Virus Name: Middelburg	Abbreviation: MIDV

Status
Arbovirus

Select Agent
No

SALS Level
3

SALS Basis
Disease is sheep, cattle, or horses.

Other Information

Antigenic Group
A

SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation
SAAr 749

Accession Number

Original Date Submitted
2/6/1984

Family
Togaviridae

Genus
Alphavirus

Information From
B.M. McIntosh

Address
National Institute for Virology, P/Bag X4, Sandringham, 2131, South Africa

Information Footnote
Revised

Section II - Original Source

Isolated By (name)
R.H. Kokernot, et al.(1)

Isolated at Institute
S. Afr. Inst. Med. Res., Johannesburg

Host Genus
Aedes caballus* (sensu lato)

Species

Host Age/Stage
Adult

Sex
Female

Isolated From

Isolation Details

Signs and Symptoms of Illness

Arthropod

Time Held Alive before Inoculation
24 hours

Collection Method
By hand off human bait

Collection Date
4/9/1957

Place Collected (Minimum of City, State, Country)
Conway, Middelburg, Cape Province, South Africa

Latitude
32° S

Longitude
24° E

Macrohabitat
Temperate, arid inland plateau

Microhabitat
Mixed grass-scrub; with pans and dams

Method of Storage until Inoculated
-20dC

Footnotes

Section III - Method of Isolation

Inoculation Date
4/11/1957

Animal (Details will be in Section 6)
nb mice

Route Inoculated
Intracerebral

Reisolation
No

Other Reasons
Other isolations from mosquitoes collected at same time and place.

Homologous Antibody Formation by Source Animal

Test(s) Used

Footnotes

Section IV - Virus Properties

Physicochemical

Pieces (number of genome segments)	Infectivity	Sedimentation Coefficients(s) (S)
Percentage wt, of Virion Protein	Lipid	Carbohydrate
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	Control Titer
Lipid Solvent (chloroform)	After Treatment Titer	Control Titer
Lipid Solvent (deoxycholate)	After Treatment Titer	Control Titer

Other (formalin, radiation)

Virion Morphology

Shape	Dimensions	
Mean **62-80 nm**nm	Range nm	
Measurement Method **Electron microscopy (3)**	Surface Projections/Envelope	Nucleocapsid Dimensions, Symmetry

Morphogenesis

Site of Constituent Formation in Cell	Site of Virion Assembly	Site of Virion Accumulation
Inclusion Bodies	Other	

Hemagglutination

Hemaggiutination	Antigen Source	Erythrocytes (species used)
Yes	**SMB or serum**	**Goose**
pH Range	pH Optimum	
6.0-6.4	**6.2**	
Temperature Range	Temperature Optimum	

Remarks
*** Taxon "caballus" since split into "caballus" and "juppi".**

Serologic Methods Recommended
HI, NT, CF

Footnotes
*** Taxon "caballus" since split into "caballus" and "juppi".**

Section V - Antigenic Relationship and Lack of Relationship to Other Viruses

Immune fluids	MID Antigen [15] HI	MID Antigen [15] CF	Antigens	MID Antibody [15] HI	MID Antibody [15] CF
Chikungunya	>1280	>128	Chikungunya	>2560	>512
Sindbis	640	>512	Sindbis	>2560	32
Semliki Forest	>1280	256	Semliki Forest	>2560	8
Ndumu	640	32	Ndumu	Not done	32

Results expressed as quotient of homologous/heterologous titers.

In cross-PRNT [4] there was slight (1/10) neutralization of MID virus by Ross River and Ndumu antisera but no reactions either way with western equine enc., Sindbis, Whataroa, Aura, Ven. equine enc., Mucambo, Pixuna, Semliki Forest, Mayaro, chikungunya, Una, o'nyong-nyong, Bebaru, Getah, and east. equine enc.
Showed no relationship to 21 alphaviruses by neutralization test in micro- cell cultures [5] .

Placed in WEE serological subgroup as a distantly related member [2] . SIRACA has determined that MID virus is not antigenically closely related to any other group A virus. It has been placed in a separate complex within serogroup A [24] .

Section VI - Biologic Characteristics

Virus Source (all VERTEBRATE isolates)
Blood (M,LV), CNS (M,LV), heart (LV), lung (M,LV), liver (M,LV), spleen (M,LV), kidney (M,LV), nasopharyngeal (M), urine (M,LV), salivary (LV), lymph node (LV), semen (M)

Lab Methods of Virus Recovery (ALL ISOLATIONS)
Guinea pig, primate

Cell system (a)	Virus passage history (b)	Evidence of Infection							
		CPE			PLAQUES			Growth Without CPE	
		Day (c)	Extent (d)	Titer TCD50/ml (e)	Day (c)	Size (f)	Titer PFU/ml (e)	+/- (g)	
BHK-21 (CL)		1	4+	7.8*(7)	3	2-3 mm	7.6* (6)		
CE (PC)					3	1-7 mm	6.6 (6)		
LLC-MK2 (CL)					8	1 mm	6.1 (6)		
MA-104 (CL)					5	2-4 mm	7.6 (6)		
MA-111 (CL)					5	2-4 mm	7.7 (6)		
PS-C1 (CL)					5	1 mm	5.8 (6)		
Vero (CL)					3	1-2 mm	7.5 (6)		

* Expressed in dex

Section VII - Natural Host Range (Additional text can be added below table)

Vertebrate (species and organ) and arthropod	No. isolations/No. tested	No. with antibody/No. tested Test used	Country and region
Man	2		Country not indicated (23)
Man		1/264 NT	Natal, South Africa(8)
Man		3/302 NT	Mozambique (9)
Man		6/492 NT	Angola (10)
Sheep, goats, cattle		173/1,816 NT	South Africa(11, 12, 13)
Horse	2	37/46 NT	South Africa (14, 15)
Horse		277/500 HI	South Africa (14)
Aedes caballus (sensu lato)	15		Cape Province, South Africa (1)
Aedes circumluteolus	3		Natal, South Africa(16, 17)
Aedes (Aedimorphus) spp.	9		Natal, South Africa (15, 17)
Aedes lineatopennis	2		Zimbabwe (15)
Aedes dalzieli	9		Senegal (18)
Aedes palpalis group	1		Ivory Coast (20)
4 Mosquito species	4		Kenya (19)
13 Mosquito species	>13		Cameroun (20, 21)
2 Mosquito species	>2		Congo (20)

Section VIII - Susceptibility to Experimental Infection (include viremia)

Experimental host and age	Passage history and strain	Inoculation Route-Dose	Evidence of infection	AST (days)	Titer log10/ml
Mice (nb)	SAAr 749, MB 7	ic	Death	2	8.4
Mice (nb)		ip	Death	2	8.4
Mice (nb)		sc			
Mice (wn)		ic	Antibody		
Mice (wn)		ip			
chicks (1 day)		im	Viremia (3 days)		
guinea pigs (ad)		ic	Antibody		
vervet monkey (ad)		ic	Antibody		
lamb			Viremia, fever, stiff gait (1)		
horse			Fever (14)		
rodents (4 species)		iv	Viremia (22)		5.2 - >7.7

Section IX - Experimental Arthropod Infection and Transmission

Arthropod species & virus source(a)	Method of Infection log10/ml (b)		Incubation period (c)		Transmision by bite (d)		Assay of arthropod, log10/ml (e)		
	Feeding	Injected	Days	°C	Host	Ratio	Whole	Organ	System
Aedes caballus									
(sensu lato)	X		4	26	sheep	1/1	10 mosq. transmitted to one lamb (1)		
	X		10	26	mice	7/7	unstated numbers fed on 7 mice (1)		
	X		19	26	chicks		5 mosq. infected at least one of 3 chicks (1)		

Section X - Histopathology

Character of lesions (specify host)

Inclusion Bodies — Intranuclear

Organs/Tissues Affected
Newborn mice: brain, muscle, connective tissue in subcutis, periosteum and arteries

Category of tropism

Section XI - Human Disease

In Nature — Residual — Death

Subclinical — Overt Disease

Clinical Manifestations

Number of Cases
Two (23)

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

Section XII - Geographic Distribution

Known (Virus detected)
South Africa (1), Zimbabwe (15), Senegal (18), Kenya (19), Cameroun (20,21), Congo (20), Ivory Coast (20)

Suspected (Antibody only detected)
Mozambique (9), Angola (10)

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Remarks

Although MID was isolated from sick horses (muscular stiffness, jaundice, abortion) in South Africa, these signs were not produced in inoculated horses (14).