ARBOVIRUS SEROLOGY IN NORTH DAKOTA MULE AND WHITE-TAILED DEER 1

Authors: HOFF, GERALD L., and ISSEL, CHARLES J.

Source: Journal of Wildlife Diseases, 9(4) : 291-295

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-9.4.291

ARBOVIRUS SEROLOGY IN NORTH DAKOTA MULE AND WHITE-TAILED DEER[1]

GERALD L. HOFF and CHARLES J. ISSEL, Department of Veterinary Science, University of Wisconsin, Madison, Wisconsin 53706, U.S.A.[2]

DANIEL O. TRAINER, Dean, College of Natural Resources, University of Wisconsin, Stevens Point, Wisconsin 54481, U.S.A.

STEPHEN H. RICHARDS, North Dakota Game and Fish Department, Jamestown, North Dakota 58401, U.S.A.

Abstract: White-tailed and mule deer sera from North Dakota were tested for the presence of neutralizing titers against 15 different arboviruses. Positive reactions in both species were obtained to eight viruses, five of which had not been previously recognized in the state. There was no significant difference (Chi square P.05) in the reactor levels of the two deer species to any of the viruses. Geographically, three of the viruses appeared to be limited to western North Dakota, while the other five were detected statewide.

INTRODUCTION

Traditionally, surveys for antibodies to arboviruses in North American deer populations have been restricted to either white-tailed *(Odocoileus virginianus)* or mule *(O. hemionus)* deer.[2,3,4,8,9,11,12,21,22,24] In 1970, epizootic hemorrhagic disease (EHD) occurred in white-tailed *(O. v. dacotenis)* and mule *(O. h. hemionus)* deer in North Dakota.[7,15] The investigation of that epizootic provided the opportunity to collect serum samples from these two species in an area where their geographic ranges overlap. The sera were subsequently tested against a battery of arboviruses, and the results of that study are presented here.

MATERIALS AND METHODS

During the fall of 1970, 104 serum samples were collected by the North Dakota Game and Fish Department from hunter-killed mule and white-tailed deer. With the exception of 18 white-tailed deer sera from Foster and Stutsman counties in the eastern part of the state, the sera were obtained from deer killed in an eight county area along the Little Missouri River drainage in west-central and southwest North Dakota.

The sera were frozen and shipped via air to the University of Wisconsin-Madison, where they were stored at —20 C. Prior to testing, the sera were heat-inactivated for 30 minutes at 56 C.

Four different serological tests were used to test the serum samples for the presence of neutralizing antibodies, based on the established criteria of positive reactions of each test, to the following viruses: 1) the plaque reduction neutralization test[18] for bluetongue (BT) and EHD; 2) the metabolic inhibition neutralization test[20] for western equine encephalomyelitis (WEE), eastern equine encephalomyelitis (EEE) and St. Louis encephalitis (SLE); 3) a neutralization test performed on microtiter tissue culture plates[10,14] for four California group arboviruses, LaCrosse (LAC), Jamestown Canyon (JC), snowshoe hare (SSH), trivittatus (TVT), and a Wisconsin isolate

[1] Supported by Project W-67-R, Federal Aid to Wildlife Restoration Program.

[2] Hoff present address: Veterinary Public Health Section, Florida Division of Health, P.O. 210, Jacksonville, Florida 32201, U.S.A.

of the Bunyamwera (BUN) group designated Is-523;[1] and 4) a tissue culture tube neutralization test[6] for Powassan (POW), Silverwater (SIL), sawgrass (SAW), Lone Star (LS) and Colorado Tick fever (CTF).

RESULTS

Neutralizing antibodies were detected in the deer to 8 of the 15 viruses used in this study: BT, EHD, WEE, EEE, SLE, LAC, JC, and BUN (Tables 1 and 2). The most prevalent virus infections in the mule and white-tailed deer were JC (50% and 50% respectively). Lower levels of activity were detected to BT, EHD, EEE, WEE, SLE, and LAC.

Overall, significant differences (Chi square P.05) were observed between the two deer species only for EEE and EHD. However, if the white-tailed deer from only the western part of North Dakota (the range of the mule deer) are considered, then there are no significant differences in the reactor levels of the deer species to these two viruses.

TABLE 1. Comparison of arbovirus serology in mule and white-tailed deer, North Dakota, fall 1970.

		Viruses[2]							
	Age[1]	BT	EHD	WEE	EEE	SLE	LAC	JC	BUN
White-tailed	Fawn	0/7[3]	1/7	0/7	2/7	0/7	0/6	0/6	0/6
	Adult	2/48	7/48	3/48	15/48	10/48	2/42	24/42	21/42
	Unknown	0/2	0/2	0/2	1/2	0/2	0/2	1/2	2/2
		2/57 (4%)	8/57 (14%)	3/57 (5%)	18/57 (31%)	10/57 (18%)	2/50 (4%)	25/50 (50%)	23/50 (45%)
Mule	Fawn	0/3	3/3	0/3	0/3	0/3	0/3	0/3	0/3
	Adult	3/37	12/37	3/37	4/37	5/37	1/34	20/34	23/34
	Unknown	2/7	2/7	0/7	3/7	1/7	0/5	1/5	1/5
		5/47 (11%)	17/47 (36%)	3/47 (6%)	7/47 (15%)	6/47 (13%)	1/42 (2%)	21/42 (50%)	24/42 (57%)

[1] Fawns are less than 6 months of age. Adult white-tailed deer ranged from 6-41 months, while adult mule deer ranged from 6-77 months.

[2] None of the deer sera reacted for SSH, TVT, POW, SIL, SAW, LS and CTF.

[3] Expressed as number positive reactions/number of sera tested.

TABLE 2. Comparative reciprocal titers of sera specifically neutralizing LaCrosse (LAC) virus with other California encephalitis group viruses.

	LAC	SSH	JC	TVT
Mule Deer 385	20	10	10	<10
White-tailed Deer 440	20	<10	<10	<10
White-tailed Deer 442	40	10	10	<10

Geographically, the activity of BT, EHD, and WEE appears to be limited to western North Dakota, while the other five viruses are found statewide.

DISCUSSION

Because little is known concerning arbovirus activity in North Dakota, the results of this serological survey must be interpreted with caution. However, since the sera were collected as part of the investigation of the 1970 laboratory confirmed EHD epizootic,[7] the presence of neutralizing antibodies to this virus was not unexpected and the reactor rates generally agree with those reported in white-tailed deer from other states.[24]

The seven deer sera which reacted with BT did not cross-react with EHD. These sera titrated between 1:40 and 1:80 and the reactions were considered to be specific.[19] While isolations of BT have not been reported from North Dakota, the virus has been recovered from livestock in surrounding states. In addition, Trainer and Jochim[22] have reported serological evidence of BT in mule and white-tailed deer from various parts of the United States and Canada.

The serologic evidence presented in this study constitutes the first evidence for the presence of JC and LAC viruses in North Dakota. Sudia et al.,[16] however, proposed that both viruses would be present in the state since likely vectors for each virus were known to exist there. Also, LAC has been isolated in neighboring Minnesota[16] while JC has been isolated in South Dakota.[13] TVT virus is the only California group arbovirus isolated in North Dakota,[17] but serologic evidence for TVT virus in the deer was not detected. This supports the claim that deer are not sensitive indicators of TVT in nature.[10]

Serologic evidence existed for the presence of LAC virus in both western and central North Dakota. According to the North Dakota State Department of Health, however, no human encephalitis cases from the state have been attributed to LAC virus.[3] Perhaps, the virus exists in relatively small endemic foci infrequently visited by man.

Of all the deer tested, 23% reacted sero-positively for EEE while 6% reacted for WEE. Since only three deer were positive to both viruses, it was felt that the reactions were not the result of serological crossing between these two viruses. In North Dakota, human and horse cases of encephalitis have been associated with WEE but not EEE virus.[3][4]

The large number of deer reacting to a BUN group virus was consistent with reports on Wisconsin, Texas,[8] and New York[23] white-tailed deer. While BUN group viruses have been associated with clinical disease in man and several species of animals,[5] the importance of deer in the epizootiology of these viruses is unknown.

Sero-positive reactions were obtained to only one of the two group B arboviruses used in this study, i.e., SLE and not POW. However, it is not known if other group B viruses occur in the state and may be responsible for the observed results. Sentinel chicken flocks in North Dakota revealed a 14% sero-conversion rate to SLE in 1958 and 1959,[3] which does not differ from the rates detected in the deer in 1970.

Overall, the present study revealed serologically that five arboviruses not previously recognized in North Dakota were active in the deer populations. Of these five viruses, BUN, LAC, JC, BT and EEE, two i.e., LAC and EEE, are currently recognized as being of public health significance and deserve further consideration. In addition, BT is of veterinary importance. It was of interest that antibodies were not found to any of the tick-borne viruses, POW, SIL, LS, CTF, and SAW.

---

[3] Mosser, K., 1972. Personal Communication. N. Dakota State Dept. of Health, Bismarck, North Dakota 58501.

[4] Flagg, D. E., 1972. Personal Communication. State of N. Dakota Livestock Sanitary Board, Bismarck, North Dakota 58501.

LITERATURE CITED

1. ANSLOW, R. O., W. H. THOMPSON, P. H. THOMPSON, G. R. DEFOLIART, O. PAPADOPPULOS and R. P. HANSON. 1969. Isolation of Bunyamwera-group viruses from Wisconsin mosquitoes. Amer. J. trop. Med. & Hyg. 18: 599-600.
2. COOK, R. S., D. O. TRAINER, W. C. GLAZENER and B. D. NASSIF. 1965. A serologic study of infectious diseases of wild populations in south Texas. Trans. N. Amer. Wildl. Conf. 13: 142-155.
3. EMMONS, R. W. 1968. Serologic study of a deer herd in California for arbovirus infections. Bull. Wildl. Dis. Assoc. 4: 78-80.
4. FRIEND, M. and L. G. HALTEMAN. 1967. Serologic survey of two deer herds in New York state. Bull. Wildl. Dis. Assoc. 3: 32-34.
5. HOFF, G. L., J. SPALATIN, D. O. TRAINER and R. P. HANSON. 1970. Isolation of a Bunyamwera group arbovirus from a naturally infected caribou. J. Wildl. Dis. 6: 438-487.
6. HOFF, G. L., S. H. RICHARDS and D. O. TRAINER. 1973. Epizootic of hemorrhagic disease in North Dakota deer, 1970-1971. J. Wildl. Mgmt. (in press.)
8. ISSEL, C. J., G. L. HOFF, D. O. TRAINER and W. H. THOMPSON. 1970. Serologic evidence of Bunyamwera group arbovirus infections in Wisconsin and Texas deer. J. Wildl. Dis. 6: 479-482.
9. ISSEL, C. J., D. O. TRAINER and W. H. THOMPSON. 1972. Serologic evidence of infections of white-tailed deer in Wisconsin with three California encephalitis group arboviruses. Amer. J. trop. Med. & Hyg. 21: 985-988.
10. ISSEL, C. J., D. O. TRAINER and W. H. THOMPSON. 1972. Experimental studies with white-tailed deer and four California encephalitis group arboviruses (LaCrosse, Trivittatus, snowshoe hare and Jamestown Canyon). Amer. J. trop. Med. & Hyg. 21: 979-984.
11. ISSEL, C. J., G. L. HOFF and D. O. TRAINER. 1973. Serologic evidence of infection of white-tailed deer in Texas with three California encephalitis group arboviruses (Jamestown Canyon, San Angelo and Keystone). J. Wildl. Dis. 9: 245-248.
12. KARSTAD, L. and R. P. HANSON. 1957. Vesicular stomatitis in deer. Amer. J. Vet. Res. 18: 162-166.
13. LARSON, D. R., J. E. ROWE, R. O. HAYES, P. HOLDEN and G. C. PARIKH. 1971. Preliminary report on arbovirus isolations from South Dakota mosquitoes collected during the summer of 1969. Mosq. News 31: 157-159.
14. PANTUWATANA, S., W. H. THOMPSON, D. M. WATTS and R. P. HANSON. 1972. Experimental infection of chipmunks and squirrels with LaCrosse and Trivittatus viruses and biological transmission of LaCrosse by *Aedes tristriatus*. Amer. J. trop. Med. & Hyg. 21: 476-481.
15. RICHARDS, S. H. 1972. Epizootic hemorrhagic disease of deer. N. Dakota Outdoors 34: 2-4.
16. SUDIA, W. D., V. F. NEWHOUSE, C. H. CALISHER and R. W. CHAMBERLAIN. 1971. California encephalitis group arboviruses isolated from mosquitoes in North America. Mosq. News 31: 576-600.
17. TAYLOR, R. M. 1967. *Catalogue of Arthropod-Borne Viruses of the World.* U.S.P.H.S. Publication No. 1760.

18. THOMAS, F. C. and J. MILLER. 1971. A comparison of bluetongue and EHD virus: Electronmicroscopy and serology. Can. J. comp. Med. 35: 22-27.

19. THOMAS, F. C. and D. O. TRAINER. 1970. Bluetongue virus (1) in pregnant white-tailed deer (2) A plaque reduction neutralization test. J. Wildl. Dis. 6: 384-389.

20. THOMPSON, W. H. and A. S. EVANS. 1965. California encephalitis virus studies in Wisconsin. Amer. J. Epidem. 81: 230-244.

21. TRAINER, D. O. and R. P. HANSON. 1969. Serologic evidence of arbovirus infections in wild ruminants. Amer. J. Epidem. 90: 354-358.

22. TRAINER, D. O. and M. M. JOCHIM. 1969. Serologic evidence of bluetongue disease in wild ruminants of North America. Amer. J. Vet. Res. 30: 2007-2011.

23. WHITNEY, E., E. P. ROZ, G. A. RAYNER and R. DIEBEL. 1969. Serologic survey for arbovirus activity in deer sera from nine counties in New York state. Bull. Wildl. Dis. Assoc. 5: 392-397.

24. WILHELM, A. R. and D. O. TRAINER. 1966. A serological study of epizootic hemorrhagic disease of deer. J. Wildl. Mgmt. 30: 777-780.

Received for publication 1 February 1973