain as to how brucellosis is associated with the disorders.

CONCLUSION AND RECOMMENDATIONS

The seroepidemiological study has established a low infection rate of bovine brucellosis in extensive management system. The disease has been detected in all districts except Arroresa. Due to this low level of infection rate, no risk factor could demonstrate distinct epidemiological association with brucellosis infection on individual basis apart from age.

The relative high herd level infection rate together with recovery of seroreactors in all districts except Arroresa, is a clear indication of its wide distribution. Brucellosis being an infectious and contagious disease, the time it needs to develop into major health and reproductive challenge will not be too far.

Brucellosis must not be viewed as a disease of an individual animal, rather always in the context of the herd and the animal population of the region. In line with the current concept of “disease free zone” establishment in the country, brucellosis should be realized. To this effect, a law should be enforced to test all herds for brucellosis and accreditation should be given accordingly. Intensive surveys and surveillances should be made for the better evaluation of brucellosis in the area.

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