

Full Length Research Paper

# Epidemiological study on foot and mouth disease in cattle: Seroprevalence and risk factor assessment in Kellem Wollega Zone, West Ethiopia

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A cross-sectional study was conducted in three districts of Kellem Wollega Zone of Oromia Regional State, West Ethiopia between November, 2011 to March, 2012 with the objectives of determining the seroprevalence of foot and mouth disease (FMD) in cattle and assessing the potential risk factors associated with the disease. Antibodies against non-structural protein of FMD virus using 3ABC ELISA was measured as an indicator of exposure to the virus. From the total 384 sera tested, the overall seroprevalence of FMD in Kellem Wollega Zone was found to be 21.4% (95% CI: 17.23 - 25.47). The highest seroprevalence was observed at Sayo 31.53% (95% CI: 22.82 to 40.24) followed by Lalo Kile district 19.01% (12.51 - 25.51) and Dale Sadi district 15.26% (9.06 - 21.46). The seroprevalence of FMD in different age groups was 24.22% (95% CI: 18.62, 29.83), 16.51% (95% CI: 9.48, 23.53) and 18.75% (95% CI: 7.55, 29.94) in group of cattle aged greater than 4 years, between 2 to 4 years and less than 2 years, respectively. Higher seroprevalence observed in female 27.17% (95% CI: 20.89 - 33.45) than male 15.34% (10.17, 20.51). Seropositivity was significantly varied with sex and district of cattle ( $P < 0.05$ ). The odds of being seropositive for female cattle was observed to be 2.05 times of the male cattle (OR; 2.05, 95% CI: 1.22 - 3.43) and Cattle from Sayo district had significantly higher seroprevalence than dale sadi cattle (OR; 2.58, 95% CI: 1.37 - 4.87). In conclusion, the result of this study showed that FMD is an important cattle disease in the study area necessitating further investigation and characterization of the circulating virus serotype to apply effective control and prevention measures.

**Key words:** Seroprevalence, foot and mouth disease (FMD), Kellem Wollega, 3ABC ELISA.

## INTRODUCTION

Foot and mouth disease (FMD) is a highly contagious viral disease of cloven-footed animals and is one of the most important economic diseases of livestock by fever

and vesicular eruptions in the mouth, on the feet and teats (Bronsvort et al., 2004). FMD is caused by a virus of the genus *Aphthovirus*, in the family Picornaviridae, of

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which there are seven immunologically distinct serotypes: O, A, C, SAT-1, SAT-2, SAT-3, and Asia-1 (OIE, 2004). Studies have shown that five (O, A, C, SAT-1 and SAT-2) of the seven FMD serotypes were identified in Ethiopia. Serotype O was more prevalent followed by types A, SAT-2, SAT-1 and C, respectively. Serotype C was not identified after 1983; however, a serotype C specific antibody in cattle was reported (Sahle, 2004; Gelaye et al., 2005; Legess, 2008; Rufael et al., 2008).

The disease has a high morbidity although mortality is rare in adult animals. The impact posed by the disease is enormous. It affects animal's performance directly through reduction of milk yield. Death of young animals and fertility impairment due to increased abortion rate are also the grave consequences of the disease. The recovered animals remain in poor physical condition over long periods of time leading to economic losses for livestock industries (Sangare, 2002). Pastoralists are severely affected by the direct impact of the disease since their livelihood is directly linked to livestock production (Bayissa, 2009). Moreover, the disease is becoming the major constraint hampering export of livestock and livestock products. For example, the Egyptian trade bans of 2005/2006 due to FMD costs Ethiopia more than US\$14 million (Leforban, 2005).

FMD is endemic to most of sub-Saharan Africa, except in a few countries in southern Africa, where the disease is controlled by the separation of infected wildlife from susceptible livestock as well as by vaccination (Sahle, 2004). In Ethiopia, FMD is endemic widely distributed and frequently noted in different farming system and agro-ecological zones of the country. During the period from 1999 -2008 on average over 77.7 numbers of FMD outbreaks were reported every year to Ministry of Agriculture and Rural Development (Gelaye et al., 2005). Recent seroprevalence studies of FMD in different districts and localities in the central, south west, northwest and in south pastoral areas of Ethiopia revealed seroprevalence of the FMD in the range of 2.5 - 21% (Bogale, 2005; Gelaye et al., 2005; Rufael et al., 2008). Regardless of its huge economic importance, FMD occurrence and risk factors associated with the disease was not substantially investigated throughout Ethiopia to indicate the real magnitude and burden of the disease in the country. Besides, there is no citable information regarding the occurrence of the disease in the Kellem Wollega Zone.

Therefore, the objectives of the present study were to estimate the seroprevalence of FMD and to assess the risk factors associated with the disease in the study area.

## MATERIALS AND METHODS

### Study area

The study was conducted in Kellem Wollega Zone, in three districts namely Sayo, Dale Sadi and Lalo Kile districts. Kellem

Wollega located in Western Ethiopia, is found at 652 km distance from Addis Ababa. Geographically, the area fall between 08° N 25' 56" to 08° N 58'05" latitude and 034° E 33'41" longitudes with an altitude of 1701 to 1827 m above sea level. However, the elevation decline progressively west ward along the Sudan border. The zone has an average annual rainfall of 700 to 1500 mm per year. The annual minimum and maximum air temperature is 18 to 38°C, respectively. It borders with the Sudan in the west, Beneshangul Gumuz Regional State in North West and Gambella Regional State in South West of the country. The quarter of the zone is estimated to be covered with forest. The farming system of the area is mixed crop livestock farming. The livestock population of the zone is 703,877 head of cattle, 123,521 head of sheep and goat, 65,225 head of horse, mule, donkey and 572,204 head of poultry. The total human population dwelling in the area is 29,448 (CSA, 2009).

### Study population

The study population was indigenous breed of cattle that are kept under traditional grazing management system in the study area. Twelve Peasant associations (PA) were selected randomly from the three districts. Approximately, about 30 animals were sampled from each PA from randomly selected herd owners.

### Sample size determination

The sample size was estimated by assuming an expected prevalence of 50% to get the maximum number required to determine the prevalence. The precision was decided to be 5% at 95% confidence level. For sample size estimation the formula described by Thrusfield (1995) was used.

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

Where, n = required sample size;  $d^2$  = desired absolute precision;  $P_{\text{exp}}$  = expected prevalence.

$$n = \frac{1.96^2 \times 0.5 (1 - 0.5)}{(0.05)^2} = 384$$

Accordingly, a total 384 serum samples from cattle were collected to determine the prevalence of FMD in the study area.

### Study design

A cross-sectional study was under taken on FMD in local cattle from November, 2011 to March, 2012. During the laboratory work, a total of 384 sera samples were tested using 3ABC ELISA for the detection of FMD antibodies.

### Sample collection and submission

Blood samples of 10 ml were aseptically collected using plain vacutainer tubes from local cattle through jugular vein puncture. The owner(s) restrained the animals properly. The samples were labeled right after collection. Then after, the sample was allowed to clot for 4 to 5 h and then centrifuged.

**Table 1.** Seroprevalence of foot and mouth disease (FMD) according to district.

District	Sample	Positive	Seroprevalence (%) (95% CI)
Sayo	111	34	31.53 (22.82, 40.24)
Dale Sadi	131	20	15.26 (9.06, 21.46)
Lalo Kile	142	28	19.01 (12.51, 25.51)

**Table 2.** Seroprevalence of foot and mouth disease (FMD) in cattle of different sex groups.

Sex	Sample	Positive	Seroprevalence (%) (95% CI)
Female	195	53	27.17 (20.89, 33.45)
Male	189	29	15.34 (10.17, 20.51)

The serum was collected aseptically from the centrifuged blood and transferred into a single sterile cryovials and labeled with the sample code. The serum transported using ice box (at <math>5^{\circ}\text{C}</math>) containing icepacks to National Animal Health Diagnostic and Investigation Center (NAHDIC), Sebeta. The sera sample then stored at  $-20^{\circ}\text{C}$  until laboratory investigation was undertaken.

#### Laboratory test

The PrioCHECK® FMDV NS 3ABC-Ab ELISA kit was designed to detect FMD virus specific antibodies in bovine serum sample. The procedure was based on a solid phase blocking ELISA. The test plates are coated with 3ABC specific monoclonal antibody (mAb), followed by incubation with antigen (3ABC protein). Consequently, test plates of the kit contain FMD virus NS antigen captured by the coated mAb. The test performed by dispensing the test samples to the wells of a test plate. After incubation, the plate was washed, the conjugate added and the chromogen (TMB) substrate was dispensed. After incubation, at room temperature ( $23 \pm 3^{\circ}\text{C}$ ) the color development was stopped. Color development measured optically at a wave length of 450 nm shows the presence of antibodies directed against FMD virus.

#### Data analysis

Data were stored in Microsoft (MS) Excel and analysis was done using STATA version 11.0 for windows (Stata Corp, Texas). The total prevalence was calculated by dividing the number of 3ABC ELISA positive animals by the total number of animals tested. Logistic regression was used to analyze whether potential risk factors (sex, age, and districts) have significantly associated with disease occurrence. The degree of association between potential risk factors and seroprevalence was computed using odds ratio. FMD Seropositivity was considered as dependent variable and risk factors that would likely predict the outcome were considered as independent variables. In all of the analysis, confidence level at 95% and  $P < 0.05$  was set to see the significance of association of the dependent and independent variables.

## RESULTS

The overall seroprevalence of FMD in Kellef Wollega Zone was found to be 21.4% (95% CI: 17.23, 25.47).

Tables 1, 2 and 3 show the seroprevalence FMD according to the origin, sex and age of cattle. The prevalence of FMD among the different origin of cattle indicated that the highest seroprevalence was observed in Sayo district (31.53%) followed by Lalo Kile district (19.01%) and Dale Sadi district (5.20%). Comparison of the seroprevalence of FMD between sex groups revealed a highest prevalence of 27.17% (53/195) in female cattle than in male ones (15.34% (29/189)). The highest seroprevalence was observed in cattle aged greater than 4 years 24.22% (56/227) followed by in group of animals aged less than 2 years 18.75% (9/48) and between 2 to 4 years 16.51% (17/109).

Table 4 shows associations of the potential risk factors associated with FMD seropositivity. Accordingly, seropositivity was significantly varied with sex and district of cattle ( $P < 0.05$ ). The odd of being seropositive for female cattle was observed to be 2.05 times of the male cattle (OR; 2.05, 95%CI: 1.22 - 3.43). Cattle from Sayo district had significantly higher seroprevalence than Dale Sadi cattle (OR; 2.58, 95% CI: 1.37 - 4.87).

## DISCUSSION

The present study revealed that FMD is a significant disease in Kellef Wollega Zone with a prevalence of 21.4% ( $n = 82$ ). The finding of this study was in agreement with the previous report in the Borana pastoral land where over all seropositivity of 21% was reported (Rufael et al., 2008). However, the seroprevalence was slightly lower than the previous findings in Ethiopia (Sahle, 2004) in which a seropositivity of 26.5% was reported. On the contrary, the seropositivity found in current study was higher than the report in Afar Regional State where seropositivity of 5.6% (Jembere, 2008) and in South Omo Zone where seropositivity of 8.18% was reported (Molla et al., 2010). The relative increase in the prevalence of the FMD in comparison to other findings might be due to extensive livestock

**Table 3.** Seroprevalence of foot and mouth disease (FMD) in cattle of different age groups.

Age	Sample	Positive	Seroprevalence (%) (95% CI)
Less than 2 years	48	9	18.75 (7.55, 29.94)
Between 2 - 4 years	109	17	16.51 (9.48, 23.53)
Above 4 years	227	56	24.22 (18.62, 29.83)

**Table 4.** Associations of potential risk factors associated with seropositivity of foot and mouth disease (FMD).

Variable	Sample	Positive	Prevalence	OR	95% CI	P-value
<b>Sex</b>						
Male	189	29	15.34	1		
Female	195	53	27.17	2.05	1.22-3.43	0.006
<b>Age</b>						
Between 2 - 4 years	109	17	16.51	1		
Less than 2 years	48	9	18.75	1.09	0.44-2.71	0.848
Above 4 years	227	56	24.22	1.67	0.91-3.06	0.095
<b>District</b>						
Dale Sadi	131	20	15.26	1		
Lalo Kile	142	28	19.01	1.36	0.71-2.59	0.353
Sayo	111	34	31.53	2.58	1.37-4.87	0.003

movement and high rate of contact at market place, grazing and watering points which are potential risk factors for the transmission of the disease in the study area.

The highest district level seroprevalence was recorded in Sayo and Lalo Kile districts, while the lowest observed in Dale Sadi district. The highest seroprevalence in Sayo and Lalo Kile districts probably reflects the higher contact pattern of domestic animals with wild animals and also due to the fact that Kellem Wollega Zone is bordered with Sudan, where possibly cattle movement across boundary occurs illegally supporting the notion that FMD peaked in cattle associated with cattle movement leading to contact of cattle in different origin, which is the predominant factor for the transmission of the disease (Rufael et al., 2008).

Animal factors like sex and age are believed to play significant role in the occurrence of a disease. Although there was no difference in the seropositivity of FMD among the different age categories statistically significant, the present study revealed the highest prevalence in cattle of age above four years (24.22%) supporting that the fact of increase in age increase the chance of exposure to the disease occurrence (Thrusfield, 1995). This is in agreement with the report of Gelaye et al. (2009). Those animals aged >4 years may have acquired the infection from multiple serotypes and/or infections. The study showed an association between sex and prevalence of FMD in cattle with the

higher prevalence of the disease in female (27.17%) than male cattle (15.34%) showed the highest prevalence. The finding was in agreement with the report of Hailu et al. (2010) in which they report a higher prevalence of FMD in female (16.63%) cattle than that of male (1.37%) cattle. However, it was in agreement with the findings of other researchers in which they report a higher prevalence in male than female animals (Remond et al., 2002; Sarker et al., 2011).

## Conclusion

The result of this study showed that FMD is an important cattle disease in the study area. It found that high prevalence of FMD with district and sex being the major risk factors for the occurrence of the disease in Kellem Wollega Zone, Western Ethiopia necessitating further investigation and characterization of the circulating virus serotype in the area to apply effective control and prevention measures.

## Conflict of Interests

The authors have not declared any conflict of interests.

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