

Clinical Foot-and-Mouth Disease in Non-Vaccinated Smallholder Dairy Cattle in Adamawa Region, Cameroon: Prevalence, Farmer's Knowledge and Practices

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Abstract

Background: Foot-and-Mouth Disease (FMD) is endemic in Adamawa and hampers production and the health of animals with no routine vaccination in dairy and beef farms leading to significant economic losses to farmers. Although the disease has already been reported in the region, surveys on clinical Foot-and-mouth disease (FMD) in dairy farms are lacking.

Objective: This study aimed at determining the prevalence of clinical Foot-and-Mouth Disease (FMD) as well as to assess farmer's knowledge and practices on the disease in dairy cattle farms in Adamawa.

Methods: Clinical diagnosis using classical Foot-and-Mouth Disease (FMD) signs and semi-structured interviews were conducted from November to December 2019, during the Foot-and-Mouth Disease (FMD) outbreak period in Adamawa.

Results: Of the 401 animals examined for clinical Foot-and-Mouth Disease (FMD) in 11 dairy farms, the overall clinical Foot-and-Mouth Disease (FMD) prevalence was 22.19% and most cases were identified in Herd 2 of Mbidjoro village besides the Ngaoundere cattle market. Of the 21 dairy farmers interviewed, 100% of them could identify clinical Foot-and-Mouth Disease (FMD) cases. Low biosecurity level during hand milking practiced by 100% of farmers could spread the disease. About 100% of farmers witnessed a drop in milk production in clinically sick animals.

Conclusion: Foot-and-Mouth Disease (FMD) clinical cases are frequent in dairy herds and are easily recognized and managed by farmers. The local milking techniques could enhance the spread of Foot-and-Mouth Disease (FMD) during outbreaks. Further investigations on Foot-and-Mouth Disease (FMD) in dairy herds using molecular and serological tools as well as associated risk factors are required.

Keywords: Foot-and-mouth disease; Serotypes; Dairy farms; Adamawa; Topotypes

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Introduction

Foot-and-mouth disease is a very contagious viral vesicular disease of even-toed animals, caused by the Foot-and-Mouth Disease Virus (FMDV) that belongs to the family Picornaviridae and genus Aphthovirus. It is clinically characterized by lesions around the mouth and feet and occasionally in other areas of the body [1]. There are seven known distinct serological types (SAT 1, SAT 2, SAT 3, O, A, C, and Asia 1) with genetically and ecologically different topotypes within serotypes and limited cross-protection between serotypes or topotypes [2]. Only four of these serotypes (SAT 1, SAT2, O, and A) identified via genetic analysis in Cameroon are known to cause clinical Foot-and-Mouth Disease

(FMD) [3,4]. Apart from the molecularly confirmed serological types, antibodies reactive to serotype SAT 3 have already been identified in animals of the Far North region [5]. **Figure 1** shows the serotypes (confirmed by serological and genetic analysis) distribution in Cameroon. In Cameroon the average annual direct cost of Foot-and-Mouth Disease (FMD) management is circa 62 billion FCFA [6]. Despite the endemic nature of Foot-and-Mouth Disease (FMD) in Cameroon, there are no vaccination programs and no commercial vaccines available to prevent outbreaks and to curb its spread.

The Adamawa region is one of the most cattle rearing region of Cameroon where close to 40% of the estimated six million cattle

are found [7]. The Adamawa Region has favourable conditions for dairy farming [8]. From field trials conducted in this region, it was noticed that cross-breeds (Holstein x Gudali F1) yielded 3-4 times milk than local breeds [8]. Cameroon spends billions of FCFA yearly to import large quantities of milk and dairy products to satisfy domestic demand [6]. It has been reported that food self-sufficiency could be attained by increasing meat and milk consumption from 13.3 kg/inhab/year to 23 kg/inhab/year by 2020 and from 9.5 kg/inhab/year to 15 kg/inhab/year respectively; and eventually export excesses to curb the trade imbalance [9]. However, most of the dairy farming regions of Northern and North West regions of Cameroon are endemic with Foot-and-Mouth Disease (FMD) that could greatly hamper production if routine vaccination is not conducted.

Dairy farming in Cameroon is mostly practiced by smallholder farmers who raise animals with the intention of getting milk and meat for sell and excesses for home consumption. Smallholder cattle farmers are those who have less than 300 cattle heads and represent an estimated 40% of the cattle population in the Adamawa region [10]. The other remaining fraction of cattle population is kept by ranchers who keep thousands of cattle heads in their ranches [10]. In traditional dairy farms, transmission is frequent because of the local milking techniques where there is no sterilization of hands and equipment by collectors during the process. During Foot-and-Mouth Disease (FMD) outbreak periods in Adamawa, farmers usually experience a drop in the volume of milk produced by their animals [11]. The direct consequences of this drop in milk production are its high cost and undernourishment [6]. Another negative consequence of this disease is that endemic countries are exempted from international trading of animals and animal products therefore causing huge economic losses. Information on the occurrence of Foot-and-Mouth Disease (FMD) in dairy farms in Cameroon is lacking, reason why the present study was designed with aim to determine its prevalence in dairy farms during outbreaks and to assess farmer's knowledge and practices on this disease.

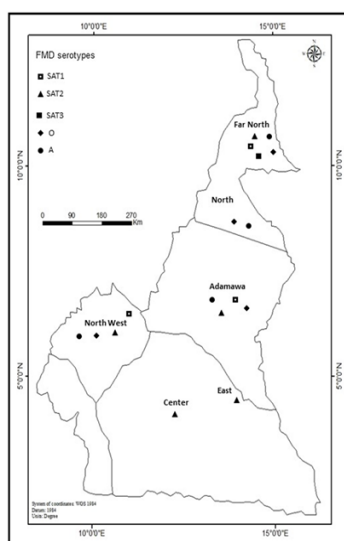


Figure 1: Map of Foot-and-Mouth Disease (FMD) serotypes distribution in Cameroon.

Materials and Methods

Study location

This study was conducted in 11 traditional smallholder dairy cattle herds in three villages (Tchabal, Mbidjoro, and Horé Mayanga) in the Vina Division of the Adamawa region of Cameroon from November to December during the 2019 Foot-and-Mouth Disease (FMD) outbreak period. Geographically, the Adamawa region is found between 06° 40' 0'' and 07° 30' 0'' north latitude and between 13° 20' 0'' and 14° 10' 0'' east longitude (Figure 2). The choice of Adamawa was because it is one of the most cattle rearing region of the country. The herds were selected based on their accessibility, presence of clinical Foot-and-Mouth Disease (FMD) cases and willingness of herders to participate in the study.

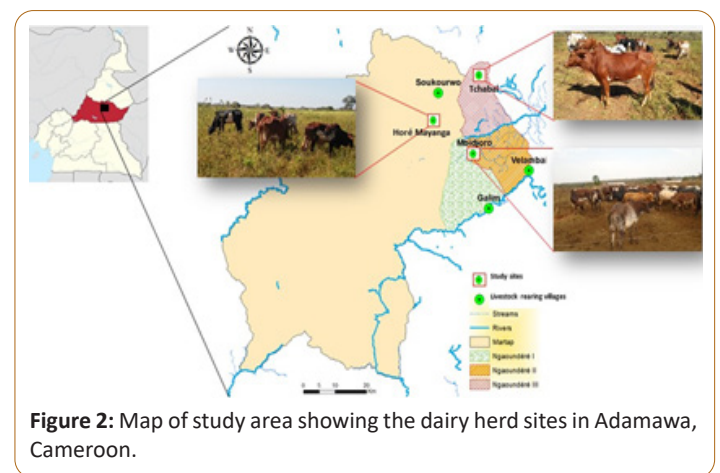


Figure 2: Map of study area showing the dairy herd sites in Adamawa, Cameroon.

Clinical diagnosis

The following cardinal Foot-and-Mouth Disease (FMD) clinical signs were considered: lesions, history of acute febrile condition, loss of appetite, and profuse salivation (ptyalism) in animals mostly noticed during an outbreak [1]. Characteristic Foot-and-Mouth Disease (FMD) lesions were around the mouth- on the tongue, dental pad, and feet-inter-digital clefts and coronary bands [1]. Animals with lesion score between one to five were considered. The proportion prevalence was calculated by simply dividing the number of clinical Foot-and-Mouth Disease (FMD) animals by number of animals examined then multiplied by 100.

Semi-structured interviews

A semi-structured interview was conducted on adult dairy farmers in 11 farms to assess their knowledge and practices during Foot-and-Mouth Disease (FMD) outbreaks.

Statistical analysis

The data obtained were analysed using the JASP 0.13.0.0 statistical software (JASP Team, 2020). The Chi-squared test was used to compare the Foot-and-mouth Disease (FMD) clinical cases

prevalence with study herds. The significant level of the test was stated at $P < 0.05$.

Results

Clinical prevalence

In the 11 dairy cattle herds selected for this study, 401 animals were clinically examined and 89 of them had clinical Foot-and-Mouth Disease (FMD) resulting in an overall prevalence rate of 22.19% (**Table 1**). There was no statistically significant difference (Chi-squared test: $\chi^2=96.000$; $df=88$; $P=0.263$) when the proportion prevalence of Foot-and-Mouth Disease (FMD) clinical cases for the different dairy herds were compared. The herd with the highest number of cases was Herd 2 found in Mbidjoro with 17 cases (**Table 1**).

Village Chi-squared test : $\chi^2=96.000$; $df=88$; $P=0.263$	Farm	No of susceptible animals	No of clinical cases	Clinical FMD prevalence (%)
Tchabal	Herd 1	59	8	13.6
	Herd 2	44	5	11.4
	Herd 3	33	3	9.1
	Herd 4	23	7	30.4
	Herd 5	42	11	26.2
	Herd 6	31	15	48.4
Mbidjoro	Herd 1	34	4	11.8
	Herd 2	53	17	32.1
Horé Mayanga	Herd 1	24	5	20.8
	Herd 2	37	9	24.3
	Herd 3	21	5	23.8
Total		401	89	22.19

Table 1: Proportion prevalence of FMD clinical cases with herd in Adamawa.

Dairy farmer's knowledge and practices during FMD outbreaks

During the study, 21 farmers were interviewed regarding their knowledge and practices on Foot-and-Mouth Disease (FMD). It was noticed that 100% of farmers could recognize Foot-and-mouth disease (FMD). Seventy percent (70%) of these farmers reported yearly Foot-and-Mouth Disease (FMD) outbreaks. Based on the milking techniques, 100% used the local hand milking method. Hand milking was conducted using utensils like dishes, containers and a short rope to restrain the hind legs of animals, then hands were used to pull out the milk. During the survey, we observed that 100% of respondents did not wash their hands between animals as well as used the same restraining rope between animals. In all the farms visited. Another striking observation was that 100% of farmers used antibiotics to manage Foot-and-Mouth Disease (FMD) in the absence of a commercial vaccine. It was noticed that during the treatment of clinical Foot-and-mouth Disease (FMD), farmers continued to collect milk without respecting the with-holding period of these antibiotics

as stipulated by the manufacturers. According to farmers, the cost of 1 liter of milk is approximately one US dollar. Regarding seasonal milk production, 100% of farmers reported five liters per day on average in the rainy season and three liters per day in the dry season. Thirty percent of farmers reported that in the outbreak season such as November, Foot-and-Mouth Disease (FMD) sick animals could only produce one liter of milk.

Discussion

The present study recorded an overall prevalence of clinical Foot-and-Mouth Disease (FMD) of 22.19%. The highest number of Foot-and-Mouth Disease (FMD) clinical cases were encountered in Herd 2 at Mbidjoro, but no statistically significant difference was recorded with study farm sites. The highest prevalence of Foot-and-Mouth Disease (FMD) in Mbidjoro has already been reported [12]. The highest cases in Herd 2 at Mbidjoro village could be explained by the fact that it was closer to the Ngaoundere cattle market that usually receives cattle from other regions of the country and even those from neighbouring countries such as Nigeria, Central Africa, Chad, and most of these animals are often sick and could contaminate sedentary herds around [11]. It has already been established that market places represent risk areas for the transmission of highly contagious diseases such as Foot-and-Mouth Disease (FMD) [13]. Likewise, a non-statistically significant difference in the clinical Foot-and-Mouth Disease (FMD) prevalence between herds was recorded. It could be explained by the husbandry system where animals shared same grazing and drinking places that could expose them to contamination. The non-statistically significant difference in Foot-and-Mouth Disease (FMD) prevalence among sedentary cattle herds in Adamawa using serological tests has already been reported [12]. Moreover, it should be noted that the prevalence of Foot-and-Mouth Disease (FMD) in this present study was based on clinical analysis and could not represent the real prevalence of the study herds because of the possibility of the presence of asymptomatic animals that could not be detected by clinical diagnosis. The use of serological and molecular diagnostic methods to capture all positive cases is underway.

The high level of knowledge on Foot-and-Mouth Disease (FMD) by dairy farmers in Adamawa indicates that the disease is important and occurs frequently. This high level of knowledge on Foot-and-Mouth Disease (FMD) by dairy farmers has also been recorded in Kenya [14]. The frequent occurrence of Foot-and-Mouth Disease (FMD) in the study area is not a strange finding as more than one epidemic of the disease in the Vina Divisio

of the Adamawa region has already been reported [11]. These frequent epizootics of Foot-and-Mouth Disease (FMD) in the study area could be related to the husbandry system. A recent study established that *Stomoxys niger niger*, a symbovine fly was associated to contaminative transmission of Foot-and-Mouth Disease (FMD) in Adamawa [15,16]. The hand milking method used by farmers to collect milk from clinical FMD animals with no history of vaccination, and without respecting biosecurity measures could lead to the contamination of animals in the herd. The Foot-and-Mouth Disease (FMD) transmission risk related to raw milk has already been reported in some areas [17]. The fact

that 100% of farmers did not respect the with-holding period before collecting milk from clinically sick animals treated with antibiotics indicates high public health issues as human health risks of antibiotic residues intake through meat has already been reported in the Far North region of the country [18]. The use of antibiotics could be replaced by Tri-Solfen® which has been proven to be efficient and cost effective for Foot-and-Mouth Disease (FMD) management in Cameroon [19].

Conclusion

Foot-and-mouth disease in the endemic area of Adamawa causes huge economic losses in the dairy sector through decrease in milk production. The highest number of cases were recorded in Herd 2 in Mbidjoro village where the Ngaoundere cattle market is located. Future studies will include the use of serological and molecular approaches to determine the real prevalence of Foot-and-Mouth Disease (FMD) and to identify the risk factors involved in its transmission in dairy farms in Adamawa in order to provide baseline data that could help dairy farmers and decision makers to better manage this disease. From the present study, the sensitization of smallholder dairy farmers on the risk of Foot-and-Mouth Disease (FMD) contamination through raw milk, public health risks linked to the use of antibiotics and the respect of antibiotic with-holding period before milk consumption are recommended.

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Author Contributions

Conceptualization, S.S.L.; methodology, K.A.B. and S.S.L.; formal analysis, S.S.L.; investigation, S.S.L. and K.A.B.; resources, S.S.L. and K.A.B.; writing-original draft preparation, S.S.L.; writing-review and editing, S.S.L., K.A.A., M.N.R., M.J.F.; visualization, S.S.L.; supervision, S.S.L. and M.J.F.; project administration, K.A.B.; funding acquisition, S.S.L. All authors have read and agreed to the published version of the manuscript.

Competing Interests

The authors declare they have no competing interests.

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Availability of Data and Materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

Animal use and care guidelines were followed. This included ensuring that all participants provided verbal informed consent

for the clinical examination of animals, farmer interviews and participation in videos and images, where written consent was unavailable due to farmer illiteracy.

Consent for Publication

Not applicable.

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