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Sero-Prevalence of Foot and Mouth Disease of Cattle in Bale Zone, Oromiya Regional State, Ethiopia

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Abstract: A cross sectional study was conducted from November 2007 to April 2008 in three districts of Bale Zone, Oromiya regional state to determine seroprevalence of Foot and Mouth Disease virus and to obtain local perception regarding the disease in the study area. A total of 301 bovine serum samples were collected from two districts and one dairy farm (Sinana 172, Goba 109 and Agarfa dairy farm 20). Semi structured questionnaire format was prepared and 80 informants were interviewed. Out of 301 serum samples examined at National Veterinary Institute by 3ABC ELISA 65 (21.59%) were positive for the disease FMD. The highest prevalence was observed at Sinana (24.41) followed by Goba (20.18%) and Agarfa dairy Farm (5%). The difference in prevalence between these sites was statistically non-significant (P= 0.066). The prevalence among age category and breed type was calculated and there is no significant difference (P=0.539 and P= 0.599 respectively). Semi structured interview result showed that out of 80 informants, 74 have described a consistent and valid clinical picture of FMD and other epidemiological information similar with other scientific literatures. The present prevalent study generated valuable information on the epidemiology of FMD in the study area. Since the study revealed high prevalence, implementing control of FMD with an integrated approaches have paramount importance in the study sites.

Key words: Sero-Prevalence · Foot and Mouth Disease · Cattle · Ethiopia

INTRODUCTION

Ethiopia is a country whose agricultural sector is the biggest to its grand domestic product (GDP) and the major contributors to its export earnings. Currently the contribution of this sector to GDP and export earning is 48% and 90%, respectively [1]. The country possesses the biggest number of livestock in Africa, with an estimated above 44 million cattle, 48 million small ruminants, 2 million camel, 7 million equine and 52 million chicken [2].

Although the contribution of the livestock sector to the national economy is quite high the productivity of this huge resource is below the Africa average and has been supplying less amount of livestock and livestock products to the national market due to certain infrastructural defects, uncontrolled and illegal livestock trading and presence of various zoonotic and contagious trans boundary epidemic diseases among which FMD is one of the most disease limiting export [3].

Foot and Mouth disease, also known as aphthous fever, was the first animal viral disease established [4]. According to the office international des epizooties (OIE), FMD ranks first among the notifiable infectious diseases of animals [5,6] FMD is caused by the virus of the genus Aphthovirus (from the Greek Aphtho means vesicles in mouth) within the family Picornaviridae [6, 7].

Foot and mouth disease (FMD) has been found to be the most contagious disease of animals and has great potential for causing heavy losses in susceptible cloven-hoofed animals [8].

FMD in cattle in Ethiopia was first recorded by Food and Agricultural Organization and world Reference Laboratory (FAO and WRL), which indicated that FMD

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serotypes O, A and C were responsible for FMD outbreaks during the period of 1957 to 1979 [9]. The antibodies of SAT2 also were detected in 1971, in sera collected from cattle in the region now known as north Omo, southwestern Ethiopia [10]. According to the annual report of Animal Health Division of Ministry of Agriculture in 2000, the incidence of FMD outbreak has increased by 1.3-1.5 folds since 1990. More recently, four FMD serotypes were isolated and reported in Borana pastoral area, Oromiya region. These serotypes include A, O, C and SAT_2 [1].

In Ethiopia, outbreak of FMD frequently occurs in the pastoral herds of the marginal low land areas of the country [11]. This is mainly due to absence of vaccination programs, absence of livestock movement control and absence of systematic disease surveillance and reliable epidemiological data. It is however likely that the disease is under reported due to comparatively high tolerance of local breeds to the clinical episodes of the disease [12]. Therefore, it seems that FMD is more prevalent and has been one of the major causes for considerable economic losses of the rural communities in the country. However, it is important to note that only small percentage of the outbreaks are reported and typed in Ethiopia. Therefore, the above figure acutely underestimates the actual problem caused by the disease during the period [11]. Despite the wide spread and enormous economic importance of FMD, clinical and serological studies to characterize the disease under the existing local conditions have never been exhausted and the endemic level is not well established. The extent to which a disease is recognized as a problem is often dependent on the efficacy of the means for diagnosing it and observing its occurrence [13]. Therefore, the objectives of the study were to determine the sero-prevalence of FMD in Bale Zone and to know perceptions of local communities about the disease.

MATERIALS AND METHODS

Location of Study: The study was conducted from November 2007 to April 2008 in Bale Administrative Zone of Oromiya Regional State, which is located 430 kms southeast from the capital city, Addis Ababa. Bale zone is bounded by four Oromiya Zones and Somali Regional State: West Arsi zone in the north, Guji zone in the south, Somali Regional State and West Hararge zone in the east and West Arsi Zone in the West.

The study area is located at an altitude range from 300 to 4377 masl and falls between 38°40′-46°3′ E longitude and 4°11′- 8°11′ N latitude. The mean annual rainfall and mean day and night temperature ranges 1100-1300mm and 3.5°C-30°C, respectively. The climatic condition is marked by two distinct seasons: Long rainy season which extends from June to early October and short rainy season between late February to early April. Dry season runs from December to May except for the short rainy season. But the low land (Pastoral) areas get rain only in spring and autumn which covers 9 districts of the Zone [14].

Bale is the paradise of culture, nature lovers, the habitat of different variety of endemic mammals and bird species, from which Bale Mountains National park alone harbors over 46 mammals and 260 bird species in which precious endemic mammals, mountain Nyala, Red fox, Bushbuck and variety of endemic birds inhabit. Moreover, the area is endowed with features of tourist attractions, namely; Dire Shek Hussein, Sofe-Omar cave and Madda walabu. Bale Mountains National park is a cascading mountain streams being the largest Afro-alpine habitat park in Africa with a vegetation of unspoiled wonder land [15].

Bale Zone is rich in livestock resource having huge number of animal population of various species. The clay-loam soil type favors the crop farming mainly wheat, barely, teff, maize, etc. There are two farming systems exercised namely pastoralism and agro-pastoralism except with small scale dairy farms located around towns. Livestock population is estimated to be 1.5 million cattle, 645,000 sheep and goats, 210,000 equine, 126,000 camels, 376,000 poultry and 193,000 bee colonies [16].

Animals: Cattle from two districts and one dairy farm (Sinana district, Goba district and Agarfa Dairy farm) were included. Both breed types, Holstein-Zebu cross and local breeds of mixed age and sex groups were included for the study in the random sample collection. Even though sample taking from very young calves (<6 months) was practically found to be difficult, sampling was designed by categorizing animals in to two age groups (i.e. young and adult cattle).

Study Design: Cross sectional study with random sampling was conducted to determine the sero-prevalence of FMD from 18 districts in Sinana and Goba and Agarfa dairy farm. Both questionnaire survey and conventional

veterinary investigation methods were applied to generate information on FMD. Questionnaire survey was conducted by preparing a format concerning FMD and asking selected farmers at veterinary clinics and vaccination centers. Additionally animal health assistants and technicians were interviewed about the occurrence and outbreak reports of FMD in their respective districts. Conventional investigation of FMD was conducted using 3ABC ELISA technique to determine sero-prevalence of the disease in the area.

Samples: For sample size estimation, Win-Episcope-2.0, Improved Epidemiological software for veterinary medicine was used [17] based on the following information:

Expected prevalence (P_{exp}) of 12.3%
Absolute precision (d^2) of 4%
95% confidence level

$$\frac{n = 1.96^2 \times P_{exp}\ (1-P_{exp})}{d^2} = \frac{1.96^2 \times 0.123(1-0.123)}{(0.04)^2} = 259$$

Thus, the sample size of 259 was determined however, maximized to 301 to increase precision and accuracy.

Blood Samples: Blood sample was collected from jugular vein of individual animal using 10 ml capacity of non-heparinized vacutainer tube. After taking the sample, each tube was labeled with specific code written on a waterproof adhesive tape attached to each sample. The sample was kept at room temperature overnight and serum was harvested in to another sterile tube and stored at -20°C until the day of dispatch. Finally, transported to National Veterinary Institute (NVI), Immunology laboratory by using an icebox containing icepacks and then stored again at -20°C until the ELISA test was conducted.

Semi-Structured Interview: Since there was no study conducted in Bale Zone on seroprevalence of FMD, a questionnaire format was prepared and additional information was generated by interviewing farmers, Animal Health Assistants and technicians about the occurrence and clinical presentations of FMD in cattle was assumed to support the conventional laboratory result of the study.

Laboratory Methods: The serological test conducted for the sero-prevalence of FMD was the 3ABC-ELISA. It provides a rapid, simple, sensitive and specific method for detecting antibodies against the pathogen responsible for FMD in serum samples of bovine origin. In the FMD 3ABC-ELISA kit, all the necessary reagents for a standard indirect ELISA technique were included with polystyrene micro-tire plate pre-coated with recombinant FMD Virus 3ABC protein [5].

Dilutions of samples to be tested are incubated in the wells. Any antibody specific for 3ABC protein binds to the antigen in the well. A peroxidase labeled anti IgG conjugate was added which binds to antibodies of the samples interacted with the antigen. The TMB-containing substrate was added to wells. Then, a stopping solution was added to the wells to stop the reaction.

The degree of color development was measured by a photometer (ELISA reader) which registers the optical density (OD value) of each well. In this assay, adequate washing procedures were under taken in order to remove unbound reagents at each step of the testing procedures.

TMB-stopped the reaction and the result was read using a spectrophotometer at 450 nm wavelength with in 2 hours of adding the stopping solution. The reader was connected to the computer loaded with ProComm and a word package was used to automate the reading of OD values. The percentage positivity (pp) for test samples in relation to the negative and positive controls was calculated as follows:

PP value = OD sample - OD negative x 100%
OD positive – OD negative

The cut off value provided by the Manufacturer was used to determine the percentage positivity. Prevalence was defined as the proportion of number of animals positive for antibody against Foot and Mouth Disease virus by the 3ABC ELISA test to the total number of animals tested, which was expressed as percentage.

Statistical Analysis: For data analysis, data entry was made on excel sheet and analyzed using Intercooled Stata 7.0 with statistical test logistic regression to assess risk factors associated with sero-positivity of the disease in the study area. In all the analysis confidence level was at 95% and $P \leq 0.05$ was set for significance.

RESULTS

Out of 301 sera tested using 3ABC ELISA test, overall FMD sero-positivity was found to be 21.59% of which 24.41% (42/172), 20.18% (22/109) and 5% (1/20) for Sinana district, Goba district and Agarfa dairy farm,

Table 1: Sero-prevalence of FMD in three sites of Bale Zone

Sites	No. of samples Examined	No. of sero-positive	Prevalence (%)
Sinana	172	42	24.41
Goba	109	22	20.18
Agarfa dairy farm	20	1	5
Total	301	65	21.59

(X^2=3.61; P= 0.066)

Table 2: Sero-prevalence and chi-square test analysis on the basis of age group

Age group	No of samples Examined	No of sero Prevalence	Positive (%)
Adult	242	54	22.31
Young	59	11	18.64
Total	301	65	21.59

(X^2= 0.38; P=0.539, at 95% CI)

Table 3: Sero-prevalence and X^2 test analysis on the basis of breeds

Breed	No of Samples Examined	No of sero Positive	Prevalence (%)
Local Arsi	195	44	22.56
Cross	106	21	19.81
Total	301	65	21.59

(X^2= 0.31 P= 0.573)

Table 4: Semi-structured interview (SSI) result obtained from the community of the area

District	No of informants Interviewed	Consistent and valid response	Percentage (%)
Sinana	50	48	96
Goba	30	26	87
Total	80	74	93

respectively (Table 1). Based on analysis using logistic regression, the difference in prevalence between the sites was not statistically significant (P= 0.066, X^2= 3.61).

Sero-prevalence status of FMD on the basis of age group was examined and prevalence was found to be statistically not significant (p>0.05). But the prevalence was higher in adults than in young's, with 22.31% and 18.64%, respectively (Table 2).

The difference in prevalence between local-Arsi and Zebu-Holstein cross breeds was statistically not significant (P> 0.05, X^2=0.31); But relatively higher in local Arsi than cross breed (Table 3).

The result of semi-structured interview conducted showed that local perception of the community regarding the disease FMD was very high. Out of 80 informants interviewed, 93% (74/80) have described valid and consistent clinical picture of FMD with mortality and morbidity status similar with what is found in Veterinary literature (Table 4).

DISCUSSION

Variation in the sero-prevalence of FMD in the present study from previous investigations might be attributed to variations in the study methodology, sample size, study population and site and other factors. From the questionnaire survey result, 93% (74/80) of informants described well most of the local perceptions of the disease signs the indigenous epidemiological knowledge that the FMD occurs usually during dry season when feed is no available. The clinical signs listed were consistent with what is indicated in veterinary literatures [18-20]. In Ethiopia, similar signs have been reported in pastoral cattle of Afar [21] Somalia [22] and Oromiya [1] regional states. The information obtained from the community indicated that the incidence of occurrence of FMD increases as age increases. This may indicate the cumulative experience of the population with the agent [23]. The survey also showed that the disease was fatal in young than adult animals and seasonal incidence was high during dry months of the year. This seasonal pattern and age as a factor was also inconsistent with the result obtained from Borana pastoral area by Tesfaye [1].

In the present study, an overall sero-prevalence of FMD in Bale (two districts and one dairy farm) was 21.59%. This result is lower than the previous study in Ethiopia by Mesfin [16] who reported the prevalence rate of 26.5% in pastoral lowland areas. This difference might be attributed to the type of animal management practice, where in the pastoral low land areas animals move from

place to place in search of feed and water unlike that of Bale high land where cattle are relatively managed under settled way of production. However, the result of the present finding was in agreement with the finding of Tesfaye [1] who reported sero-prevalence of 21% in Borana pastoral area.

The result of the present study is much higher (21.59) than another study by Bediru [24] on quarantined bulls for export at Nazareth and Dire Dawa stations which was 5.53%. Because, this study was conducted on herd level in extensively kept animals and the result was higher than quarantined bulls where these animals may be originated from farms (intensively kept) animals that restrict movement and all age and sex groups were involved in the present study.

The highest district level sero-prevalence of 24.41% (42/172) recorded in Sinana district when compared to Goba district 20.18% (22/109) and Agarfa Dairy farm 5%(1/20) (Table 1) reflects the higher population density and large cattle market which permits possible mixing of animals from different origins. Besides the less population density in Goba district, the cascading mountain topography might also lowers the spread and transmission of the disease unlike that of plane topography of Sinana district which is considered as dry season refuge for cattle from different origins.

The lower prevalence rate of 5% (1/20) in Agarfa dairy farm might be associated with the confinement of the farm animals that limits contact with other neighboring herds and thus, results in reduction of the prevalence rate in the farm than the extensively free grazing herds in the Sinana and Goba districts. Moreover, other attributes might be that the sample size of the two districts and the dairy farm were not proportional and also sick animals were included in sampling from Sinana district.

In this study, the prevalence of FMD in adult age group was higher than young group although statistically non-significant (Table 2). This might be because adults have acquired the infection through repeated exposure to the different serotypes of the virus and could get access to mix with other herds at market places and communal pasture land. Conversely, young's have low frequency of exposure to the virus and prevailing passive maternal immunity can give them protection against the disease.

Breed variation in the sero-prevalence of FMD between local and cross breads were found to be statistically non-significant. However, the higher prevalence in local Arsi breed than that of cross breed might be attributed to large herd size of local Arsi breed with uncontrolled movement and extensive management unlike that of relatively controlled movement in cross breeds with confinement. Moreover, the proportion of samples taken from local breeds might also contribute to this high prevalence.

CONCLUSION

The result of the serological survey in the study area showed that the difference in prevalence among age and breed categories has no statistical significance which indicates the disease affects all age groups and breeds. Even though the prevalence level was higher in adult local Arsi breed, clear clinical picture was observed in Holstein cross breed. The level of sero-positivity in the present study and economic loss due to morbidity and mortality described by the community justify some means of control program in the area.

As FMD is prevalent in the study area, further study should be conducted to assess the economic impact of the disease and to implement appropriate control measures. Identification of circulating strains in the area should be further studied in order to undertake vaccination program, perception of local communities as to the importance of the disease with participatory appraisal should help to complement the epidemiological investigation in the control and prevention of the disease.

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