Virus Name: Bluetongue	Abbreviation: BLUV

Status
Arbovirus

Select Agent
No

SALS Level
2

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

Other Information
USDA Permit Required, USDA Restricted, USDA High Consequence Agent

Antigenic Group
Bluetongue

SECTION I - Full Virus Name and Prototype Number

Prototype Strain Number / Designation

Accession Number

Original Date Submitted
2/10/1985

Family
Reoviridae

Genus
Orbivirus

Information From
Arthropod-borne Animal Dis. Res. Lab.

Address
Arthropod-borne Animal Disease Lab. USDA, ARS, Denver, Colorado 80225, USA

Information Footnote
Revised

Section II - Original Source

Isolated By (name)
Spreull (26)

Isolated at Institute
at Republic of South Africa

Host Genus
Ovine

Species

Host Age/Stage

Sex
Not Answered

Isolated From	Isolation Details
Whole Blood	
Serum/Plasma	
Organs/Tissues	**spleen pulp (26)**

Signs and Symptoms of Illness
Fever, facial edema, catarrhal discharge, lesions of mouth, feet, death often due to pneumonia (noncontagious disease)

Arthropod

Time Held Alive before Inoculation

Collection Method
Blood of sick sheep

Collection Date
6/6/1901

Place Collected (Minimum of City, State, Country)
South Africa (Cape Colony)

Latitude

Longitude

Macrohabitat

Microhabitat

Method of Storage until Inoculated
Defibrinated blood + glycerin + phenol (virulent to 174 days)

Footnotes

Section III - Method of Isolation

Inoculation Date

Animal (Details will be in Section 6)
Ovine ** or goat**

Route Inoculated

Reisolation
Yes

Other Reasons
South Africa; repeated isolation; vaccine production (28); plurality of strains (23)

Homologous Antibody Formation by Source Animal

Test(s) Used

Footnotes

Section IV - Virus Properties

Physicochemical
RNA, Double Strand

Pieces (number of genome segments) **10(31)**	Infectivity	Sedimentation Coefficients (s) (S)
Percentage wt, of Virion Protein	Lipid	Carbohydrate
Virion Polypeptides: Number **7 (14)**	Details **The core has 2 major and 3 minor pooypeptides and is surrounded by outer capsid layer with 2 major polypeptides, No. 2 and 5; No. 2 appears to be main determinate of serotype specificity. (14).**	
Non-virion Polypeptides: Number **2(12);3(25)**	Details **Polypeptide 5A associated with a tubular-like**	
Virion Density **1.36 gm/cm3 (20)** **1.38gm/cm3 in cesium chloride**	Sedimentation Coefficients(s) **550 (20)**(S)	
Nucleocapsid Density **1.38 (20) 1.42(32) in cesium chloride**	Sedimentation Coefficients(s) **470 (20)**(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)
Resis. to ether, chloroform, deoxycholate; resis. depends on purification (3,10,31)

Virion Morphology

Shape **Icosahedral, orbivirus (2)**	Dimensions **50-70 nm**	
Mean nm	Range nm	
Measurement Method **Electron microscopy**	Surface Projections/Envelope **No envelope present (2); occ. pseudoenvelopes (3)**	Nucleocapsid Dimensions, Symmetry **Capsid diam.: D= 3 nm; L=69 nm (20); 32 capsomeres**

Morphogenesis

Site of Constituent Formation in Cell **Cytoplasm**	Site of Virion Assembly **Cytoplasm**	Site of Virion Accumulation **Cytoplasm**
Inclusion Bodies **Cytoplasmic (4)**	Other	

Hemagglutination

Hemaggiutination **Yes**	Antigen Source **BHK 21 cell culture; fluoro-carbon ext. + cent. thru sucrose**	Erythrocytes (species used) **Several (a)**

Yes	BHK-21 cell culture, fluoro-carbon ext. + cent. thru sucrose gradients (11,30)	Several (a)

pH Range
6.0-9.0

pH Optimum
6.0-9.0

Temperature Range
4dC, 22dC, 37dC

Temperature Optimum
4dC, 22dC, 37dC

Remarks
(a) Sheep, chicken, goose, guinea pig, mouse erythrocytes

Serologic Methods Recommended
CF, modified direct CF, agar gel precipitin, NT C

Footnotes
(a) Sheep, chicken, goose, guinea pig, mouse erythrocytes

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

Bluetongue virus is the type species for the Orbivirus genus [21] . The orbiviruses are distinguished from the reoviruses by acid lability, slight solvent sensitivity, serology (CF and HI), and capsid structure [2] , [21] . In addition, there is no nucleic acid sequence homology between Reovirus members and members of other genera [21] . At present, there are 12 serological subgroups of genus Orbivirus. The BLU subgroup consists of the 23 serotypes of bluetongue virus [34] .
Isolation of field virus has been by inoculation into sheep, embryonated chicken egg, or less so, cell culture and suckling mice; the iv inoculation of embryonated chicken eggs has proven the most sensitive isolation system [3] , [10] . The agar gel immunodiffusion test has been the most widely used group specific test for bluetongue virus antibody and has detected all serotypes of BLU [35] , [36] . The modified direct CF test (MDCF) and IFA tests also have been used as group specific for bluetongue [35] , [36] .
A plaque-reduction neutralization test differentiates between BLU and EHD virus antibodies; this test is currently used to identify the 23 serotypes of BLU [34] . Various serum neutralization tests have previously been used to differentiate BLU serotypes [3] , [10]
Antigenic relationships have been demonstrated between the bluetongue serogroup and the EHD, Eubenangee and Palyam serogroups [22] , [36] . Immunological cross-reaction documented between virus-specified tubules of BLU and EHD viruses [13] .
Two-way cross-relationships between Ibaraki virus and EHD virus, serotypes 1 and 2, demonstrated by agar gel precipitin and indirect fluorescent antibody tests [5] . By neutralization tests, Ibaraki virus was more closely related to EHD virus, serotype 2 (Alberta strain). Antigenic relationship not observed between Ibaraki virus and four serotypes of BLU then found in USA.

Section VI - Biologic Characteristics

Virus Source (all VERTEBRATE isolates)
Blood (LV), CNS (LV), spleen (LV), skin lesions (LV), lymph node (LV); fetal: calf spleen; sheep CNS, liver, lung; lab. mice CNS. Bovine and ovine placenta

Lab Methods of Virus Recovery (ALL ISOLATIONS)
Newborn mice, chick embryos and Vero cell cultures, BHK-21.cell cultures

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)	

Hamster kidney (BHK-21) cell cultures are commonly used. Virus multiplication is noted and is accompanied by the production of CPE (34). Other cell lines used are Vero and L mouse fibroblasts. Bluetongue virus multiplies without CPE in Aedes albopictus and Ae pseudoscutellaris cell cultures at 27C and 37C. Maximum titers are detected on days 3 and 6 respectively. Viral multiplication was not demonstrated in Ae aegypti cell cultures (15).

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
Bluetongue is an acute, subacute, and possible chronic virus disease of wild and domestic ruminants (3,10). Sheep often have high morbidity with variable mortality, cattle morbidity is usually low and goat morbidity lower. Although wild ruminants may be severely affected (27), the incrimination of particular species is usually the result of serologic surveys that have shown that a large number of wild ruminants are susceptible (29,33) including epizootics at zoos (9). Culicoides were first incriminated as vectors in South Africa (6). Virus isolations worldwide have incriminated several species from different Culicoides subgenera but many previous isolations are inconclusively labelled because of taxonomic problems within species complexes. These problems and the likely vector species for each geographic area, primarily belonging to the subgenus Avaritia, are discussed (37); the false assessment of a high vector potential for C. brevitarsis in Australia was prevented through carefully related taxonomic, ecologic, and vector competence studies with field populations of the species of the subgenus Avaritia (38). The primary vector of BLU in the USA is C. variipennis, (Monoculicoides), which is probably a species complex and is the only BLU vector species that has been colonized (17). It has been suggested for South Africa that Culicoides may serve as overwintering BLU hosts in endemic areas with mild winters (24); but pathogenesis studies with C. variipennis reconfirmed the unlikelyhood of transovarian transmission of bluetongue virus (39).			
Amblyomma variegatum	3		Guinea (41)

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)		ic			
Mice (nb)		ip			
Mice (nb)		sc			
Mice (wn)		ic			
Mice (wn)		ip			

Experimental hosts are sheep, cattle, goats, some wild ruminants, suckling mice, and hamsters, embryonating chicken eggs, and certain cell lines. CF antigen is usually prepared from baby mice, or cell cultures.

Experimental results depend on the strain of BLU used (3,10).

Several findings promoted experimental BLU research (3,10): the showing of the plurality of strains (23), the successful use of the propagation of BLU inembryonated chicken eggs(1), the development of cell culture as a neutralization assay system (8), and the demonstration for wild and colonized populations of C. variipennis that this species was a biological vector of bluetongue virus(7). Subsequent research in the USA showed the viremic curves of BLU in sheep andcattle (18). A genetic selection program for oral susceptibility to BLUdeveloped two highly susceptible and a resistant line from the baseline colony of C. variipennis (Sonora strain) that was only 30% susceptible (16).

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
A carrier state of BLU was identified in cattle (19); this state explained an overwintering mechanism for BLU, partially in relation to bites of the vector that increased circulating virus.									

Section X - Histopathology

Character of lesions (specify host)
Natural infection often inflammation: sheep-lesions buccal, nasal and intestinal mucosae, and striated musculature; fetal lambs-brain lesions; cattle-necroses of oral mucosa, teats and udder (3,10)

Inclusion Bodies — Intranuclear
Lower Vertabrates

Organs/Tissues Affected
Skeletal muscles (LV); sheep-death often pneumonia; death of fetus and congenital abnormalities common in lambs and sheep, cattle, goats, wild ruminants; embryonated chicken eggs;suckling mice, hamsters and guinea pigs.

Category of tropism
Striated muscle, mucosa of head and digestive epithelium (3,10)

Section XI - Human Disease

In Nature	Residual	Death
Subclinical	Overt Disease **Reported**	
Clinical Manifestations		
Number of Cases	Category (i.e. febrile illness, etc.)	

Section XII - Geographic Distribution

Known (Virus detected)
Most of Africa, Near and Far East, and also from USA, Mexico and most parts of Latin America (40).

Suspected (Antibody only detected)

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Remarks

First immunization carried out with bluetongue virus in 1901-2 (26).