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## SUSCEPTIBILITY OF MINK TO CERTAIN VIRAL ANIMAL DISEASES FOREIGN TO THE UNITED STATES

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Abstract: Mink (Mustela vison) were inoculated with viruses: African horse sickness (AHS), African swine fever (ASF), bovine herpes virus II (BHV2), foot-and-mouth disease (FMD), goat pox (GP), hog cholera (HC), peste des petits ruminants (PPR), rinderpest (RP), swine vesicular disease (SVD), vesicular exanthema of swine (VES) and vesicular stomatitis (VS). Their susceptibility was measured by development of clinical signs, virus isolation and detection of precipitin and/or virus neutralizing antibodies. SVD virus produced a lesion in one mink. Virus was isolated from mink inoculated with SVD, FMD and BHV2. Neutralizing and/or precipitin antibodies were detected in mink inoculated with ASF, FMD, GP, RP, SVD and VS viruses. Mink were not susceptible to AHS, HC, PPR and VES viruses.

#### INTRODUCTION

Experimental infection of certain wild animals with some viruses of domestic livestock foreign to the United States are known to produce acute infection with lesions. 3,5,6,14,15 White-tailed deer (Odocoileus virginianus)<sup>5,6</sup> and whitecollared peccaries  $(Tyassu \ tajucu)^3$  are susceptible to rinderpest (RP) virus. White-tailed deer were also susceptible to foot-and-mouth (FMD) disease virus.9 On the other hand, one-toed pig (Sus Scrofa) were extremely susceptible to viruses of vesicular exanthema of swine (VES), vesicular stomatitis (VS), African swine fever (ASF), swine vesicular disease (SVD), hog cholera (HC) and FMD but not to RP virus.15 White-collared peccaries developed mild clinical signs with FMD, VS, VES and HC viruses but were resistant to African swine fever (ASF) virus.3 Armadillos (Dasypus novemcinctus) were susceptible to FMD but not to ASF, HC, RP, VES and VS viruses.14 Indian squirrels (Funambulus pennanti) were recently shown to be extremely susceptible to FMD by intramuscular or intradermal route but failed to cause infection by oral route or by contact.<sup>13</sup>

There are large populations of mink in the wild and in captivity in the United States. The role of mink as a carrier of the viral diseases foreign to the United States is not known. The purpose of this experiment was to establish the susceptibility of mink to AHS, ASF, BHV2 also known as bovine herpes mammilitis or allerton, FMD, goat pox (GP), HC, peste des petits ruminants (PPR), RP, SVD, VES and VS viruses (Table 1).

#### MATERIALS AND METHODS

#### **Test Animals**

The test group consisted of 15 mink. The mink were divided into four groups. Three groups, each consisting of four mink, were inoculated with viruses. The mink were anesthesized by intramuscular inoculation with a mixture of xylazine 0.3 mg  $\Xi$  and ketamine

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<sup>&</sup>lt;sup>2</sup> Rompun, Haver-Lockhart Lab., Shawnee, Kansas 66201, USA.

TABLE	1. Exp	perimental de	sign for testing	g susceptibility of	mink to certai	n animal diseas	ses foreign to the United S	States.
Group No.	Virus <sup>a</sup>	Inoculation Day	Virus Type	Virus Doses <sup>b</sup>	Site of Inoculation	Type of Serological Test Used <sup>c</sup>	Biological System Used for Virus Isolation and VN Testd	References
1	FMD	0	0,	1×10 <sup>7</sup> <sup>9</sup> MLD <sub>50</sub>	Foot Pad &	VN and CF	Mice 3-5 day old	3, 9
	RP HC	14 28	Kabete "O" Ames	5×10 <sup>3</sup> TCID <sub>50</sub> 1×10 <sup>4</sup> PLD <sub>50</sub>	1 ongue Muscular Muscular	VN FA plaque	Vero cell line PK <sup>15</sup> cell line	5 Text
	SVD	42	UK	5×10 <sup>5</sup> TCID <sub>50</sub>	Foot Pad	VN and CF	MVPK cell line	14
2	AHS GP	0 14	9 Held, Turkey	5×10 <sup>7</sup> <sup>1</sup> TCID <sub>50</sub> 1×10 <sup>4</sup> <sup>5</sup> TCID <sub>50</sub>	Muscular Muscular	VN and CF VN and AGD	Vero cell line Primary lamb testis	14, 15 1
	NS	28	ſN	×10 <sup>6</sup> 5 EID <sub>50</sub>	Foot Pad	NN	7 day old fertile chicken egg	14
en en	ASF	0	Tengani	1×10 <sup>5</sup> PLD <sub>50</sub>	Muscular	Immunoelec- troosmopho- resis (IEOP)	Swine buffy coat	7, 14, 15
	BHV2 VES PPR	14 28 42	Allerton A48	2×10 <sup>6</sup> 6 TCID <sub>50</sub> 5×10 <sup>7</sup> <sup>8</sup> TCID <sub>50</sub> 5×10 <sup>3</sup> <sup>3</sup> TCID <sub>50</sub>	Intravenous Foot Pad Muscular	NN NN	Primary bovine kidney Vero cell line Vero cell line	14 6
4	None	I	1	1	1	I	1	Ι
5	FMD		$\mathbf{A}_5$	1×10 <sup>7</sup> 5 MDL <sub>50</sub>	Foot Pad & Tongue	VN and CF	Mice 3-5 day old	3, 9, 14
<sup>a</sup> FMD AHS : BHV2	= foot-a = Africs ! = bovi	nd-mouth dis in horse sickr ne herpes viri	ease; RP = rin 1ess; GP = goa us II; VES = v	derpest; HC = ho (t pox; VS = vesic esicular exanthem	g cholera; SVI ular stomatitis 1a of swine; PI	) = swine vesicu ; ASF = africar PR = peste des I	ılar disease 1 swine fever; 0etits ruminants	
<sup>c</sup> VN =	= mous	e lethal dose; eutralization;	TCID = tissue FA = fluoresc	: culture infective sent antibody; CF	dose; PLD = p = complement	ig lethal dose; F fixation; AGD	GID = egg infective dose = agar gel diffusion	
dVero =	= green	mondey kidn	ey; PK <sup>15</sup> and <b>N</b>	AVPK = pig kidne	- fa		)	

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hydrochloride 1.8 mg.  $\square$  Three uninoculated mink of the 4th group served as controls. All mink of groups 1, 2, 3 and 4 were inoculated with FMD type A<sub>5</sub> virus and called group 5. All inoculated mink were observed for 14 days postinoculation (DPI) for clinical signs of infection. Blood samples for virus isolations were taken at 2, 3 and 7 DPI. The blood samples were diluted 1:10 and 1:100 in Hank's BSS before inoculating into tissue culture and animals, respectively. Sera for serological tests were taken at 14 DPI from the jugular vein.

#### **Cell Cultures and Media**

Vero (green monkey kidney) cell line, pig kidney cell lines (PK 15 and MVPK), primary lamb testis, primary bovine kidney and swine buffy coat were used.

MEM (Eagle) with Hank's salt, Lglutamine, 2.2g NaHCO<sub>3</sub>/L, penicillin, (100 IU/ml), streptomycin (50  $\mu$ g/ml) and kanamycin (10  $\mu$ g/ml) were used throughout the experiment. Ten percent bovine fetal calf serum was added to medium used for growing tissue culture and 5% serum for maintenance of the cultures.

### Viruses Inoculation, Isolation And Serology

Table 1 describes the experimental design.

#### Fluorescent Antibody Plaque Inhibition (FAPI) Test

FAPI test was used for hog cholera (HC). Sera taken at 14 DPI were diluted from 1:4 to 1:64 in phosphate buffered saline (PBS) pH 7.4. A 0.2 ml of each dilution of serum was mixed with 0.2 ml of viruses in PBS pH 7.4 containing 100 plaque forming unit (PFU) of HC virus. The virus-serum mixture was incubated in a 37 C water bath for 30 min. PK 15 cell line on cover slips (50 mm  $\times$  10.6 mm) in Leighton tubes were inoculated with 0.2 ml of virus-serum mixture. The virus was adsorbed for 1 h and washed 3 times with 2 ml of PBS, after which 2 ml of MEM (Eagle) with 5% fetal calf serum was added to each tube. At 18 h after infection, all coverslips were fixed in cold acetone for 10 min. Fluorescein isothiocyanate (FITC) conjugated antihog cholera serum was used as described.<sup>8</sup> A dilution of serum that inhibited 90% of the fluorescent plaques was considered the titer of the serum.

#### RESULTS

#### Virus Isolation and Clinical Signs

Three viruses were isolated from mink out of the 12 viruses used in the experiment. BHV II (Allerton), FMD type  $A_5$ and SVD viruses were isolated from blood samples (Table 2). SVD and BHV2

Virus isolated	No. isolated/ No. inoculated	Days postinoculation
BHV2	2/4	2,3
$FMD(A_5)$	1/15	1
SVD	1/4 <b>a</b>	2,3

TABLE 2. Virus isolation from blood of mink inoculated with animal disease viruses foreign to the United States.

<sup>a</sup>Mink showed a vesicle on right side of upper lip and on pad of left hind foot at 2 DPI

<sup>&</sup>lt;sup>3</sup> Ketaject, Bristol, Lab., Syracuse, New York 13201, USA.

viruses were isolated at 2 and 3 DPI from one and two mink respectively. FMD type  $A_5$  was isolated from 1 of 15 mink at 1 DPI only.

Other than one mink inoculated with SVD virus, no clinical signs were observed in mink inoculated with all other viruses used in the experiment. Small vesicles appeared on right side of the upper lip and left hind foot of that mink at 2 DPI. They were healed by 5 DPI. Virus was isolated from blood of this mink. No attempt was made to isolate virus from the vesicles.

#### **Serologic Reactions**

At 14 DPI in mink sera, antibodies were detected to ASF, FMD types  $0_1$ , and  $A_5$ , GP, RP, SDV and VS viruses (Table 3). Antibody was detected in 1 out of 4 mink to FMD type O, and ASF viruses. High virus neutralizing antibody titers were observed to RP (1:16 to > 1:64), SDV (1:16 to 1:64), VS (>1:64) and FMD type  $A_5$  (1:4 to >1:64) viruses. Precipitin antibody to GP virus was observed in all four mink and 4 of 15 mink had a complement fixing titer of 1:16 to FMD type  $A_5$  virus. Serum antibody was not

TABLE 3. Serologic response of mink to infection with various exotic animal disease viruses.

		Serological Tests	
		No. with antibody	No. inoculated
Group	Viruses <sup>a</sup>	A*	B**
1	<b>FMD</b> $(O_1)$	1/4	1/4
-	RP	ND	3/4
	HC	ND	0/4
	SVD	2/4	4/4
2	AHS	0/4	0/4
	GP	1/4 ND ND 2/4 0/4 4/4 ND 1/4 0/4 0/4	1/4
	VS	ND	4/4
3	ASF	1/4	ND
-	BHV2	0/4	0/4
	VES	0/4	0/4
	PPR	ND	0/4
4	None	0/3	0/3
5	$FMD(A_5)$	4/15	9/15

 $^{a}FMD =$  foot-and-mouth disease; RP = rinderpest; HC = hog cholera;

SVD = swine vesicular disease; AHS = african horse sickness; GP = goat pox;

VS = vesicular stomatitis; ASF = african swine fever;

BHV2 = bovine herpes virus II; VES = vesicular exanthema of swine;

- PPR = peste des petits ruminants
- $\mathbf{A} = \mathbf{IEOP} \text{ or } \mathbf{AGD} \text{ or } \mathbf{CF} \text{ tests};$

**B** = virus neutralization tests;

ND = not done

- \* = Complement fixation (CF) titer for preinfected sera was<1:8, the titer of positive sera for homologous virus varied from 1:8 to 1:32.
- \*\* = Virus neutralization titer of preinfected sera was <1:4, the titer of positive sera for homologous virus varied from 1:4 to >1:64.

observed to HC, AHS, BHV2, VES and PPR viruses.

#### DISCUSSION

The most frequent method of transmission of FMD in enzootic areas is by direct contact among susceptible animals.4 Mink were found to be partially susceptible to FMD. FMD type  $A_5$  virus was isolated in 1 of 15 mink but type O virus was not isolated. Serologic studies also indicated a partial susceptibility because antibody was induced in 9 of 15 mink inoculated with type  $A_5$  and 1 of 4 mink with type  $O_1$ . These limited studies do indicate that mink could carry and become infected with FMD virus, especially type  $A_5$ , and could contaminate feed by their excrement. However, the ability to transfer FMD to susceptible domestic animals would be minimal. Mink are shy and do not routinely mix with domesticated animals.

BHV2 virus produced a detectable viremia in 2 of 4 mink at 2 and 3 DPI. Therefore, mink must be considered susceptible and capable of transmitting BHV2 virus even though no lesions or morbidity were detected. The possibility that a carrier state could develop *in* mink with BHV2 virus must also be considered because detectable antibodies fail to develop within 14 days.

SVD is a newly isolated virus that has been responsible for extensive lesions in swine in Europe and Asia.<sup>2,10,11</sup> The virus has a limited host spectrum. Cattle, rabbit, chicken, hamster, sheep and guinea pig are all resistant to SVD virus.<sup>2,10</sup> However, mink are susceptible. All mink had high antibody level to SVD virus and one of four inoculated mink that was viremic at 2 and 3 DPI had a vesicule on the right side of the upper lip. Based on clinical signs, mink must be considered in the epizootiology of SVD outbreaks on farms.

Mink inoculated with RP, GP and VES viruses developed antibody; however, virus was not isolated. The susceptibility of mink to these viruses cannot be determined, because antibody could be either a response to the virus inoculum or to virus replication. Mink are resistant to HC, AHS, VES and PPR viruses because neither virus nor antibody was detected.

#### LITERATURE CITED

- 1. AL-BANA, A.S. 1978. Purification, physical and chemical analysis of sheep pox virus and the response of sheep and goats to infection with sheep and goat pox viruses. Ph.D. thesis, Cornell Univ., Ithaca, New York.
- BURROWS, R., J.A. MANN, D. GOODRIDGE and W.G. CHAPMAN. 1974. Swine vesicular disease: Attempts to transmit infection to cattle and sheep. J. Hyg. (CAMB) 73: 101-107.
- 3. DARDIRI, A.H., R.J. YEDLOUTSCHNIG and W.D. TAYLOR. 1969. Clinical and serological response of American white-collared peccaries to African swine fever, foot-and-mouth disease, vesicular exanthema of swine, hog cholera and rinderpest viruses. Proc. 73rd Ann. Meet. U.S. Anim. Health Ass. 437-452.
- 4. FEDERER, K.E. 1969. Susceptibility of the agouti (*Dasyprocte aguli*) to foot-andmouth disease virus. Zbl. Vet. Med. Reihe B 16 (9): 847-854.
- HAMDY, F.M., A.H. DARDIRI, D.H. FERRIS and S.S. BREESE, JR. 1975. Experimental infection of white-tailed deer with rinderpest virus. J. Wildl. Dis. 11: 508-515.

- HESS, W.R. and D.E. DeTRAY. 1960. The use of leukocyte culture for diagnosis of African swine fever (ASF). Bull. Epizoot. Dis. Africa. 8: 317-320.
- 8. KAWAMURA, A. JR. 1969. Fluorescent Antibody Techniques and Their Applications. Univ. Park Press, Baltimore, Maryland.
- McVICAR, J.W., P. SUTMOLLER, D.H. FERRIS and C.H. CAMPBELL. 1974. Foot-and-mouth disease in white-tailed deer: Clinical signs and transmission in the laboratory. Proc. 78th Ann. Meet. U.S. Anim. Health Ass. 169-180.
- NARDELLI, L., E. LODETTI, G.L. GUALANDI, R. BURROWS, D. GOODRIDGE, F. BROWN and B. CARTWRIGHT. 1968. A foot-and-mouth syndrome in pigs caused by an enterovirus. Nature 219: 1275-1276.
- OHASHI, Y. 1974. The first case of swine vesicular disease in Japan. Bull. Off. Int. Epizoot. 81 (9-10): 839-843.
- PAN, I.C., C.J. DeBOER, and W.R. HESS. 1972. African swine fever: Application of immunoelectroosmophoresis for the detection of antibody. Can. J. Comp. Med. 36: 309-314.
- TEWARI, S.C., I.P. SINGH, V.K. SHARMA, and D. PRASAD. 1976. Susceptibility of the Indian squirrel to foot-and-mouth disease virus. Vet. Rec. 99 (July 24): 71-72.
- WILDER, F.W., A.H. DARDIRI and R.J. YEDLOUTSCHNIG. 1974. Clinical and serological response of the nine banded armadillo (Dasypus novemcinctus) to virus of African swine fever, hog cholera, rinderpest, vesicular exanthema of swine, vesicular stomatitis and foot-and-mouth disease Proc. 78th Ann. Meet. U.S. Anim. Health Ass. 188-194.
- \_\_\_\_\_, \_\_\_\_, J.G. GAY, H.C. BEASLEY, A.A. HEFLIN and J.A. ACREE. 1974. Susceptibility of one-toed pig to certain diseases exotic to the United States. Proc. 78th Ann. Meet. U.S. Anim. Health Ass. 195-199.

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