



Foot-and-mouth disease virus infection-specific nonstructural protein antibodies detected in populations of mithun (*Bos frontalis*), yak (*Bos grunniens*) and their hybrids maintained in farms and villages of Arunachal Pradesh, India

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The mithun or gayal (*Bos frontalis*) is an important bovid of the north-eastern (NE) region playing a principal role in the economy, mythology and culture of the indigenous tribes. At higher elevations, mithun territories are also shared by yak (*Poephagus grunniens*). As per the 19th Livestock Census (2012), nearly 249,000 mithuns and 14,061 yaks belong to Arunachal Pradesh. Out of the total mithun and yak population in India, Arunachal Pradesh is home to 83.48% of mithun and 18.34% of yak. The mithuns in Arunachal Pradesh are under traditional and primitive method of rearing and suffer from foot-and-mouth disease (FMD) and hemorrhagic septicemia (Gambo 2015). FMD is an economically devastating disease of agriculturally important animals. In this study, antibodies against FMD virus (FMDV) nonstructural protein (NSP) were detected in mithun, yak and their hybrids in farms and villages of Arunachal Pradesh signifying their role in the disease epidemiology, so that awareness can be created and necessary actions can be undertaken to prevent these rare species against such dreadful disease.

The study was undertaken on serum samples collected from mithun, yak and their hybrids maintained in farms and villages of West Kameng and Tawang districts in Arunachal Pradesh. A total of 857 serum samples from 804 yaks, 44 mithuns and 9 hybrids of mithun and yak were collected. The vaccination status and managerial practices followed were also collected during the survey along with sampling. The sera were screened for antibodies against 3AB NSP of FMDV using the in-house r3AB3 NSP

ELISA kit, according to the protocol followed by Mohapatra and colleagues (2011). Specifically, positivity was considered for the samples producing corrected optical density values $\geq 40\%$ of that of the positive control.

This study reports the FMDV NSP-Ab prevalence in semi-domesticated mithun, yak and their hybrids inhabiting the villages, farms and hilly areas of Arunachal Pradesh. A total of 202 of 804 (25.12%) yaks and 1 out of 44 (2.27%) mithun were found positive for NSP-Ab suggesting their previous exposure to FMDV. However, none of their hybrids showed the NSP seroreactivity. The results confirmed the FMDV exposure/circulation within these species in the studied regions. Moreover, it is to be mentioned that the NSP-Ab prevalence figure for the randomly sampled bovine population in Arunachal Pradesh state had been reported to be 14.12% during the year 2014–2015 (Annual Report PDFMD 2014–2015). In situation, where no restriction of animal movement and their intermixing with other FMD-susceptible species is followed, the infection can be exchangeable between the species at any point of time. Severe FMD had been reported previously in semi-domesticated mithun and yak (Verma and Sarma 1997, Rajkhowa *et al.* 2003). Frequently, migratory herds of domestic cattle come into contact with these species and transmission occurs. In 1960, an outbreak due to FMDV serotype O was recorded in Ganzi county of Sichuan with infection rate of 72% and mortality rate of about 4%.

Studies based on such serological investigations in semi-domesticated ruminants will bridge a major gap in understanding the epidemiology of FMD in hilly unapproachable areas of NE regions of the country especially in Arunachal Pradesh. Further field studies are warranted to collect clinical samples from the diseased animals in order to enable the antigenic and genomic characterization of FMDV circulating in these rare threatened species. Reduction in intermixing of mithun and yak with other susceptible animals can decrease the risk of

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FMDV transmission. In addition, it should be noted that these species usually come in contact with other domestic livestock and human. As FMD requires a relatively close contact setting for interspecies transmission, the distance between mithun, yak and other livestock should therefore be more apart to downturn the risk of disease transmission. FMD due to serotype O virus had been reported from mithun in Bannerghatta Biological Park, Bangalore, India (Hegde *et al.* 2011). A total of 6,239 mithuns belonging to 57 villages were affected in a span of 9 months in Arunachal Pradesh during 1994–1995, among which, 818 animals succumbed during the course of the disease (Verma and Sarma 1997). FMDV types O, A, A₂₂ and Asia 1 were reported to be the cause of outbreak by Barman and co-workers (1999) in wild and semi-domesticated animals of NE states of India. Choudhury and his associates (1992) reported FMD in gayals (*Bos gaurus frontalis*) in Calcutta zoo with massive myocardial lesions in the young ones. The source of infection was predicted to be the number of people visiting the zoo from endemic districts of West Bengal. Widespread outbreaks of FMD among domestic animals like cattle, buffalo, goats and pigs had been recorded during the same time period in the districts of West Bengal, which might have been the possible source of infection in mithuns kept in the zoo.

Under the changing socio-economic scenario, mithun and yaks need greater attention for being improved and preserved as important farm animals. The sufferings and deaths faced by these species due to infectious diseases need to be addressed. This can be done by improving and expanding the veterinary infrastructure and its services by adopting and applying the best technology and scientific management system. These populations are diminishing day by day. The Food and Agriculture Organization (FAO) of the United Nations definition of animal genetic resources eligible for conservation includes animal populations with economic potential, scientific use and cultural interest. Mithun fulfills all of these criteria (Mondal *et al.* 2014). Still no adequate and robust conservation policy exists in favour of mithun and yak. Such prevalence studies extending to characterization of FMDV(s) circulating in mithuns and yaks of other NE states of the country need to be undertaken. Routine prophylactic immunization against FMD should be followed, which can help protecting these species against the disease and can uplift the living condition of the tribal people of the NE regions of the country through better livestock protection.

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SUMMARY

There is dearth of availability of surveillance reports elucidating the role of mithun, yak and their hybrid populations inhabiting north-eastern regions of India in the epidemiology of foot-and-mouth disease (FMD). This study conducted during 2015–2016, therefore highlights the serological status of the disease in these animals of Arunachal Pradesh. A total of 857 sera from 804 yaks, 44 mithuns and 9 hybrids of mithun and yak were collected and an indirect 3AB nonstructural protein (NSP) ELISA was performed to detect NSP-antibodies (NSP-Abs). A prevalence of FMD virus (FMDV) NSP reactive sera in 25.12% (202/804) yak and 2.27% (1/44) mithun was estimated, while 0% seroreactivity was observed in their hybrids. The findings inferred that FMDV circulates in the said animals populating Arunachal Pradesh. Hence, necessary control measures including prophylactic vaccination for FMD should be put into practice to safeguard these rare threatened species considered to be the pride of the country.

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