

Virus Name: Eastern equine encephalomyelitis		Abbreviation: EEEV
Status Arbovirus	Select Agent Yes	SALS Level 2
SALS Basis Additional criteria 1,2,3,4, etc.		
Other Information USDA Permit Required, DOC Permit Required, Vaccination Recommended		
Antigenic Group A		

SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation	Accession Number	Original Date Submitted 4/5/1985
Family Togaviridae	Genus Alphavirus	
Information From Roy W. Chamberlain	Address Arbovirology Unit, Center for Disease Control, Atlanta, Georgia 30333, USA	
Information Footnote Reviewed by editor		

Section II - Original Source

Isolated By (name) Ten Broeck and Merrill (1) and / Giltner and Shahan (2)		Isolated at Institute Rockefeller Ins., Princeton, NJ / USDA, Bur. Animal Ind.	
Host Genus Horse	Species	Host Age/Stage Adult	
Sex Not Answered			
<u>Isolated From</u>	<u>Isolation Details</u>		
Organs/Tissues	Brain (8 pos. brains stated by Giltner and Shahan)		
Signs and Symptoms of Illness High fever, incoordination, hyperirritability, convulsions; death frequently		Arthropod	
Time Held Alive before Inoculation 24-48 hrs after onset			
Collection Method Autopsy	Collection Date 8/1/1933		
Place Collected (Minimum of City, State, Country) Delaware; Virginia; Maryland, USA			
Latitude 40° N	Longitude 75° W		
Macrohabitat Coastal areas	Microhabitat	Method of Storage until Inoculated Not recorded	
Footnotes			

Section III - Method of Isolation

Inoculation Date
1/1/1933

Animal (Details will be in Section 6)
gp

Route Inoculated
Intracerebral

Reisolation

Other Reasons

Isolations and identifications performed independently by Ten Broeck and Merrill; Giltner and Shahan

Homologous Antibody Formation by Source Animal

Test(s) Used

Footnotes

Section IV - Virus Properties

Physicochemical
RNA, Single Strand

Pieces (number of genome segments)	Infectivity No	Sedimentation Coefficients(s) (S)
Percentage wt. of Virion Protein 49%	Lipid 54%	Carbohydrate 4.0%; 4.4% RNA (4)
Virion Polypeptides: Number	Details	
Non-virion Polypeptides: Number	Details	
Virion Density	Sedimentation Coefficients(s) (S)	
Nucleocapsid Density	Sedimentation Coefficients(s) (S)	

Stability of Infectivity (effects)

pH (infective range)

Lipid Solvent (ether - % used to test)	After Treatment Titer <3.0 dex	Control Titer 8.0 dex (5)
Lipid Solvent (chloroform)	After Treatment Titer	Control Titer
Lipid Solvent (deoxycholate)	After Treatment Titer 0 dex	Control Titer 4.5 dex (7)
Other (formalin, radiation) 1:1000 deoxycholate: 5.5 dex inactivation (6)		

Virion Morphology

Shape	Dimensions 40-47 nm; 55 nm (25)	
Mean nm	Range nm	
Measurement Method Electron microscopy (3)	Surface Projections/Envelope Envelope present	Nucleocapsid Dimensions, Symmetry

Morphogenesis

Site of Constituent Formation in Cell	Site of Virion Assembly Budding through plasma membranes (25)	Site of Virion Accumulation
Inclusion Bodies	Other	

Hemagglutination

Hemagglutination Yes	Antigen Source SMB ext. by acetone-ether or sucrose-acetone	Erythrocytes (species used) Goose
pH Range 5.9-6.5	pH Optimum 6.2	
Temperature Range 4dC- 37dC	Temperature Optimum 37dC	
Remarks		
Serologic Methods Recommended HI, CF, NT		
Footnotes		

The following information was extracted from Casals [9] :

Immune Sera*	Antigen of registered Virus		Antigens	Immune serum of registered virus*	
	HI Ht/Ho	Ind		HI Ht/Ho	Ind
Chikungunya	N.D./1280+		Chikungunya	40/10,240	1/256
Mayaro	40/1280	1/32	Mayaro	20/10,240	1/512
Semliki	40/2560	1/64	Semliki	20/10,240	1/512
Sindbis	80/1280	1/16	Sindbis	20/10,240	1/512
WEE	80/10,240	1/128	WEE	160/10,240	1/64
VEE	160/640+	1/4+	VEE	80/10,240	1/128

* Hyperimmune mouse sera

The above data demonstrate the antigenic relationship of EEE with representative members of the group, using hyperimmune sera. There is generally less crossing by CF: the NT is most specific. For antigenic relationship to other members of Group A, consult their respective catalogue cards and see References [9] , [26] - [29] .

EEE virus has been antigenically classified as a distinct virus type and is considered not to be closely related to any of the other alphaviruses [30] .

North American and South American antigenic varieties of EEE virus exist in nature; and they usually are distinguished by specialized serological techniques [21] , [22] .

Section VI - Biologic Characteristics

Virus Source (all VERTEBRATE isolates)
Blood (M)(LV), CNS (M)(LV), heart (LV), liver (LV), spleen (LV);
can be isolated from many tissues of exp. infected birds and
small mammals

Lab Methods of Virus Recovery (ALL ISOLATIONS)
Newborn and weanling mice, baby chicks (<1-day old), chick
embryos, hamsters, guinea pigs; primary avian and hamster
kidney cell cultures

Cell system (a)	Virus passage history (b)	Evidence of Infection						
		CPE			PLAQUES			Growth Without CPE +/- (g)
		Day (c)	Extent (d)	Titer TCD50/ml (e)	Day (c)	Size (f)	Titer PFU/ml (e)	
Chick embryo (PC)		1-2	CPE	9.0-10.0**		Plaques	9.0-10.0**	
Hamster kidney(PC)		1-2	CPE	9.0-10.0				
Duck embryo (PC)					3-5	Plaques	10.5-11.5	
BHK-21 (CL)	P-471	1	4+	10.5 (31)				
Vero (CL)	P-22				2	11 mm	10.1 (32)	
LLC-MK2 (CL)					3	3 mm	9.7 (32)	

** Expressed in dex

Vertebrate (species and organ) and arthropod	No. isolations/No. tested	No. with antibody/No. tested Test used	Country and region
<p>Man: About 25 isolations in Massachusetts, New Jersey, Louisiana, Gulf Coast States (brain). One from blood (10). Antibody in 8-9% in endemic areas of US and Panama; up to 29% in Brazil; 17% in Dominican Republic, 1948-49. One death in Czechoslovakia (18).</p> <p>Horses: Several hundred isol.(brain); Antibody in >0% in some enzootic areas.</p> <p>Pheasants (Eastern US): Over 100, mostly from brain.</p> <p>Wild birds: Many isol. (blood, also liver and spleen). Antibody rate high in residents of enzootic areas. At least 86 species susceptible; none known not susc. (11).</p> <p>Wild rodents: 2 isol.: white-footed mice in N.J., Nov. 30 (blood) and Dec. 27, 1962 (brain); antibody in white-footed mouse and meadow vole (12). Several isol. in Brazil from <i>Oryzomys</i>, <i>Proechimys</i>, and <i>Marmosa</i> (13). From <i>Apodemus</i> in Czechoslovakia (18). Dog (puppy): Isolation (brain) NW Florida.</p> <p>Monkey: one isol. (brain), Philippine Is. (14).</p> <p>Goat: 2/14 immune, Dominican Republic, 1949.</p> <p>Cows: 6/17 immune, Dominican Republic 1949.</p> <p>Arthropods * : Numerous isol. from mosquitoes in endemic areas; few from other arthropods. U.S. Main vector for birds, <i>Culiseta melanura</i>. Also from <i>An. crucians</i>, <i>Cq. pertubans</i>, <i>Cx. restuans</i>, <i>Cx. salinarius</i>, <i>Cx. quinque-salinarius</i>, <i>Ae. vexans</i>, <i>Cx. nigripalpus</i>, <i>Ae. mitchellae</i>, <i>Ae. fulvus pallens</i>, <i>Ae. sticticus</i>, <i>Ae. atlanticus</i>; <i>Culicoides</i> sp., <i>Eomenocanthus stramineus</i>, <i>Dermanyssus gallinae</i>, <i>Eusimulium johannseni</i>, <i>Simulium meridionale</i>.</p> <p>Other areas: <i>Ae. taeniorhynchus</i>, <i>Cx. taeniopus</i> (Brazil): <i>Cx. taeniopus</i>, <i>Cx. nigripalpus</i> (Trinidad); <i>Cx. pipiens quinquefasciatus</i> (Bangkok, Thailand (16)). <i>Aedes sollicitans</i> 3/470 ** isolations, So. coastal areas, New Jersey, USA (34).</p>			

* Compiled from many sources; incomplete listing.

** Isolations during epizootic period in 1982.

Experimental host and age	Passage history and strain	Inoculation Route-Dose	Evidence of infection	AST (days)	Titer log ₁₀ /ml
Mice (nb)	Ar 167 P-3	ic 0.02	Paralysis, death	2-3	10.5-11.0
Mice (nb)		ip 0.03	Paralysis, death	2-4	10.5
Mice (nb)		sc			
Mice (wn)		ic 0.03	Paralysis, death	2-4	9.5-10.5
Mice (wn)		ip 0.03	Paralysis, death	4-7	7.5-9.0
chicks (1/2 day)		sc 0.03	Weakness, prostration, death	20-36hr	11.0-11.5
chicks (7 day)		sc 0.03	Occasional death		
guinea pig (3-4 wk)		ic 0.1	Paralysis, death	2-5	
embryonated eggs (10 day)		al.c. 0.1	Death, gen.hem., necrosis	22-36hr	8.5-9.0
™ (7 day)		ys 0.1	Death, gen.hem., necrosis	22-36hr	8.5-9.0
™ (13 day)	am.s. 0.03	Death, gen.hem., necrosis	22-36hr	10.5-11.5	
Many wild birds sp (all ages)	GA,CE 2-9	sc 0.03	Death or inapparent infection; viremia		
Misc. reptile species (all ages)		sc 0.03	Erratic viremias and antibody responses. Average viremias: 12 days, with titers of 2.0 to 10.5 dex/ml (15).		

Section IX - Experimental Arthropod Infection and Transmission

Arthropod species & virus source(a)	Method of Infection log10/ml (b)		Incubation period (c)		Transmission by bite (d)		Assay of arthropod, log10/ml (e)		
	Feeding	Injected	Days	°C	Host	Ratio	Whole	Organ	System

Misc. arthropods of several orders, larvae and adults, successfully infected by parenteral inoculation; serial passage of virus achieved regularly. No ill effects observed in arthropods; virus yields obtained of up to >8.0 dex based on body weight.

Many mosquito species susceptible, including Aedes, Psorophora, Culiseta, Mansonia, Culex, Wyeomyia, Orthopodomyia; some Culex refractory; Anopheles poor transmitters.

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Section X - Histopathology

Character of lesions (specify host)

Path. of nat. occurring infections in man and horse confined mostly to CNS. Acute lesions: ill-defined foci of polymorphonuclear leucocytic infiltration, neuronal necrosis. Lesions most in frontal cortex, decrease caudally. Round cells replace polys in older lesions. Exp. infections similar except mice show lessened leukocytic response. Birds may show encephalitis or hepatic necrosis in absence of encephalitis.

Inclusion Bodies

Intranuclear

Organs/Tissues Affected

Brain (M)(LV)

Category of tropism

Neurotropic and/or viscerotropic

Section XI - Human Disease

In Nature
Significant

Residual
Significant

Death
Significant

Subclinical
Reported

Overt Disease

Clinical Manifestations

Fever (S), headache (S), prostration (S), stiff neck (S), myalgia(S), arthralgia (S), CNS signs (including encephalitis)(S), leukopenia (S); coma

Number of Cases
Approximately 100

Category (i.e. febrile illness, etc.)
Encephalitis

Section XII - Geographic Distribution

Known (Virus detected)

Eastern USA, Panama, Trinidad, Dominican Republic, Guyana, Brazil; Philippine Islands (14), Argentina (17), Thailand (16), and Czechoslovakia (18), eastern Canada (19), Colombia (23)

Suspected (Antibody only detected)

Eastern Canada to Argentina; Surinam (33)

Section XIII - References

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Remarks

A good general account of EEE and other group A viruses is found in reference No. 20. The important work of Casals (21) suggests that antigenic variants of EEE virus occur in nature, and that South American types differ from North American types. The work of Calisher, et al. (22) tends to confirm this suggestion.