THE STATUS OF FOOT-AND-MOUTH DISEASE (FMD) IN ETHIOPIA

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The study was designed to determine the serotypes and subtypes of FMD virus circulating in the country, and to generate epidemiological information. Out of 241 submitted samples FMD virus was isolated from 89.2% (n= 215) of samples in cell culture and identification of the serotype was made using Complement Fixation Test (CFT) revealed presence of five different serotypes of the virus; O (72.9%), A (19.7%), C (1.4%), South African Territories (SAT) 1 (1.8%) and SAT 2 (4.1%). SAT 2 was identified for the first time in 1989 from a bovine sample collected from Leben Ranch, Borena area, southern Ethiopia and SAT 1 in 2007 from Mezan Teferi area, however SAT 3 has never been reported in Ethiopia.

The records of ministry of agriculture and rural development (MOARD) from 1997 to 2006 also indicated that FMD outbreaks occurred every year with the highest in 1999. Also serological study was conducted using serum samples collected from cattle from the whole part of the country. From the total 4465 sera tested 10.5% (n=467) were positive for FMD. From 1876 samples collected from pastoral areas of the country 14.8% (n=325) prevalence was obtained.

The epidemiology of FMD in sub-Saharan Africa is probably more complicated than in any other region of the world. Not only have six of the seven serotypes occurred in Africa (only Asia 1 has never been recorded), but also marked regional differences in the distribution and prevalence of serotypes and intratypic variants occur (Vosloo et al., 2002; Sahle et al., 2004). Foot-and-mouth disease was first recorded in Ethiopia in 1957 when serotypes O and C were found (Martel, 1974; Martel and Gallon, 1975). Type A and SAT 2 were not identified until 1969 and 1989, respectively (Martel and Gallon, 1975). During the period 1988 to 1991 samples from 16 Foot-and-mouth disease outbreaks in Ethiopia were examined at the National Veterinary Institute, Ethiopia, and at the FAO World Reference Laboratory for Foot-and-mouth Disease, UK. Typing of the virus responsible was possible in 13 of these outbreaks representing 10 separate disease events; 8 of these were caused by serotype O and 2 by serotype SAT2. This is the first record of the presence of serotype SAT 2 Foot-and-mouth disease virus in Ethiopia. In contrast to earlier studies serotypes A and C were not detected (Roeder et al., 1994).

The molecular epidemiology of FMDV has been studied in some detail for world using nucleotide sequencing of the main antigenic determinant of the virus and phylogenetic analysis. However, sufficient genetic information of viruses from Ethiopia has not been available to determine the number of viral lineages and genotypes and to investigate whether certain patterns of spread in the country have occurred in the past. This study also describes an initial attempt to describe the status of FMD using sero-surveillance through the detection of antibodies in serum samples collected from cattle and using FMD outbreak reports, from the whole parts of the country to address the need and to indicate the possible areas for disease free zone establishment.

Therefore the objectives of this study are:

- To isolate and identify the circulating serotypes and subtypes of FMD Virus;
- To determine the strains appropriate for vaccine production;
- To generate epidemiological information of FMD that helps to design control measures.

2. MATERIALS AND METHODS

2.1 Samples collection and processing

Serum samples collected over from 2003 to 2006 period for sero-surveillance of rinderpest from cattle between 1 and 3 years of age were supplied by Sebeta laboratory and used for this study. During rinderpest sero-surveillance 20 sera were collected from each of randomly selected village. The sera were processed with the Bommeli Diagnostics FMD virus non-structural enzyme-linked immunosorbent assay (3ABC ELISA with 95% sensitivity and 97% specificity) for identifying infected animals from none infected ones (Egel, et al., 2008).
The records of ministry of agriculture and rural development (MOARD) from 1999 to 2006 were also used to determine the status of FMD in the country.

Tissue samples were collected from veterinary clinics, regional veterinary laboratories, animal health and production research centers and farms and submitted to the National Veterinary Institute, Foot and Mouth Disease Laboratory, between 1981 and 2007. A total of 133 tissue culture FMD virus samples were submitted to Institute for Animal Health (IAH), Perbright, UK for further molecular characterization and phylogenetic analysis. The VP1 gene characterization was used to study phylogenetic relationships between serotypes of Foot-and-mouth disease (FMD) viruses in Ethiopia as well as with other serotype isolates from East, South and West Africa, the Middle East, Asia and Europe.

2.2 Data Analysis
A homologous region of 639 nucleotides corresponding to the whole VP1 gene was used for all phylogenetic analysis. Nucleotide sequences of serotype O isolates from other African countries were included to deduce the phylogeny of this serotype on the African continent as well as isolates from the Middle East, Asia and South America to ensure that all previously identified lineages and genotypes were represented (Knowles and Samuel, 2003). Phylogenetic trees were constructed using methods of analysis included in MEGA version 4.0 (Tamura et al., 2007) and confidence levels were assessed by 1000 boot-strap replications. Serotypes were distinguished on the basis of nucleotide sequence differences of 30-50% and high boot-strap support (> 90%) while a divergence of > 15% distinguished Topotypes (Knowles and Samuel, 2003).

For serological result; the 3ABC test results for each animal, origin (village, woreda, zone and administrative region) were recorded in an Excel (Microsoft Corp.) spreadsheet 3. Descriptive statistical analysis was carried out using Stata software version 9 (State Corp., College Station, TX, USA), while spatial regression was analyzed with GeoDA 0.9-1 (Beta). The maps were generated using ArcGISv9.0 (ESRI, Redlands, CA, USA)

3. RESULTS

3.1 Retrospective result
The records of ministry of agriculture and rural development (MOARD) from 1997 to 2006 indicated that FMD outbreak occurred every where through out the country with the highest in central part particularly in North showa 128 outbreaks reported during the indicated period of time (figure 1).
3.2 Serology result
From the total 4465 sera tested 10.5% (n=467) were positive for FMD with 3ABC ELISA test. The highest seroprevalence was detected from samples of Oromia (20.7%), but from Gambella and Benshagul FMD virus specific antibody was not detected. In zonal administration level the highest sero-positivity was obtained from Eastern zone of Tigray with 41.5 % followed by Guji and Yeka sub-city of Addis Ababa with 32.7% and 30 % respectively. From 1876 samples collected from pastoral areas of the country 14.8% (n=325) prevalence was obtained (P<0.05) (figure 2).

Figure 1: Map showing No FMD outbreaks recorded in different part of Ethiopia (1999-06).

Figure 2: Sero-prevalence of FMD in different parts of Ethiopia.
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Figure 3: Status of FMD in Ethiopia.

![Map showing FMD status in Ethiopia](image)

Key: PER_P = percent positive, INC= incidence, MEAN_OB= mean number of outbreak in general the mean number of outbreaks, incidence rate and sero-prevalence of FMD showed that Tigray, central and southern part of Ethiopia are highly affected areas.

3.3 Viruses isolated
Of the total 241 outbreak samples examined, cytopathic effect (CPE) was observed in 215 samples in primary calf kidney or IBRS 2 cell culture for the FMD virus. The CPE was characterized by a fast destruction of the cell monolayer and infected cells were round and formed singly. Complete destruction of the cell sheet was mostly seen with in 48 hours of inoculation. On those samples that showed CPE further examination were done to identify the type of the virus with complement fixation test; thus serotype O, A, C, SAT1 and SAT 2 were recorded. Type O was the dominant serotypes identified with 72.9% rate, while type A (19.7%), C (1.4%) SAT 2 (4.1%) and SAT1 (1.8 %) rate were detected. SAT 2 was recorded for the first time in Ethiopia in 1989 from a Bovine sample collected from Borena area (Third Livestock Development Project), southern Ethiopia, while SAT1 from Mizan Teferi area recently in 2007 (figure 5).

Figure 4: The map indicating areas where different FMD serotypes isolated.

![Map of FMD serotypes](image)
3.4 Phylogenetic analysis

Phylogenetic trees were constructed using the Neighbour-joining method (MEGA4) based on the comparison of complete VP1 gene. Pairwise distance matrix was used to study phylogenetic relationships of Foot-and-mouth disease (FMD) virus isolates of Ethiopia as well as with other isolates from the rest of the world (Tamura et al., 2007).

Most of the O serotype isolates of Ethiopia lies on East Africa Lineage III (figure 3). A new topotype was identified for the first time from serotype O and it is designated as East Africa 4 (EA-4) from Samples of Mizan Teferi located South West of Addis Ababa bordering Kenya and Sudan and also two National Parks (Omo and Mago) are adjacent to this location and also SAT1 was isolated from the same area for the first time from samples collected in 2007.

4. DISCUSSION

Foot-and-mouth disease is enzootic as in most parts of Africa and only few countries in the south and north of the continent have managed to control the disease and have access to lucrative export markets for live animals and animal products (Sahle et al., 2004, Vosloo et al., 2002). In Ethiopia, factors such as the presence of high numbers of susceptible animals, wild and domestic animals sharing common grazing pastures and watering points in areas where wildlife occur, as well as lack of control of animal movement contribute to the frequent occurrence of FMD outbreaks and to the difficulty in controlling the disease (Sahle et al., 2004).

The results of this study indicated that the occurrence of Foot and Mouth Disease outbreak has been serious challenge every year in Ethiopia with the highest in 1999 with 821 outbreaks and this statement agrees with report of Asfaw (2000). Out of the seven serotypes of FMD virus the existence of serotype O, A, C, SAT1 and SAT 2 were recorded between 1981 and 2007 from Bovine and Swine samples collected from outbreak areas of the country. Most of the outbreaks were occurred by serotype O followed by A, SAT 2, C and SAT1 (figure 5). This shows that type O has highly prevalent and a dominant serotype causing an outbreak in Ethiopia and this observation agrees with the survey result (Martel, 1974; Martel and Gallon, 1975) that there is a tendency for type O strain to occur most frequently in the outbreak area. The first isolation of SAT 2 was in 1989 a sample collected from Bovine that were reared in Leben Ranch, Borena Zone southern Ethiopia operated by the Third Livestock Development Project (TLDP); These animals were purchased from an area called Wachle, which is around 100 km far from the border with Kenya. SAT1 and SAT2 were isolated recently from Mezan Teferi and Benshagul-Gumuz areas bordering Kenya and Sudan respectively from 2007 collected samples. This suggests that SAT1 and SAT 2 might be introduced from Kenya and Sudan along with cattle movement since SAT 1 and SAT 2 are endemic in those countries (OIE, 2002; Vosloo, et al., 2002). These findings are also similar to the previous report by Martel (1974) that SAT 1 SAT 2 were not isolated in Ethiopia.

In a country such as Ethiopia where FMD is endemic, and where large numbers of susceptible domestic and wild ruminants exist with limited vaccination on some dairy farms, serological surveys are a pre-requisite to understand the epidemiology of FMD. To delineate the epidemiological profiles of the endemic occurrence of FMD in Ethiopia, 4465 sera of cattle from different regions were investigated using 3ABC ELISA serological test and 10.5 % prevalence was obtained. This result is lower than the study of Sahle (2004) who reported 26.25%, this might be due to the decrease of FMD outbreak for instance it was 176 in 2001 but decrease to 26 in 2005 (MOARD report).

In zonal administration level the highest sero-positivity was obtained from Eastern zone of Tigray with 41.5 % followed by Guji, Yeka sub-city of Addis Ababa and Borena zones with 32.7 % 30 % and 26.7 % respectively. Rufael and others (2008) reported 21 % sero-prevalence from Borena zone which comparable with the current finding.From 1876 samples collected from pastoral areas of the country 14.8% (n=325) prevalence was obtained (P<0.05).

5. ACKNOWLEDGEMENTS

The researchers would like to thank Agricultural Research Fund (ARFCG-2003) programme, Ethiopian Agriculture Research Institute, for funding this project. Molecular analyses were supported by the Department for Environment, Food and Rural Affairs (DEFRA), UK (Grant numbers SE291 and SE2935). We need to thank also National Animal health diagnostic and Investigation centre (NAHDIC-Sebeta) for their supply of serum samples for this study. The eight months stay of Mr. Ayelet in IAH and Royal Veterinary College was supported by Rothamsted International African Fellowship Programme. EuFMD/FAO for funding the current FMD study project and my participation in this meeting.
6. REFERENCE


