| Virus Name: Sindbis | Abbreviation: SINV |
|---|---|

Status
**Arbovirus**

Select Agent
**No**

SALS Level
**2**

SALS Basis
**Results of SALS surveys and information from the Catalogue.**

Other Information

Antigenic Group
**A**

## SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation
**Ar 339**

Accession Number

Original Date Submitted
12/9/1984

Family
**Togaviridae**

Genus
**Alphavirus**

Information From
**R.M. Taylor**

Address
**School of Public Health, University of California, Berkeley, California 94720**

Information Footnote
**Reviewed by editor**

## Section II - Original Source

Isolated By (name)
**R.M. Taylor, et al. (1,2)**

Isolated at Institute
**NAMRU-3, Cairo, Egypt**

Host Genus
**Culex univittatus**

Species

Host Age/Stage
**Adult (imago)**

Sex
**Female**

Isolated From

Isolation Details

Signs and Symptoms of Illness

Arthropod

Time Held Alive before Inoculation

Collection Method
**Light trap**

Collection Date
**8/14/1952**

Place Collected (Minimum of City, State, Country)
**Sindbis Village, Nile Delta, Egypt**

Latitude
**30° N**

Longitude
**32° E**

Macrohabitat
**Irrigated, highly cultivated, delta plain, subtropical climate**

Microhabitat
**Light trap set in village street during night**

Method of Storage until Inoculated
**None; inoculated same day as captured**

Footnotes

## Section III - Method of Isolation

Inoculation Date
**8/14/1952**

Animal (Details will be in Section 6)
**nb mice**

Route Inoculated
**ic and sc**

Reisolation
**Yes**

Other Reasons
**Original source; subsequently 12 other isolations and presence of antibodies in vertebrates of region**

Homologous Antibody Formation by Source Animal

Test(s) Used

Footnotes

## Section IV - Virus Properties

Physicochemical
**RNA, Single Strand**

| | | |
|---|---|---|
| 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)<br>**20%** | After Treatment Titer<br>**<2 dex** | Control Titer<br>**4.5 to 6 dex (4)** |
| Lipid Solvent (chloroform) | After Treatment Titer | Control Titer |
| Lipid Solvent (deoxycholate)<br>**1:1000** | After Treatment Titer<br>**<2 dex** | Control Titer<br>**4.5 to 6 dex (4)** |

Other (formalin, radiation)

### Virion Morphology

| | | |
|---|---|---|
| Shape | Dimensions<br>**32 nm** | |
| Mean<br>nm | Range<br>nm | |
| Measurement Method<br>**Electron microscopy (3)** | Surface Projections/Envelope<br>**Envelope present (27)** | Nucleocapsid Dimensions, Symmetry<br>**Capsid (27)** |

**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 ext. by acetone-ether** | **Goose** |
| pH Range | pH Optimum | |
| Temperature Range | Temperature Optimum | |

Remarks
**Originally reported as resistant to both ether and sodium deoxycholate, but subsequently found to be sensitive though not to the degree of some other arboviruses (5). Sindbis and SF viruses are both RNA viruses and have been used extensi**

Serologic Methods Recommended
**HI, CF, NT**

Footnotes
**Originally reported as resistant to both ether and sodium deoxycholate, but subsequently found to be sensitive though not to the degree of some other arboviruses (5). Sindbis and SF viruses are both RNA viruses and have been used extensi**

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

In the initial studies by Casals [6] , Sindbis was found by the HI method to fall into serogroup A and to be most closely related to WEE. Since then a number of strains of viruses have been isolated in widely separated parts of the world that are either indistinguishable or very closely related to Sindbis virus and are regarded as strains of this virus [7] . These strains are SAAr-86 isolated in South Africa [8] , IA-1036 isolated in India [9] , MM-2215 isolated in Malaya [10] , P-886 isolated in the Philippines [11] , MRM-39 isolated in Australia [12] and MP-684 isolated in Uganda [13] .
As far as is known Sindbis is not related to any viruses not in Group A.

References on antigenic and serologic relation to other members of Group A are too numerous to include.

## Section VI - Biologic Characteristics

Virus Source (all VERTEBRATE isolates)
**Blood (M)(LV), heart (LV), spleen (LV) (9), skin lesions (M) (14)**

Lab Methods of Virus Recovery (ALL ISOLATIONS)
**Newborn mice; primary monkey kidney cell cultures (9)**

| 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) | |
| Vero (CL) | SM 9 | | | | 3 | 10 mm | 7.7* (17) | | |
| LLC-MK2 (CL) | | | | | 2 | 1 mm | 8.0 (17) | | |
| BHK-21 (CL) | Amm 2215 SM 2 | 1 | 4+ | >8.5* (40) | | | | | |

Grows readily and forms plaques on chick embryo, primary monkey kidney, human amniotic cells, and other mammalian cell cultures (16). Both primary and continuous cell cultures have been used. Numerous other references are available.

* 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 | 5 | 74/938 HI | Uganda (13); SE Anatolia, Turkey (37) |
| Man | 1 | 122/445 NT | South Africa (14); Nile Delta, Egypt (2) |
| Man | 1 | 16/132 NT | Cent. Af. Rep. (34); Sudan (2) |
| Mammals | | 52/168 NT | Nile Delta, Egypt (2) |
| Avian species | | 9/125 NT | |
| Corvus corone sardonius | 1/159 | | |
| Birds, wild | 1 | | South Africa (15) |
| Motacilla alba | 1 | | India (9) |

| | | | |
|---|---|---|---|
| Gracula religiosa | 1 | | |
| Sentinel mice | 4 | | Ibadan, Nigeria (20) |
| Culex pseudovishnui | 16 | | Sarawak, Malaysia (21) |
| Culex univittatus | 9 | | Nile Delta, Egypt (2); South Africa (14) |
| Cx atennatus | 4 | | Nile Delta, Egypt (2) |
| Cx tritaeniorhynchus | 1 | | Malaya, Malaysia (10) |
| Cx bitaeniorhynchus | 1 | | Philippines (11) |
| Cx annulirostris | 5 | | Australia (12) |
| Culex mixed pools | 12 | | S. Africa (8, 14); India (9) |
| Aedes normanensis | 1 | | Australia (12) |
| Ae vigilax | 1 | | Australia (12) |
| Anopheles pharoensis | 1 | | Nile Delta, Egypt (2) |
| Mansonia semptempunctata | 1 | | Australia (12) |
| Ma fuscopennata | 1 | | Uganda (13) |
| Bdellonyssus bursa | 1 | | India (9) |
| Culex quinquefasciatus | 1 | | Queensland, Australia (39) |
| Hyalomma marginatum Hipposideridae sp. and Rhinolophidae sp. | 1 | | Sicily (35) |
| (insectivorous bats; organs) | 1 | | Zimbabwe (38) |
| Culex univittatus | 13 | | Al Khobar, Saudi Arabia (41) |
| Cx. tritaeniorhynchus | 1 | | |
| Cx. pipiens complex | 1 | | |
| Culex spp. | 1 | | |
| Aedes mosquitoes (89% Ae. communis) | 1 | | Karelian area, USSR (42) |

## 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) | SMB 5 | ic 0.02 | Paralysis and death | 2-4 | 7.5 |
| Mice (nb) | | ip 0.02 | Paralysis and death | 2-4 | 6.9 |
| Mice (nb) | | sc | | | |
| Mice (wn) | | ic 0.03 | No deaths* | | |
| Mice (wn) | | ip | | | |
| emb. eggs(8 day) | SMB 3 | ys 0.1 | Death | 1-3 | 6.0 |

Cercopithecus aethiops and Macaca mulatta, young chickens and cattle egret (Bubulous ibis ibis) can be infected by bite of mosquito, circulate virus and develop NT antibodies. Crows (hooded) and doves susceptible to sc inoculation. One trial to infect sheep by mosquitoes failed. Adult hamsters and rabbits survive ic inoculation.

Chickens and pigeons circulate virus and death may result. Rabbits, rats, and marsupials are resistant (22). 42 of 53 S. African wild birds of 14 species circulated virus after im inoculation and developed antibodies (23).

* Strain isolated in South Africa was adapted to adult mice (8).

## 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 |

Culex univittatus readily become infected and transmit by bite. Ornithodoros savignyi ticks infected by parenteral inoculation will infect by bite but complete cyclic transmission by this tick and Argas persicus was not achieved. Ae aegypti and Anopheles albimanus will also transmit by bite (24), and virus is expelled from anus by infected Ae aegypti (25).

Sindbis appears to be essentially a bird virus transmitted mainly by Culex mosquitoes, but man and other mammals may become tangentially infected.

## Section X - Histopathology

Character of lesions (specify host)
**sm; ic, ip: CNS and skeletal muscles principally involved (2). Necrosis in periarticular tissue, marrow, thymus, heart muscle, connective tissue and brown fat (14). Eosinophilic intranuclear inclusions observed in tissue culture (14)**

Inclusion Bodies — Intranuclear

Organs/Tissues Affected
**Brain (LV), heart (LV), blood vessels (LV), marrow (LV), skeletal muscles (LV), secretory glands (LV)**

Category of tropism

## Section XI - Human Disease

In Nature
**Reported**

Residual
**Reported**

Death

Subclinical

Overt Disease

Clinical Manifestations
**Fever(R), headache (S), prostration(R), stiff neck(R), myalgia(S), arthralgia (R), hemorrhagic signs (R)(36), rash (S), jaundice (R)**

Number of Cases
**>30; Uganda; South Africa (13,14,15,18); Australia (26)**

Category (i.e. febrile illness, etc.)
**Febrile illness with rash**

## Section XII - Geographic Distribution

Known (Virus detected)
**Egypt (2), Uganda (13), South Africa (8,14,15), Cameroun (28),India (9), Philippines (11), Malaysia (10,21,29), Australia (12).Cent. Afr. Rep. (28), Israel (30), Mozambique (31), USSR (32),Czechoslovakia (33), Italy (35), Zimbabwe (38), Nigeria (**

Suspected (Antibody only detected)

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## Remarks