Epidemiological investigation on Bovine alphaherpesvirus *1 and bovine viral diarrhea virus in cattle and camels in southern Egypt*

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Summary

In this study, the ELISA procedure was used to detect antibodies against bovine viral diarrhea and infectious bovine rhinotracheitis (IBRV) viruses.

The BVDV serological survey in Aswan province in southern Egypt was carried out on 184 unvaccinated cattle and camels. The overall seroprevalence was 18.48% (34/184), in cattle and 2.18% (2/92) in camels. The serological survey on infectious bovine rhinotracheitis virus IBRV antibodies for was conducted on 460 unvaccinated cattle from three different provinces (Qena, Luxor, and Aswan).

The overall seroprevalence was 60.00% (276/460). The infection rate in Aswan was a higher (83.70%) than Luxor and Qena, 54.65.% and 53.63%, respectively. Epidemiological status was established to clarify the influence of location and management systems for the increased rate of infection in animals.

This study aims to investigate the seroprevalence rate of *Bovine alphaherpesvirus* 1 and Bovine viral diarrhea virus in different animals and localities in southern Egypt.

Introduction

Bovine viral diarrhea virus (BVDV) and *Bovine alphaherpesvirus 1* (BoHV-1) are important pathogen of cattle that cause a large economic loss due to reproductive disasters, several calf mortalities, enteric and respiratory disease. Bovine viral diarrhea and infectious bovine rhinotracheitis are globally distributed and tend to be endemic in most animal populations (Houe 1999, Lindberg 2003). Bovine viral diarrhea is responsible for huge economic losses (Fourichon *et al.* 2005) in farm animals, the BVD virus is RNA-virus which belongs to the *Pestivirus* genus of the *Flaviviridae* family. BVDV can be transmitted from animals to another animal iatrogenically and through nasopharyngeal secretions (Lindberg and Houe 2005). The acute infection typically remains inapparent or causes only moderate disease and establishes a strong immunity. The significance of BVDV is due to the occurrence of persistently infected animals, resulting from infections of pregnant cows throughout gestation before the development of

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the immune system of the fetus, the virus is not recognized and the animal after birth will spread the virus long-lasting. Persistently infected cattle may also enhance fatal mucosal disease (Bachofen et al. 2008).

The isolation of BVDV and the prevalence of persistently infected animals have been documented in a range of free-ranging and captive species (Frölich *et al.* 2002, Vilcek and Nettleton 2006).

Bovine alphaherpesvirus 1 (BoHV-1) is an important pathogen of cattle, affecting the respiratory and genital tracts. It can cause abortion, infertility, encephalomyelitis conjunctivitis, mastitis, enteritis and dermatitis (Straub 2001, Muylkens *et al.* 2007).

BoHV-1 and different viral infections can play a direct or indirect role in the etiology of bovine mastitis (Wellenberg *et al.* 2002, Barkema *et al.* 2009), thereby affecting milk parameters (Halasa *et al*. 2007). It has been observed that milk parameters of subclinical mastitis had a significantly greater somatic cell count and lower fat content compared with those of healthy cows (Tomazi *et al.* 2015).

BoHV-1 can stay latent throughout the lifetime of the host in the trigeminal ganglion, pharyngeal tonsils and the sacral ganglia following a main infection of the conjunctiva, nasal cavities, and genitalia, (Ackermann and Wyler 1984, Winkler *et al.* 2000) or can be reactivated via factors that cause stress or alter the immune system of the animal such as parturition, transportation, mixing or movement of animal (Jones and Chowdhury 2010), inclement weather, overcrowding (Sylvia Van Drunnen, 2006) or following therapy with corticosteroids (Winkler *et al.* 2000).

BVDV and BoHV-1 long-time eradication programs have been executed in some European countries, which is based on barring the use of vaccines, recognizing and removing infected animals, collectively with accelerated herd biosecurity. The national BVD programs in the Scandinavian countries, as well as the regional programs in a few other nations in Europe, have had success with control of BVDV and are pointing toward eradication (Synge *et al.* 1999, Bitsch *et al.* 2000).

Material and methods

The hypothesis of the study

Southern part of Egypt (Upper Egypt) is a naive area for different kinds of research. Investigating the seroprevalence of BoHV-1 and BVD in different animals and localities would clear the picture of infectious diseases burden and give a chance for strong preventive and control measures.

Animals and geographic locations

A total of 644 serum samples were collected from apparently and clinically healthy animals including cattle and camels of different locations, breeding systems and sex.

Serum samples were randomly collected between May/ 2017 to June/ 2019 from animals of different villages in Aswan, Qena and Luxor governorates in southern Egypt (Figure 1).

The animals were not subjected to vaccination program agains amongst individual owners and smallholder farms located in similar environmental and husbandry conditions which were characterized by hot and dry weather.

Data collection

Data including breed, age, sex, body condition, temperature, respiratory rate, and mucous membranes were recorded.

Blood sampling

Blood samples were collected through vein puncture from each animal in glass tubes without anticoagulant and serum was separated by centrifugation and stored at –20C until use.

ELISA procedure

Two commercial ELISAs (Monoscreen Ab ELISA BVDV, NS3, Bio-X Diagnostics, Belgium; ID Screen IBR gB Competition, France) were used to examine the collected sera. The protocols described by the kit manufacturer were followed and also the results were expressed according to the instructions of the manufacturers.

Data management and analysis

The collected data were analyzed using Microsoft 2016 excel.

Results

All animals appear generally healthy and all general parameters including temperature, mucous membrane examination and pulse rate were in normal ranges.

For BVD, serum samples were collected from 184 animals including cattle and camels from Aswan in southern Egypt (Figure 1).

The BVD overall seroprevalence was 18.48% (34/184), 34.78% (32/92) and 2.18% (2/92) in camel (Table I).

For infectious bovine rhinotraheitis (IBR), serum samples were collected from 460 cattle from three governorates Qena, Luxor, and Aswan (Figure1 and Table II) was 60.00% (276/460).

Regarding possible factors which may act as a predisposing factor to increase the rate of infection in animals (Table III), it appeared that location and breeding system might play an important role. Aswan had a higher infection rate (83.70%) than Luxor (54.65.%) and Qena (53.63%), while intensive breeding system had a higher infection rate than the individual breeding system.

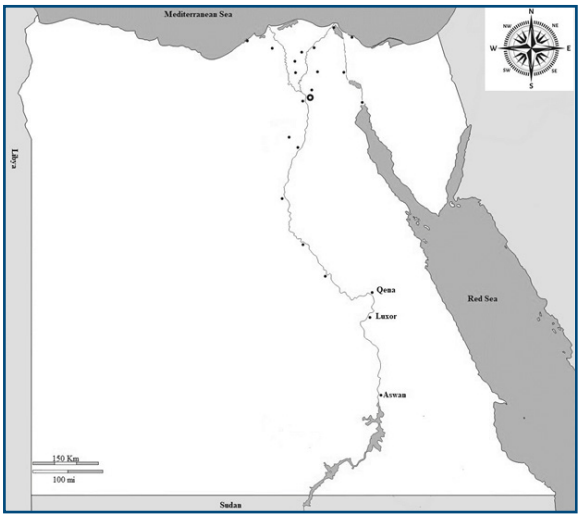

Figure I. *Map of Egypt showing the location of Qena, Luxor and Aswan governorates where the samples have been collected.*

Table I. *Percentage of bovine viral diarrhea virus infection of cattle and camels in Aswan.*

Animals	Sex	Location	Age	Breeding System	Positive No. (%)	Negative No. (%)	Total No.
Cattle	Female	Aswan	3-5 years	Individual breeding system	32 (34.78%)	60 (25.22%)	92
Camel	Male	Aswan	3-5 years	Individual breeding system	2 (2.18%)	90 (98.82%)	92
Total					**34(18.48%)**	**150(81.52%)**	**184**

Table II. *Percentage of infectious bovine rhinotracheitis in cattle in southern Egypt.*

Location	Positive No. (%)	Negative No. (%)	Location
Qena	148 (53.63 %)	128 (46.37%)	276
Luxor	42 (54.65%)	50 (54.35%)	92
Aswan	77 (83.70%)	15 (16.30%)	92
Total	**267 (60.00%)**	**193 (40.00%)**	**460**

Table III. *Infectious bovine rhinotracheitis infection of cattle in regard to location, age, sex, and breeding system.*

Location	Sex	Age	Breeding System	Positive No. (%)	Negative No. (%)	Total No.
Qena	Female	3-5 years	Intensive breeding system	133 (52.36 %)	121 (47.64%)	254
	Male	3-5 years	Intensive breeding system	15 (68.18%)	7 (31.82%)	22
Luxor	Female	3-5 years	Individual breeding system	35 (42.17%)	48 (57.83%)	83
	Male	3-5 years	Individual breeding system	7 (77.78%)	2 (22.22%)	9
Aswan	Female	3-5 years	Intensive breeding system	74 (84.10%)	14 (15.90%)	88
	Male	3-5 years	Intensive breeding system	3 (75.00%)	1 (25.00%)	4
Total				**267(60.00%)**	**193 (40.00%)**	**460**

Discussion

Infection with BVDV is mutually recognized throughout the globe as one of the most important causes of reproductive disorders (Bolin and Ridpath, 1996). The number of samples tested in the present study was not large, because sampling was restricted to animals for which data on age, sex, breed, and vaccination history were survey overall seroprevalence was 18,48% (34/184), in 34.78% (32/92) in cattle and 2.18% (2/92) in camels. This study provides useful information on the current BVDV antibody prevalence in southern Egypt as no data are currently available for cattle and camels. The BVD infection is commonly transmitted between animals by inhalation or ingestion of nasal and ocular secretions, saliva, urine, and feces. The infection is additionally transmitted by semen from an infected bull, or by transfer of contaminated embryos. The fetus infection can cause abortions, congenital malformations, persistently infected animals, mummifications, and embryonic absorption (Houe 1995).

Latent infections are possible, making it difficult to regulate the exposure of recent animals by relying on clinical examination and quarantine. In our result, the IBR overall seroprevalence was 60.00% (276/460) in this study Aswan had a higher infection rate (83.70%) than Luxor (54.65 %) and Qena (53.63%). This result for farm animals of the southern part of Egypt lead us to indicate that there is no risk factor neither from the breeding system or geographic location in southern Egypt, this may be due to there is no high difference in temperature and climate in this area. BoHV-1 could be a generally spread pathogen showing critical differences in regional incidence and prevalence concerning the geographical area and breeding management (Ackermann and Engels 2006).

The best method for the control of IBR infection in cattle herds has been vaccination of the animals. The profitability of cattle herds relies upon cost control and the creation of saleable items. Disease with BoHV-1 or BVDV can diminish reproductive efficiency (Inui et al. 2000).

BoHV-1 which harms the production output of infected cattle herds contributes to substantial economic losses for cows (Renault *et al.* 2018). BVDV is the pathogen that affects the reproductive system most in cattle, contributing to low rates of pregnancy, abortions, and congenital abnormalities, as well as increasing the susceptibility of the animals to other respiratory and enteric pathogens (Mehmet *et al.,* 2016). Various factors contribute to the calving interval variation. Some of them depend primarily on the genetic material and others only on the environment or the relationship between genetic and environmental variables (Abdalla *et al.* 2017). The prevalence of infectious agents in cattle herds can be attributed to many variables: health care of livestock and herds, method of diagnosis, nature of the samples to be tested and the processing system (Walz *et al.* 2015). The target animals and vaccination systems for vaccines against BoHV-1 and BVD are very alike. Polyvalent vaccines can be used with different vaccinations schemes including the booster (Álvarez *et al*. 2007, Saravanajayam *et al*. 2015, Gethmann *et al*. 2015, Santman-Berends *et al.* 2018). No definitive research has so far been performed on the efficacy of BoHV-1 / BVDV vaccination in reducing reproductive losses caused by these diseases in cattle. Also, there is an apparent risk that BVDV modified live vaccines cause fetal deaths, so it is an important dilemma for practicing veterinarians working in the field to determine whether or not vaccination can be carried out (Schumaher *et al.* 2019).

Conclusions

This study provides valuable data on the high prevalence of BVDV and IBR in cattle and camels in southern Egypt; that will assist in the development of prevention and control strategies for the disease. The high level of BVDV and IBRV infection in cattle may be the principal factor to limit the cattle industry in Egypt . More researches and efforts are needed from governmental and non-governmental partners to minimize the economic losses caused by viral infection.

Authors contributions

Both authors contributed equally in sampling collection, experiment design, the data analysis, interpretation of results, and writing the manuscript.

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