academicJournals

Vol. 7(16), pp. 1574-1578, 16 April, 2013
DOI: 10.5897/AJMR12.2032
ISSN 1996-0808 ©2013 Academic Journals
http://www.academicjournals.org/AJMR

African Journal of Microbiology Research

Full Length Research Paper

Serosurveillance for some diseases in livestock living within protected areas designated for wildlife reintroduction in Saudi Arabia

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Accepted 24 January, 2013

The aim of this study is to investigate the prevalence of some diseases in domestic livestock in two protected areas in Saudi Arabia where gazelles have been reintroduced. King Khalid Wildlife Research Centre (KKWRC) was established in 1986 to breed and undertake scientific research on Saudi wildlife for reintroduction purposes. Mountain gazelles (*Gazella gazella*) were reintroduced to the Ibex Reserve 150 km south of Riyadh in central Saudi Arabia, which supports viable population of wild ibex. Sand gazelles (*Gazella marica*), Mountain gazelles and Arabian oryx (*Oryx leucoryx*) were reintroduced to Uruq Bani Ma'arid (UBM) Reserve in the Al Rub al Khali desert. Domestic livestock (camels, sheep and goats) owned by local people use the Reserves and the area surrounding for grazing and there is contact between these animals and reintroduced wildlife. Two surveys have been carried out at each Reserve. Serum samples collected from 1012 camel, sheep and goats were screened for some viral, bacterial and parasitic diseases that are of particular concern in Saudi Arabia. The results show the presence of antibodies against tuberculosis, brucellosis, bluetongue virus, akabane virus, contagious pustular dermatitis and toxoplasmosis. The Suadi Wildlife Authority (SWA) coordinated with the Ministry of Agriculture and established monitoring and remedial programmes to control diseases reported in the present study. The epidemiological significance, of the study, to wildlife was discussed.

Key words: Domestic livestock, serosurvaillence, Ibex Reserve, Uruq Bani Ma'arid, Saudi Arabia.

INTRODUCTION

The Saudi Wildlife Authority (SWA) has established 16 protected areas throughout the country. These areas have been selected according to their habitats and suitability to support animals and plants that are indigenous to the Kingdom. Of these protectorates, the Ibex Reserve and the Uruq Bani Ma'arid (UBM) Reserve have been selected to release Saudi wildlife into them. In 1991 a group of mountain gazelle (*Gazella gazella*) have been released

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into the Ibex Reserve and during 1995 a herd of sand gazelle (*Gazella marica*) together with mountain gazelle and Arabian oryx (*Oryx leucoryx*) have been released into UBM (Dunham et al., 1993; Wacher and Kichenside, 1998). Wild animals released into the Reserve have been bred at King Khalid Wildlife Research Centre (KKWRC). Before their release, wild animals were routinely vaccineted against the common diseases in the area and dosed with a broad spectrum anthelmintic in order to control prevalent diseases and parasites (Mohammed, 2003; Mohammed et al., 2003).

Wildlife in Saudi Arabia, during the last century, was on its peak by observing huge herds of sand, mountain and Saudi gazelles, Arabian oryx, cheetah, Aabian leopard, ostrich and onager (Carruthers, 1935; Raswan, 1935; Vesey-Fitzgerald, 1952). During the late 80 years all these large animals have been greatly reduced in numbers and some such as ostriches, onager sand and Saudi gazelles Arabian oryx have exterminated from the wild (Habibi, 1986; Kingdon, 1988; Thouless, 1991; Hammond et al., 2001). The large mammal species that has survived better than any is the Nubian Ibex, probably because it is capable of surviving in the most inaccessible rocky areas as in the Ibex Reserve. The Ibex Reserve is historically a home for the mountain gazelles and the ibex while UBM in the Empty Quarter is the home for the Arabian oryx and the sand gazelle. For this reason the SWA is releasing these animal species into these protected areas in order to conserve them and to make sure none of the reason that led to their extermination from the wild still exists including infectious diseases, which may possibly be contracted from domestic livestock.

Diseases of domestic livestock in Saudi Arabia which can potentially be transmitted to wildlife as a result of coming in contact have been reported in the Kingdom (Abu Elzein et al., 1990; 1998; 2004; Housawi et al., 1992; Hussein et al., 1988; Mohammed and Hussein, 1994). In the present investigation a serological disease survey for some common prevalent diseases in the Kingdom has been carried out to assess how prevalent these diseases in domestic livestock raised in some protected areas where some susceptible wildlife were reintroduced.

MATERIAL AND METHODS

Study areas

The Ibex Reserve

The Ibex Reserve is 150 km south of Riyadh in central Saudi Arabia (23º 30' N and 46º 30' E). The Reserve covers around 1800 km^2 and comprises a series of deep and steep sided canyon wadis separated by gently undulating, stony, limestone plateau, 800 to 1100 m above sea level (Dunham et al., 1993). A viable population of Ibex (*Capra nubiana*) was reported in the Reserve which has been historically protected by local people before the Saudi Wildlife Authority (SWA) took over the responsibility of managing the Reserve. A group of 54 Idmi gazelle (*Gazella gazella*) have been reintroduced into the Reserve during 1991 and 1992. The population started to increase followed by partial decline and then stabilized (Dunham, 1997; Dunham 2001). Domestic livestock are owned by the locals who live in the Ibex Reserve and they are counted in large numbers during the routine surveys conducted in the Reserve.

Uruq Bani Ma'arid (UBM)

Uruq Bani Ma'arid Reserve is located 700 km south of Riyadh (18º 30' - 20º N 54º - 46º 15' E) in the western edge of the Empty Quarter desert (Child and Grainger, 1990).The area covers 1200 km^2 with central core zone of 2200 km^2 as strictly protected. Reem (*Gazella marica*), Idmi (*Gazella gazella*) and the Arabian oryx (*Oryx leucoryx*) have been reintroduced into the Reserve during 1995 to 1996 (Wacher and Kichenside, 1998). Sheep, goats and camel owned by local people are seen in different camping sites throughout the Reserve.

Sample collection

Blood samples were collected in plain vacutainers from different domestic animals by jugular venipuncture. Serum was separated on-site and kept frozen until used. It was extremely difficult to convince the local people to get blood samples from their animals especially from camels. Veterinary services and medications were provided free of charge to encourage animal owners to cooperate with sample collection campaigns.

Two surveys were conducted in each Reserve. During the first survey a total of 223 samples were collected from sheep, goats and camels in the Ibex Reserve and a total of 146 samples were collected from sheep, goats and camels in UBM. During this survey the samples were screened against some viral, bacterial and parasitic diseases. In the second survey conducted at the Ibex Reserve a total of 338 (130 goats, 72 sheep and 136 camel) samples were collected from domestic livestock while 305 (123 goats, 86 sheep and 96 camel) samples were collected from domestic livestock in UBM Reserve. Samples collected during the second survey were only screened for some bacterial diseases.

Laboratory methods

Serum samples were subjected to laboratory investigations for detecting antibodies against the following diseases: bluetongue, infectious pustular dermatitis (orf), Peste des Petits Ruminants (PPR), Akabane, tuberculosis, brucellosis and toxoplasmosis. For the detection of bluetongue and orf antibodies, the agar immunodiffusion test (AGID) was performed. For the detection of bluetongue virus antibodies, the method of Mohamed and Taylor (1987) was performed using soluble bluetongue virus antigen, prepared from bluetongue virus serotype 1 (provided by Pirbright Laboratory, UK). The method of Sawhney et al., (1973) was used for the detection of orf antibodies.

Akabane virus and PPR virus antibodies were detected using the microserum neutralsation test (SNT) of Sellers and Herniman (1981) and Rossiter et al., (1985) respectively. The PPR virus used in this study was the Saudi isolate (SAU 1/88) which was isolate d by Abu Elzein et al., (1990). For the detection of tuberculosis antibodies the method of Rietkerk et al., (1993) was followed using the ELISA test developed for the red deer in New Zealand. The tube and slide agglutination tests were sued to detect antibodies against brucellosis in domestic animals using kits from Biomeriuax, France.

The indirect haemagglutination test (IHA) was used for the detection of toxoplasmosis antibodies following the method of Mohammed and Hussein (1994).

Table 1. Prevalence of antibodies against some viral, bacterial and parasitic diseases in domestic livestock in the Ibex Reserve.

Animal specie	BT	PPR	Akabane	ORF	TB	Brucellosis	Toxoplasmosis
Sheep and goats (184)	8(4.3%)	-	6(3.3%)	15 (8.2%)	9 (4.9%)	3(1.6%)	21(11.4%)
Camel (39)	4 (10.3%)	-	3(7.7%)	8 (20.5%)	-	1(2.6%)	10(25.6%)

BT, bluetongue; PPR, Peste des Petits Ruminants ; ORF, infectious pustular dermatitis; TB, tuberculosis.

Table 2. Prevalence of antibodies against some viral, bacterial and parasitic diseases in domestic livestock in Uruq Bani Ma'arid Reserve.

Animal specie	BT	PPR	Akabane	ORF	TB	Brucellosis	Toxoplasmosis
Sheep and goats (127)	105 (88.6%)	-	127 (100%)	-	4 (3.1%)	1(0.8%)	2(1.6%)
Camel (19)	11 (57.9%)	-	19(100%)	-	1(5.2%)	1(5.2%)	1(5.2%)

BT, bluetongue; PPR, Peste des Petits Ruminants; ORF, infectious pustular dermatitis; TB, tuberculosis.

RESULTS

The Ibex Reserve disease survey

Table 1 shows the results of the disease survey conducted in domestic livestock in the Ibex Reserve. Sheep and goats exhibited 4.3% prevalence of antibodies to bluetongue virus disease and 10.3% prevalence was reported from camel in the Reserve. Antibodies against Akabane virus disease have been reported in 3.3% of the sheep and goats investigated and in 7.7 % in the camel. Antibodies against infectious pustular dermatitis (orf) were detected in 8.2% of the sheep and goats while 20.8% was reported from camel. No antibodies were detected against PPR in all domestic animals investigated.

Bacterial disease antibodies were reported as follows: 4.9% of the sheep and goats showed evidence of antibodies against tuberculosis and none of the camel showed antibodies against tuberculosis. Regarding *Brucella* antibodies, it has been reported in 1.6% of the sheep and goats and in 2.6% of the camel at the Reserve. *Toxoplasma godnii* antibodies have been detected in 11.4% of the sheep and goats and in 25.6% of the camel investigated at the Reserve.

Results of the second survey conducted at the Reserve indicated that antibodies against tuberculosis were detected in 3.3% of the goats, in 4.2% of the sheep investigated at the Ibex Reserve and none of the camel investigated showed evidence of antibodies against tuberculosis. *Brucella* antibodies have been detected in 2.0% of the goats investigated and none was detected in sheep and camel from the Reserve.

The Uruq Bani Ma'arid Reserve Survey

Table 2 shows the results of disease screening of domestic livestock in UBM. No antibodies against PPR and Orf viral disease have been report from all animals investigated. Antibodies against bluetongue virus disease have been reported in 88.6% of the sheep and goats and in 57.9% of the camel investigated at UBM. On the other hand 100% of the samples investigated from sheep, goats and camel showed evidence of Akabane virus disease. Tuberculosis antibodies have been detected in 3.1% of the sheep and goats and in 5.2% of the camel investigated at the Reserve. *Brucella* antibodies have been reported in 0.8% of the sheep and goats and in 5.2% of the camel investigated at the Reserve. *Toxoplasma gondii* antibodies were detected in 1.6% of the sheep and goats and in 5.3% of the camel.

Results of the second survey showed that 2.4% of the goats and 1.2% of the sheep revealed antibodies against tuberculosis, while none of the camel showed tuberculosis antibodies. With regard to *Brucella* antibodies; it was found in 1.6% goats, 1.2% sheep and 1.0% camel.

DISCUSSION

The serological disease survey conducted at two protectorates in the Kingdom of Saudi Arabia reveals various diseases reported from domestic livestock. The reintroduced wildlife will inevitably come in contact with domestic livestock and hence the possibility of exchange of diseases between the two groups of animals is highly likely to happen. Although, PPR has previously been reported from the Kingdom (Abu Elzein et al., 1990) but none of the samples screened during the present study show evidence of this disease, which means that the disease is absent from the two protected areas investigated. Likewise the infectious pustular dermatitis (orf) has been reported to be widely distributed in the Kingdom (Housawi et al. 1992; Gameel et al. 1995; Abu Elzein and Housawi, 1997), during the present investigation, however, none of the samples screened from UBM protected areas showed any evidence for this disease. Animals screened from the Ibex Reserve, however showed antibodies against orf

and infected domestic animals are certainly a potential source of infection to wildlife and humans in the area. As a precaution; reintroduced mountain gazelles in the Ibex Reserve should be kept away from domestic livestock in order to minimize contact, hence controlling the spread of orf since gazelles are susceptible to this disease (Yeruham et al. 1994).

The absence of PPR and orf antibodies from domestic animals in UBM Reserve is explained by the fact that the Rub Alkhali or the Empty Quarter where the Reserve locates represents a natural barrier for animals within its zone; hence it is likely that contagious viral diseases could represent a potential hazard to animals living in the area. On the other hand, high levels of antibodies of two arboviruses (bluetongue and akabane) were found in this area. These two viral diseases are transmitted by *Culicoides* vectors and the arid environment of UBM Reserve is unsuitably ideal for the breeding of *Culicoides* (Lane, 1983; Al-Busaidy and Mellor, 1991; Mellor, 1996). This fact can be explained possibly by wind-driven virally infected arthropod vectors and this wind could be either from other parts of the Kingdom or from countries around Saudi Arabia. The levels of infection of these arboviruses from the animals in the Ibex Reserve could be explained by the fact that the mountainous ecosystem is not suitable for breeding of the vector(s); or that the directions of the blowing winds, bathing the Ibex Reserve area, don't bring infected vectors to the area.

Detection of tuberculosis and brucellosis antibodies in both Reserves is interesting and there is always a possibility that reintroduced wild animals might become infected with these bacterial diseases as a result of coming in contact with infected domestic livestock. However, lower rates have been reported during the recent surveys in both protected areas. This is possibly an indication that there is no increase in the numbers of infected animals or no new infected animals have been reintroduced into the Reserves. The low level of tuberculosis antibodies in both protected areas is consistent with the desert arid environment and the difficulty in the spread of the disease in such areas. Hence, the reintroduced animals may hardly contact the infection when coming in contact with domestic livestock. Since both diseases are zoonotic so humans living in the area are subjected to the infection with these two diseases. Locals in the area have been informed with these results and they were told about the seriousness of these diseases. Furthermore, the Ministry of Agriculture has been notified of these results. A joint control programme is taking place in collaboration with the Ministry of Agriculture in order to control these two important diseases.

Detection of *Toxoplasma gondii* antibodies indicates that the definitive host is prevalent in both protected areas. Domestic cats are most likely the source of infection as *T. gondii* antibodies have previously been reported from wildlife and camel (Hussein et al., 1988; Mohammed and Hussein, 1994). But the possibility of other wild felids like *Felis margarita*, *Felis silvestris*, *Acinonyx jubatus* and *Panthera pardus* as potential definitive hosts could not be excluded as all these species of felines occur in Saudi Arabia and that they likely occur in the protected areas (Harrison and Bates, 1991. Most likely that reintroduced gazelles and oryx could be infected with *T. gondii* as a result of consuming food contaminated with cats' faeces. Humans are also subjected to infection as a result of any contamination that may occur as a result of having cats around their vicinity. *Toxoplasma gondii* antibodies have previously been reported in gazelles at King Khalid Wildlife Research Centre (KKWRC) but it has not been reported from the oryx living under the same conditions, however, it has been reported from Oryx leucoryx from outside KKWRC and has been associated with abortion (Mohammed and Hussein, 1994; Mohammed et al. 2012).

Reintroducing gazelles and oryx into protected areas in the Kingdom of Saudi Arabia would undoubtedly augment the wildlife conservation effort by SWA in the country and would constitute a genuine outlet for the captive breeding programmes in the country. Detecting antibodies against certain diseases will draw attention to such diseases and enable vaccination or other measure for controlling such diseases. Such diseases would also be considered in case of any mass deaths or decrease in animal numbers in the protected areas.

ACKNOWLEDGEMENTS

The authors express their gratitude to His Highness Prince Bandar bin Saud, President of the Saudi Wildlife Authority, for encouraging research at King Khalid Wildlife Research Centre. Thanks are also due to Dr Thomas Butynski, KKWRC Director, for his encouragements. The Authors extend their appreciation to the Deanship of Scientific Research at King Saud University for funding the work through the research group project No RGP-VPP-020.

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