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Research Article

Sero Prevalence of Bovine Foot and Mouth Diseasesin in Bale Zone Selected Districts Sinana and Agarfa Oromia, Ethiopia

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Abstract

Ethiopia is country with the most abundant livestock population in Africa with an estimated domestic animal number of 56.71 million cattle. The Foot and mouth disease (FMD) virus is a highly contagious and economically devastating transboundary disease of cloven hooved domestic and wild animals. The Foot and mouth disease virus, the causative agent of foot and mouth disease belongs to the genus Aphthovirus and the family Picornaviridae. It has seven sero types, namely: O, A, C, South African Territories (SAT) SAT1, SAT 2, SAT 3, and Asia

The study was conducted from January 2022 to February, 2022 in two selected districts of Bale zone namely Sinana and Agarfa which are Located in the administrative zone of Oromia Region, Ethiopia. The study populations were local and cross breed of cattle above the age of six months having no clinical symptom of any disease were included. A cross sectional study design was take place to determine the sero-prevalence of FMD. The present study was considered 50% expected prevalence, 95% confidence level and 5% absolute precision or marginal error. Whole blood samples each approximately amounting to 8-10ml were collected from jugular vein of cattle using disposable needles and 10 ml non-heparinized vacutainer tube and 21 Gauge needle. The collected sera were tested by commercially available FMD NSP competitive ELISA kit (Non-structural proteins used as DIVA test) (ID Screen(r) FMD NSP Competition, ID-VET, Grabels, France) for the detection of antibody to 3ABC poly-protein. A total of 461 serum samples were collected and tested for FMD. Over all 103 samples gave positive results yielding a prevalence of 22.34 %. Of the samples collected from Agarfa 25.97 % (60/231) were positive whereas of the 18.70 % (43/230) samples collected from Sinana were found positive. The presence of this disease in the country is a major obstacle to the development of livestock resource because of its adverse effects on production and their product exports. An extensive regular surveillance and serotyping of the FMD isolates throughout the country should be conducted to check the introduction and circulation of new serotype in the country.

Key words: foot and mouth disease (fmd); sero-prevalence; competitive elisa kit

1.Introduction

Ethiopia is country with the most abundant livestock population in Africa with an estimated domestic animal number of 56.71 million cattle [1]. The Foot and mouth disease (FMD) virus is a highly contagious and economically devastating transboundary disease of cloven hooved domestic and wild animals [2]). FMD is also among the most important livestock diseases that affects production and trade of animal and animal products in Ethiopia [3]. Sero-surveys done in different parts of Ethiopia reported FMD with different degrees of prevalence reaching up to 26% (6–9). Outbreak incidence studies have also indicated that FMD occurs throughout the country with significant variation in geography and production systems[3] (Jemberu *et al*., 2016). Among the seven serotypes of FMDV, four of them (O, A, SAT 2, and SAT 1) have been reported in Ethiopia in recent times [1].

The Foot and mouth disease virus (FMDV), the causative agent of foot and mouth disease (FMD), belongs to the genus Aphthovirus and the family Picornaviridae. It has seven serotypes, namely: O, A, C, South African Territories (SAT) SAT1, SAT 2, SAT 3, and Asia [4]. The highly infectious nature of the virus, the generation of high titers in respiratory secretions, the prolonged survival of the virus in secretions, the fast replication cycle, and the brief incubation time contribute to the virus's rapid dissemination to fully susceptible populations. In addition to the animal-to-animal transmissions, FMDV is easily transmitted mechanically via fomites such as clothes, shoes, vehicles, and veterinary instruments [5]. Moreover, its spread is aggravated by uncontrolled movements of infected animals across geographic

boundaries [6]. In Ethiopia, the disease has been affecting mainly cattle, while also causing problems in small ruminants at infrequent intervals [7].

Historically, the disease was first identified in 1957, but it had certainly been present in the country before that, since most livestock keepers were familiar with it and some were using traditional methods of immunization against it, such as "mouthing [7]. According to the report of [8] FMD serotypes O, A, and C were responsible for FMD outbreaks from 1957 to 1979. A separate report on the genetic characterization of FMDV from 1981 to 2007 disclosed additional serotypes such as SAT 1 and SAT 2. The occurrence of the disease leads to loss of production, restriction of exports, and other socio-economic problems in the area [9].

Direct impact of FMD includes meat and milk production losses, loss of drought power, lower weight gains, fertility problems, changes in herd structure, delay sale of cattle and products, and death of cattle, while the indirect impacts include additional cost of treatment, vaccination, vaccine delivery, movement control, diagnostic tests, culled cattle, and denied access to both local and international markets [10]. FMD currently is widely prevalent and distributed in all areas of Ethiopia across the different farming systems and agro ecological zones of the country. Previously, the disease used to frequently occur in the pastoral herds of the marginal low-land areas of the country. However, this trend has changed, and the disease is frequently noted in the central/highland parts of the country [11] . Sero-prevalence investigations undertaken so far in the different parts of the country reported the prevalence that ranges from 5.6% to 53.6% in cattle [12] . In the current study area, knowing the status of the disease is very important because of a high cattle population and cattle marketing activities, the practice of communal grazing and watering and cattle movement.

FMD is endemic to most countries in sub-Saharan Africa and will not be eradicated from southern East Africa while infected buffalo are present with the exception of few countries Southern Africa, where the disease is controlled by the separation infected wild life from susceptible livestock as well as by vaccination. Largely due to the endemicity of the disease and the fact that FMD does not cause high mortality rates in adults animals which is (2%) and 20% in young animals. Number of countries now realizes that FMD is one of the transboundary diseases that should be controlled to ensure economic stability and access to lucrative international export markets for animal and animal products. Furthermore, they recognize that a regional approach would be needed to succeed [13]. Lack of movement control within countries and across international borders for both wildlife and domestic animals aggravates the problem, and gives credence to the face that FMD will remain a problem on the sub-continent for the foreseeable future [14]. Countries free of FMD impose strict import regulation on animals and animal products and potential viral contaminated fomites from FMD free countries. Greater loss can result from refusal from FMD free countries to import livestock and livestock products from endemic regions [15].

Several studies have been conducted on the sero-prevalence and associated risk factors of FMD in cattle in different parts of the country and still there is a scarcity of information in the study area. Implementing both sero-prevalence and associated risk factors investigation is crucial to generate baseline information about the disease in the selected Zone.

- Therefore, the objective of the present survey was to estimate the sero-prevalence and to assess associated risk factors of FMD sero-prevalence in Sinana and Agarfa districts.

2. Materials and Methods

2.1. Description of the Study Areas

The study was conducted from January 2022 to February, 2022 in two selected districts of Bale zone namely Sinana and Agarfa which are Located in the administrative zone of Oromia Region, Ethiopia.

Sinana is located in Oromiya Regional State, Bale Administrative Zone. It is at about 460 Km southeast of Addis Ababa and it has an altitude of 2400 m above sea level. It's geographical from 07º 06'29" northern latitude and from 40º 12'52" eastern longitude.

It has a bimodal rainfall pattern with the first peak from April to May and the second from August to October. The mean annual maximum temperature is 21.06^{0C} and monthly values range between 19.39^{0C} in October and 22.94^{0C} in February. The mean annual minimum temperature is 9.32^{0C} and monthly values range between 7.12^{0C} in December and 10.81^{0C} in April. The coldest month is December whereas February is the hottest month.

Agarfa district is found in the Bale Administrative Zone of Oromia Regional State, in Southeastern part of Ethiopia. It lays between 7˚8'N to 7˚28'N latitude and 39˚31'E to 40˚5'E longitude. The elevation of Agarfa district ranges from 1400 m to 3800 m above mean sea level (a.m.s.l). About 61% of the district is plain with slope ranging from 0 to 8 degrees and the majority of this area lies in the southeastern and western parts of the study area. Wabe shabelle river gorges and related rugged terrains make about 31% of the district.

Agarfa district falls within three traditional agro-climatic zones, vernacularly termed as Gamoji (hot), Bada-dare (temperate), and Bada (cold). Mean maximum and mean minimum temperatures are 25˚C and 10˚C respectively. The amount of maximum and minimum rainfall received in the area ranges between 1200 mm and 400 mm, respectively.

2.2. Study Populations

The study populations were local and cross breed of cattle above the age of six months having no clinical symptom of any disease were included. In addition, herd sizes considered were small, medium and large as some of researches handle the same way.

2.3. Study Design

A cross sectional study design was take place to determine the sero-prevalence of FMD and associated risk factors in two selected districts of Oromia region and different herd size were included in the study based on the inclusion criteria. Semi-structured questionnaires were administered to herd owners for the assessments of animal and herd level risk factors.

2.4. Sampling technique and Sample Size determination

Study districts were purposively selected based on higher study population, access to transportation and history of outbreaks for sero-prevalence determination and assessment of potential risk factors of FMDV. Individual animal from each herd were selected randomly as sampling unit to draw the required sample size. Since there was no previous study conducted on FMD in cattle found in the selected areas, the present study was considered 50% expected prevalence, 95% confidence level and 5% absolute precision or marginal error. Based on these assumptions, the total number of animals to be included in the study got determined using Thrusfield (2007) formula form the two Districts selected. The sample size was determined using the formula given as follows:

$$N=\frac{1.96^2 * Pexp\ (1-Pexp),}{d^2}$$

Where, N = required sample size, Pexp = expected prevalence, d^2 = desired absolute precision.

$$n = \frac{(1.96) * (1.96) \times (0.5) \times (1-0.5)}{(0.05) * (0.05)} = 384$$

2.5. Sample Collection and Transportation

A total of all 768 whole blood samples each approximately amounting to 8-10ml were collected from jugular vein of cattle using disposable needles and 10 ml non-heparinized vacutainer tube and 21 Gauge needle. Following whole blood sample collection, vacutainer tubes were labeled and transported to around veterinary clinic and kept overnight at room temperature to allow the blood clot at slant position. Correspondingly, each sample was identified along with sex, age, and district. Then, serum samples

are transferred from vacutainer tubes to cryogenic vials and stored in -20°C refrigerator at Asela veterinary regional laboratory. The samples were tested using the FMD non-structural protein ELISA to determine if animals in the herd had been recently infected with FMD virus thereby estimating the sero-prevalence in the two selected districts.

Open and closed ended questionnaires were administered to herd owners to assess potential risk factors of the disease alongside with sample collection. Respondents from each district were randomly selected and interviewed to assess potential risk factors of the disease. Study populations' sex, age, herd size and district are considered as hypothesized risk factors for the occurrence of FMDV. Herd owner having cattle are the sampling units for questionnaire survey.

All necessary epidemiological information was collected tabulated, coded and analyzed using suitable statistical analysis on individual animal bases.

2.6. Serological Diagnostic Test

The collected sera were tested by commercially available FMD NSP competitive ELISA kit (Non-structural proteins used as DIVA test) (ID Screen(r) FMD NSP Competition, ID-VET, Grabels, France) for the detection of antibody to 3ABC poly-protein which is a useful indicator of past FMDV infection regardless of the serotype involved. The 3-ABC-ELISA was used according to the manufacturer's instructions. The test principle is the blocking of plate bound NSP antigen by antibodies present in the serum samples. Any antibody spesic for 3ABC binds to the antigen in the wells and forms an antigen/antibody complex on the plate well surface. Antibody to the assay was performed according to manufacturer's instruction and results were analyzed and interpreted.

2.7. Data Management and Analysis

Data generated from laboratory analysis and questionnaire survey were be recorded and coded using Microsoft Excel spreadsheet (Microsoft Corporation) and analyzed using STATA version 13.0 and R studio. Descriptive statistics (frequency and percentage) were employed to calculate the proportion of risk factors for FMD. Individual level animal prevalence was calculated by dividing the number of animals with positive ELISA tests by the total number of tested animals. In all the analyses, confidence levels at 95% were calculated, and a $P < 0.05$ was used for statistics.

3. Results

3.1. Prevalence of *FMD* in the samples

A total of 461 serum samples were collected and tested for FMD. Over all 103 samples gave positive results yielding a prevalence of 22.34 %. Of the samples collected from Agarfa 25.97 % (60/231) were positive whereas of the 18.70 % (43/230) samples collected from Sinana were found positive as described in table 1 below.

Place of sample	Number	*FMD*(+)	Prevalence	P-value	Chi-square
Agarfa	231	60	25.97%		
Sinana	230	43	18.70	0.818	0.0529
Total	461	103	22.34%		

Table 1: Prevalence and distribution of FMD in Agarfa and Sinana Woreda

At the kebele/Peasant Association level 18.25%, 19.23%, 26.78% and 25.21%of the samples collected from Alemgena, Kasoshek maro, Makora chafe, kasomaro, respectively gave positive results for FMD as shown in table 2 below.

Type of Kebeles	Number	*FMD* (+)	Prevalence	Chi-square	P-value
Alemgena	126	23	18.25%		
Kasoshek maro	104	20	19.23%	3.6326	0.304
Makora chafe	112	30	26.78%		
Kasomaro	119	30	25.21%		

Table 2: Prevalence of FMD from each sampled Kebeles

From tested samples for *FMD* cross breeds were 26.40% and local breeds were 30.04% as shown in table 3 below. Risk factors such as breed, sex, age and body conditions were considered. Higher sero-prevalence was recorded in local breed cattle with prevalence of 30.04 %. Cattle with medium body condition have higher sero-prevalence 23.3%. Sex and age shows almost nearly the same result.

Factors	Number	*FMD* (+)	Prevalence	Chi-square	P-value
Cross	125	33	26.40%		
Local	233	70	30.04%	0.2940	0.588
Male	195	43	22.05%	0.8892	0.828
Female	266	60	22.56%		
Adult	268	60	22.39%	1.4693	0.689
Young	193	43	22.28%		
Good	82	17	20.73		
Medium	206	48	23.30	0.2459	0.884
Poor	173	38	21.97		

Table 3: Prevalence of FMD positive with different considered risk factors

4. Discussions

The overall sero-prevalence rate of 22.34% reported in this study was in agreement with the previous finding from Ethiopia [16] (Sahle, 2004) in which sero-positivity of 26.5% was reported. Compared to the present findings lower prevalences of 5.6% [17], 8.01% [18] (Abunna, 2013) and 9% [19] (Beyene et al., 2015) were reported from Afar Regional State, Dire Dawa and western Ethiopia, respectively. On the other hand relatively higher sero-prevalence was previously reported in samples from the Eastern zone of Tigray with 41.5%; followed by the Guji zone of Oromia and Yeka district of Addis Ababa city, with 32.7% and 30% respectively [20]. [21] in Sudan, [22], in Saudi Arabia and [23] in Uganda also reported sero-prevalences of 16%, 53% and 77% respectively, from FMD virus infected cattle. The observed prevalence variation may be resulted from differences in individual animals breed, age, and sex and production system.

7. Conclusion and Recommendations

FMD is prevalent in the study Districts as conformed serologically and reported to be endemic in Ethiopia. The presence of this disease in the country is a major obstacle to the development of livestock resource because of its adverse effects on production and their product exports. In Ethiopia, factors such as the presence of high numbers of susceptible domestic animals, herd composition or the involvement of multiple hosts (cattle, sheep and goats), herd size and individual animal age variability, lack of prophylactic vaccination, absence of regulation for prohibition of animal movement, high contact of animals at marketing and common grazing place as well as at watering points could contribute to the occurrence of FMD and create the difficulty in controlling the FMD Disease.

Therefore, the followings are offered as recommendations:

An extensive regular surveillance and serotyping of the FMD isolates throughout the country should be conducted to check the introduction and circulation of new serotype in the country and to ensure that circulating viruses are protected by existing vaccines and/or look for alternative vaccines.

- Government strategy in FMD control through regular vaccination and movement control should be implemented.
- Further detailed studies on the molecular characterization of the viruses and their genetic closeness with the existing vaccines need to be conducted to establish the nature of their diversity on the tree.

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