

Foot and mouth disease virus serological study of dromedary camels in Oman

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Summary

The potential role of camels in the epidemiology of foot and mouth disease in Oman was investigated. Sera from local dromedaries ($n = 151$) that graze with animals (cattle and small ruminants) positive for foot and mouth disease virus (FMDV) non-structural protein antibody (NSP–Ab) were tested for the detection of FMDV NSP–Ab. The samples were tested using a commercial competitive enzyme-linked immunosorbent assay (cELISA) (IDvet, Grabels, France), a rapid immunochromatographic assay (BioNote, Inc., Hwaseong-si, Republic of Korea) and a solid-phase cELISA for the detection of antibodies specific to FMDV serotype O (IZSLER Biotechnology Laboratory, Brescia, Italy). The results from all three assays were negative when tested with dromedary sera. This indicates that FMDV was not transmitted to dromedary camels kept with FMDV NSP–Ab positive ruminants.

Keywords

Dromedary camel – FMD – Foot and mouth disease – Non-structural protein antibody – NSP–Ab – Oman.

Introduction

Foot and mouth disease (FMD), caused by seven distinct serotypes of virus, is an economically devastating disease of ruminant livestock. The host range of the disease includes many species of domestic and wild cloven-hoofed animals (1). A few published reports suggest that Bactrian and New World camels are also susceptible to natural infection (2, 3, 4). The infection of dromedary camels with foot and mouth disease virus (FMDV) is questionable (2, 4, 5), but a few reports describe the presence of antibodies in these animals (6, 7, 8).

Foot and mouth disease virus is endemic in Oman, and serotype O is predominant with the occasional incursion of other serotypes. The Animal Health Research Center (AHRC) of the Ministry of Agriculture and Fisheries received samples from 64 FMD outbreaks from 2011 to 2015, and all samples were diagnosed as serotype O (9). Dromedary camels, with an estimated population of 0.3 million (10), constitute an important component of livestock in Oman. Camel rearing is an old tradition, and camels are kept for the purpose of production (milk and meat) and sports (racing and showing). In most of Oman, except the highlands of southern Dhofar governorate, camels are generally managed with small ruminants under an extensive grazing system. Their housing is usually open, with fencing and shared feed and water. In contrast, the camels of the Dhofari highlands are in close contact with cattle and share communal pastures and ponds with other FMD-susceptible ruminants. It was deemed necessary to study the possibility of FMDV exposure in camels kept with other susceptible species in Oman.

Therefore, the purpose of this investigation was to detect FMDV non-structural protein (NSP) antibodies in camels in contact with NSP-positive animals (cattle and small ruminants).

Materials and methods

A study was conducted from 2016 to 2017 to investigate the potential role of dromedary camels in the epidemiology of FMDV in the Sultanate of Oman. For this purpose, 151 randomly selected local dromedary camels (129 females and 22 males) of various ages, from 36 herds (located in the seven governorates of Oman), were tested for the presence of antibodies against FMDV NSP (NSP–Ab) (Fig. 1). These herds were selected on the basis of an initial survey that was conducted in 884 herds to investigate the presence of NSP–Ab in cattle and small ruminants.

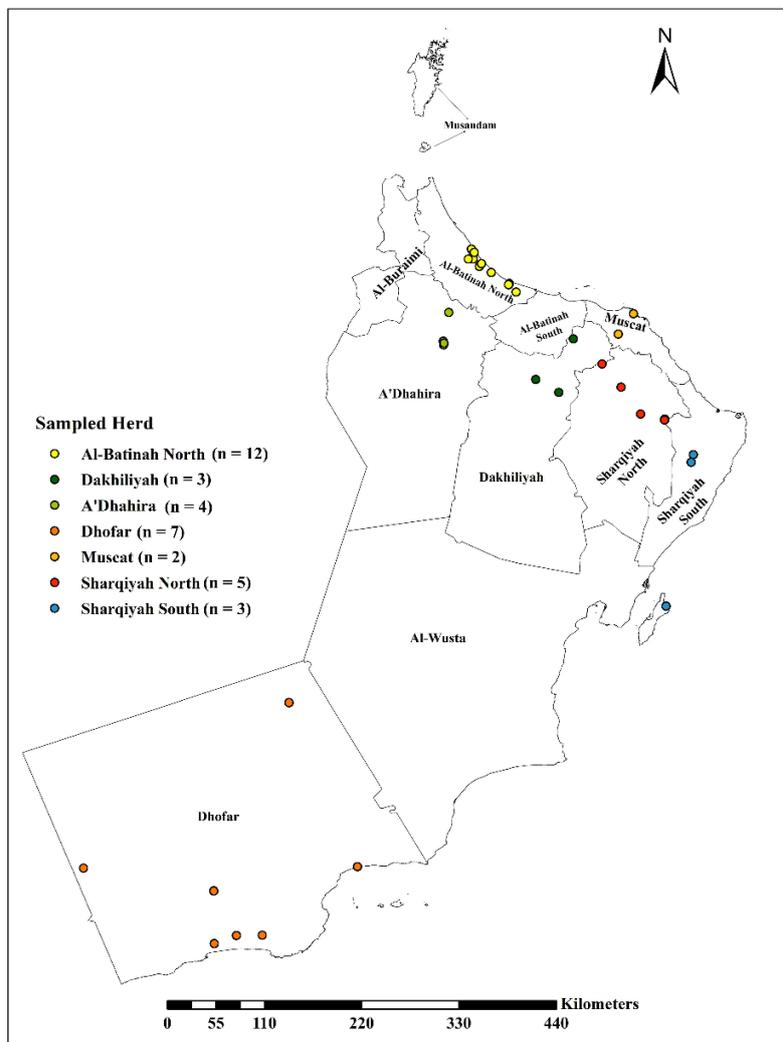


Fig. 1
Location of the mixed species herds from which camels were sampled for this study

The serum samples from camels were collected from FMD NSP-Ab positive herds of mixed species. The samples were investigated using three commercial test kits: ID Screen[®] FMD NSP competition (IDvet, Grabels, France), Anigen rapid FMD NSP–Ab test kit (BioNote, Inc., Hwaseong-si, Republic of Korea) and a solid-phase competitive enzyme-linked immunosorbent assay (cELISA) (IZSLER Biotechnology Laboratory, Brescia, Italy), respectively.

ID Screen[®] foot and mouth disease non-structural protein competition enzyme-linked immunosorbent assay

The ID Screen[®] FMD NSP assay is a commercial cELISA for detection of antibody to the NSP of FMDV in serum from multiple species. The microwells of the ELISA plate were coated with FMDV NSP and the test was carried out as recommended by the manufacturer to detect FMD NSP–Ab. The test was performed by strictly adhering to the guidelines provided by the manufacturer. The optical density (OD) of each well was read at a wavelength of 450 nm. The competition percentage (S/N%; OD of specimen divided by OD of negative control) was calculated for the samples and those with $S/N\% \leq 50\%$ were considered to be positive.

Anigen rapid foot and mouth disease non-structural protein antibodies test kit

This is a rapid immunochromatographic assay for the qualitative detection of FMDV antibodies in whole blood, serum or plasma of multiple species. Briefly, 10 µl of serum was aliquoted into the square sample hole, and after 1 min three drops of assay diluent were added to the round assay diluent hole. The results were interpreted after 15 min of incubation at room temperature. A sample with the development of a control line and dark test line was considered positive for the presence of FMD NSP–Ab.

Solid-phase competitive enzyme-linked immunosorbent assay

A solid phase cELISA for the detection of antibodies specific to FMDV serotype O was used. The microwells of the ELISA plate were coated with FMDV type O inactivated antigen captured by homologous monoclonal antibodies (MAbs). The kit was recommended by the manufacturer to detect antibodies in serum or plasma samples from FMDV-infected animals of any susceptible species. The optical density of each well was read at a wavelength of 450 nm, and sera with percentage inhibition $\geq 70\%$ at 1/10 dilution were considered to be positive.

Results and discussion

The camel sera were collected from FMD NSP–Ab positive herds of mixed species, where antibodies were detected in 32 cattle and 116 small ruminants (56 goats and 60 sheep). The results showed that the camel samples were all negative by the three test kits (Table I), although 18 out of 884 farms reported recent/ongoing FMD outbreaks at the time of sampling.

Table I

Results of non-structural protein testing in field animals from various governorates using two commercial test kits: ID Screen® foot and mouth disease non-structural protein competition enzyme-linked immunosorbent assay and Anigen rapid foot and mouth disease non-structural protein antibodies test kit

Governorate	Camels tested							Ruminants tested			
	Herd	Camel	Sex		Age (years)			NSP positive	NSP positive		
			Male	Female	≤ 2	2.1–5.0	> 5		Cattle	Goat	Sheep
A'Dhahira	4	18	2	16	5	3	10	0	0	1	4
Al-Batinah North	12	50	5	45	6	12	32	0	14	28	25
Dakhiliyah	3	15	7	8	5	6	4	0	5	9	10
Dhofar	7	30	1	29	9	7	14	0	4	4	3
Muscat	2	8	0	8	3	1	4	0	6	7	6
Sharqiyah North	5	17	6	11	7	8	2	0	3	5	10
Sharqiyah South	3	13	1	12	0	2	11	0	0	2	2
Total	36	151	22	129	35	39	77	0	32	56	60

NSP: non-structural protein

All the sampled camels had been born and raised in the herds in which they were tested. Out of the 36 herds sampled, in 20 (55.6%) herds both cattle and small ruminants were found to be NSP positive, and in the remaining 16 (44.4%) either small ruminants ($n = 14$ herds, 38.9%) or cattle ($n = 2$ herds, 5.6%) were found to be FMD NSP–Ab positive (Table I).

Foot and mouth disease outbreaks are common in Oman and serotype O is the predominant strain (11). In Oman, camels are generally kept in contact with susceptible ruminant species and exposed to FMDV through outbreaks in these animals. In this study, the camel sera tested came from herds where camels were kept in close contact with NSP–Ab positive ruminant cohorts. The three

serological tests used were designed to detect antibodies in multiple species. A recent FMD outbreak was reported on 4 out of 36 of the sampled farms, and serotype O was detected in samples collected at the time of these outbreaks. However, all the samples from camels were found to be negative on the three tests. This finding supports previous reports that camels are not infected by FMDV, and they do not play a role in its epidemiology (2, 4, 12). However, some studies have reported the presence of antibodies against FMDV in camels in Nigeria (6) and Saudi Arabia (7). Although both manuscripts reported unrestricted contact of camels with susceptible or infected ruminants, the results of serological or molecular investigations in these ruminants were not reported. The failure to detect antibodies against FMDV in the present study could be related to the presence of different serotypes of FMDV or the absence of sufficient direct contact with infected cohorts. In Oman, camels have more direct contact with small ruminants than with cattle, except for those kept in the highlands of southern Dhofar governorate. The maintenance of FMDV for long periods in small ruminants, in the absence of cattle, is uncertain (1, 13). Small ruminants are most likely to transmit FMDV in the early stages of clinical or subclinical infection and the risk of transmission decreases seven days post infection (14). This may be a possible reason for limited exposure to FMDV in the Omani camels tested. The authors recommend the collection of probang samples of oesophagopharyngeal fluid in future research, with testing for viral recovery. This proposed study would provide data to clarify the potential role of FMDV infection or transmission in camels.

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