



VMC 321: Systematic Veterinary Virology

Bluetongue virus

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VMC 605: SYSTEMATIC ANIMAL VIROLOGY

BLUETONGUE VIRUS

Presented by: Dr Manoj Kumar, Assistant Professor

Classification

Family - *Reoviridae*



Subfamily - *Sedoreovirinae*



Genus - *Orbivirus*



Species - *Bluetongue virus*

Orbivirus - BTV

22 SPECIES OR SEROGROUPS IN THE GENUS ORBIVIRUS

An orange rounded rectangular box containing the text '22 SPECIES OR SEROGROUPS IN THE GENUS ORBIVIRUS'. A large, semi-transparent orange arrow points downwards from the bottom right corner of this box towards the grey box below.

BTV IS NOTIFIABLE TO THE WORLD ORGANIZATION FOR ANIMAL HEALTH (OIE).

A grey rounded rectangular box containing the text 'BTV IS NOTIFIABLE TO THE WORLD ORGANIZATION FOR ANIMAL HEALTH (OIE)'. It is positioned below the orange box and is connected to it by a large, semi-transparent orange arrow pointing downwards.

Morphology

- Nonenveloped with two concentric protein shells
- Architecturally complex icosahedral structures
- Composed of seven discrete proteins - VP1 to VP7 in order of their decreasing size
- Outer layer consists of 60 sail-shaped, spike like structures made up of VP2 trimers and VP5 trimers
- Core particle composed of two major proteins (VP7 and VP3), three minor proteins (VP1, VP4, and VP6).
- Complete virions are relatively fragile and the infectivity of BTV is lost easily in mildly acidic conditions.
- Genome consisting of ten dsRNA segments.



Genome organisation

- Genome consisting of ten dsRNA segments.
- Genome is 19 kbp in length with a molecular weight of 1.3×10^7 da
- Individual sizes of BTV-10 RNAs - range from 3954 bp (segment 1) to 822 bp (segment 10,).



Genus Orbivirus

Replication

Replication (I)

- BTV multiply in arthropods as well as in vertebrate hosts
- **Adsorption :**
 - BTV adsorbs to sialoglycoprotein via the outer capsid protein VP2 in mammalian cells
- **Penetration:**
 - Virion enters inside host cell via receptor-mediated endocytosis by clathrin-coated vesicles
 - second outer capsid protein VP5 to permeabilize the endosomal membrane.
- **Transcription:**
 - core particles do not disassemble further
 - initiate the transcription of the viral genome

Replication (II)

Replication of viral dsRNA occurs in two distinct steps.

- First, plus-strand RNAs (mRNAs) → transcribed and extruded from the core particle.
- Second, the plus strand RNAs → serve as templates for the synthesis of new minus-strand RNAs.

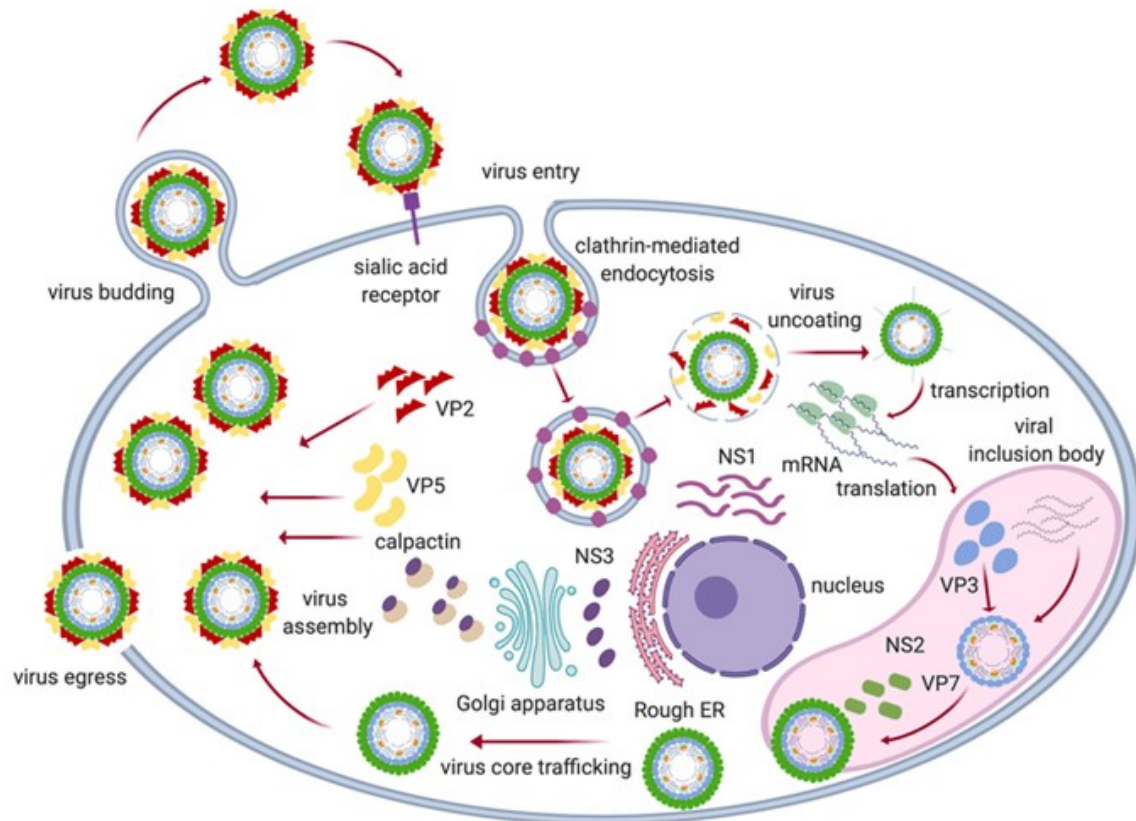
Capsid Assembly:

- Initiation of core assembly - formation of VP3 decamers and the complex formed with VP1 and VP4.
- These assembly intermediates subsequently recruit
- Viral RNA, and VP6, prior to completion of the assembly of the VP3 subcore and the addition of VP7 trimers.

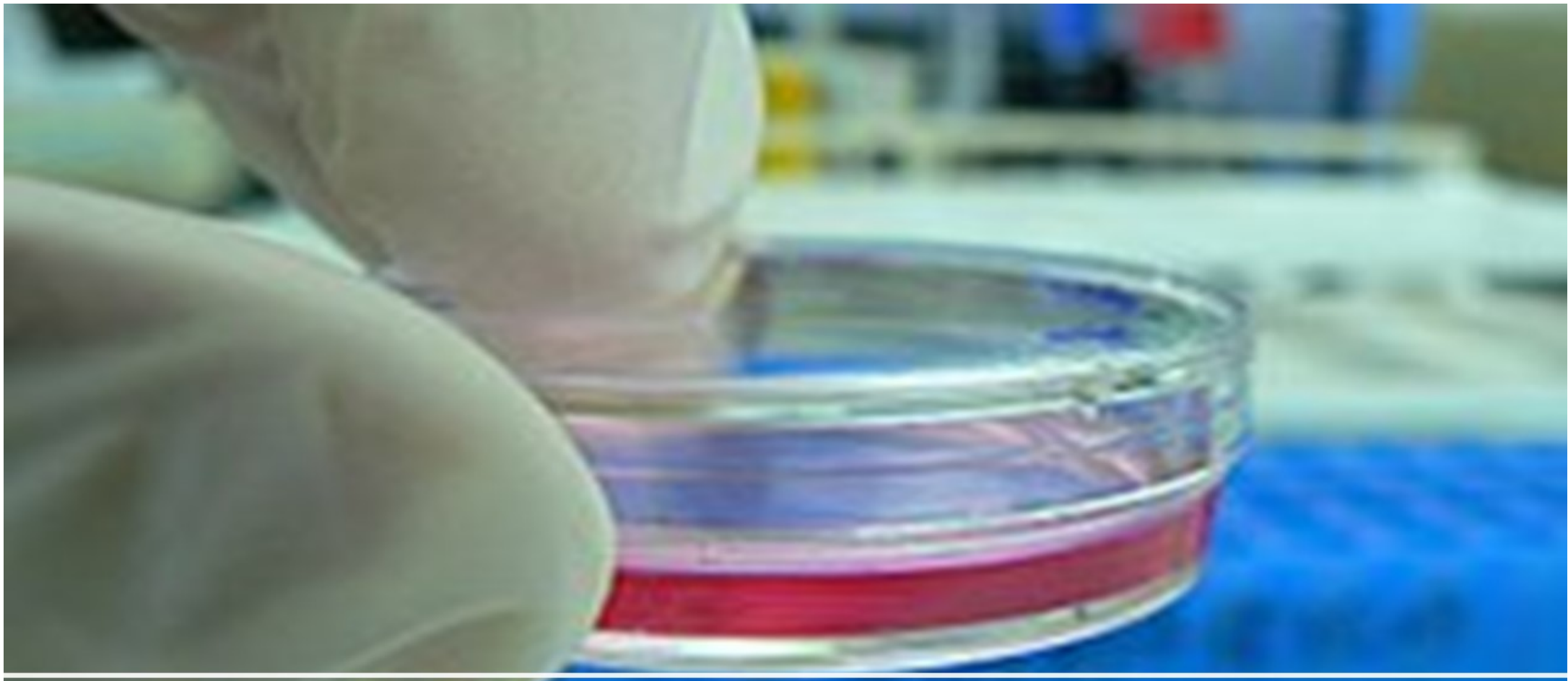
Replication (III)

Egress from Host Cells

- Virus particles release through
 - budding out from cell membrane
 - move in groups through a local disruption of the plasma membrane.



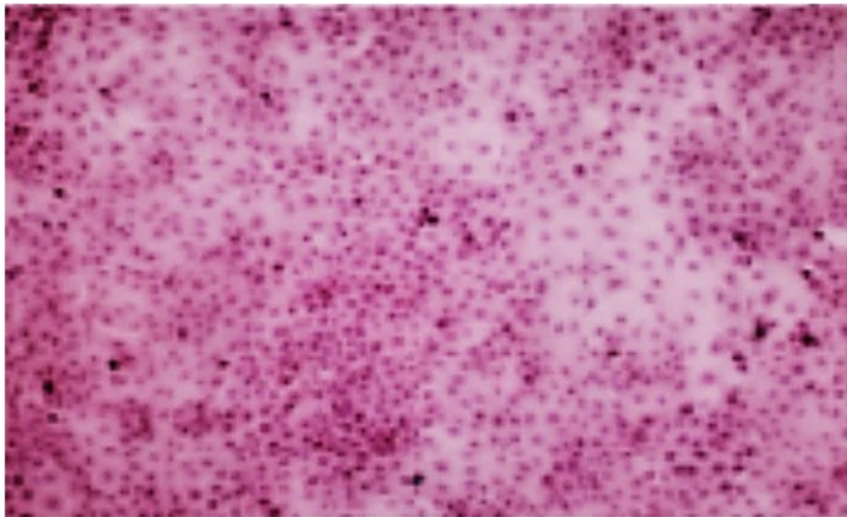
Schematic representation
-
Replication cycle of BTV



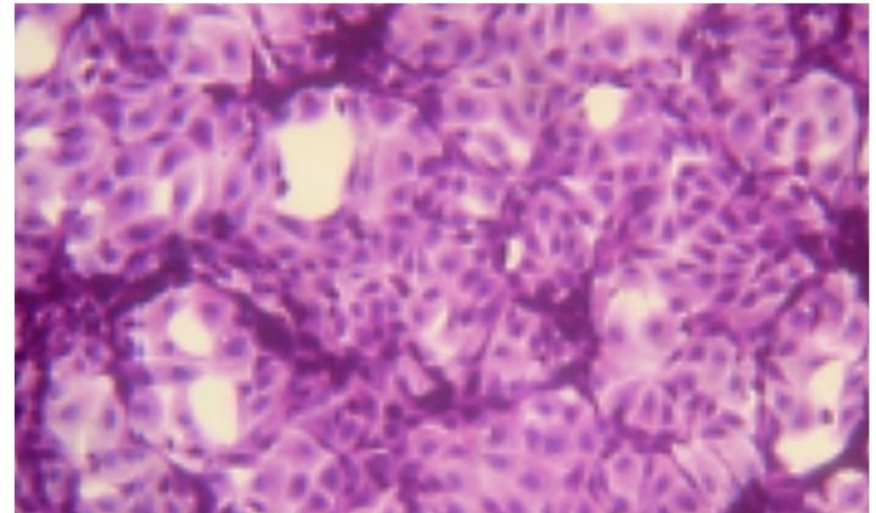
Cultivation of BTV

Cultivation of BTV in cell culture

Uninfected vero cells



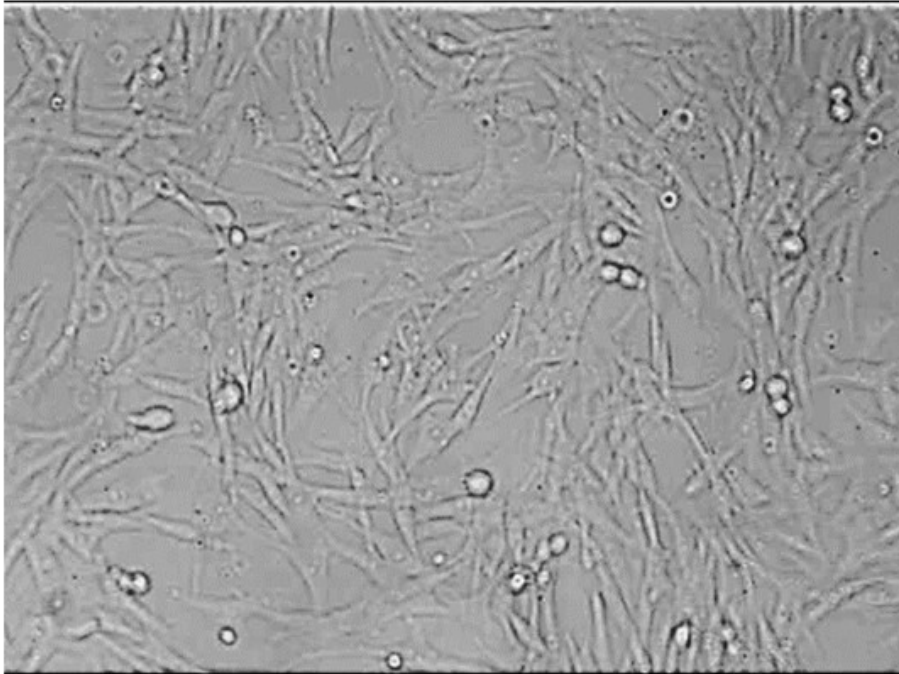
BTV infected vero cells



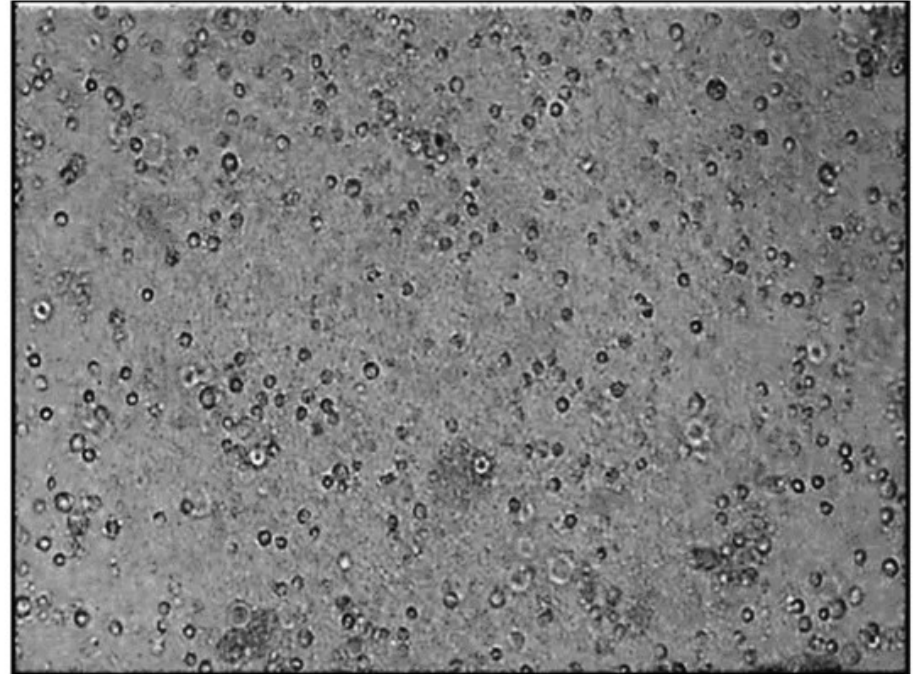
Rounding of cells, syncytia formation, giant cell formation and grouping of cells

Growth of BTV in BHK -21 cells

- Uninfected BHK-21 cells

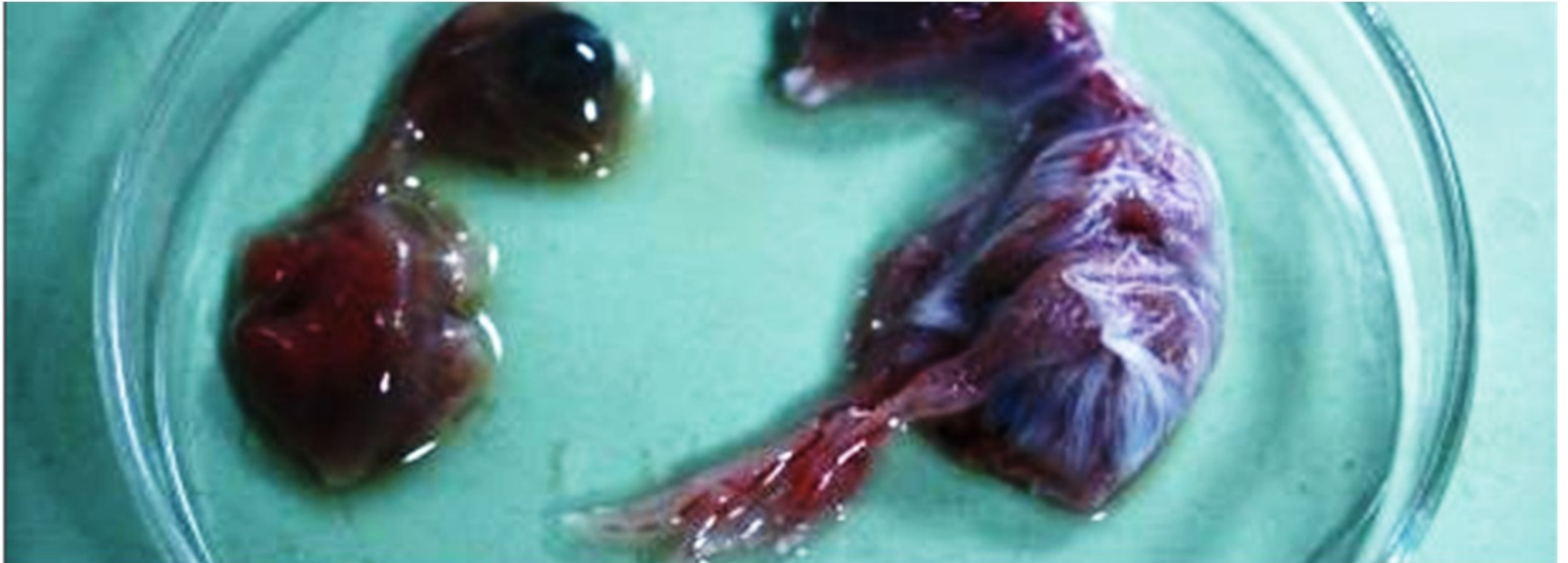


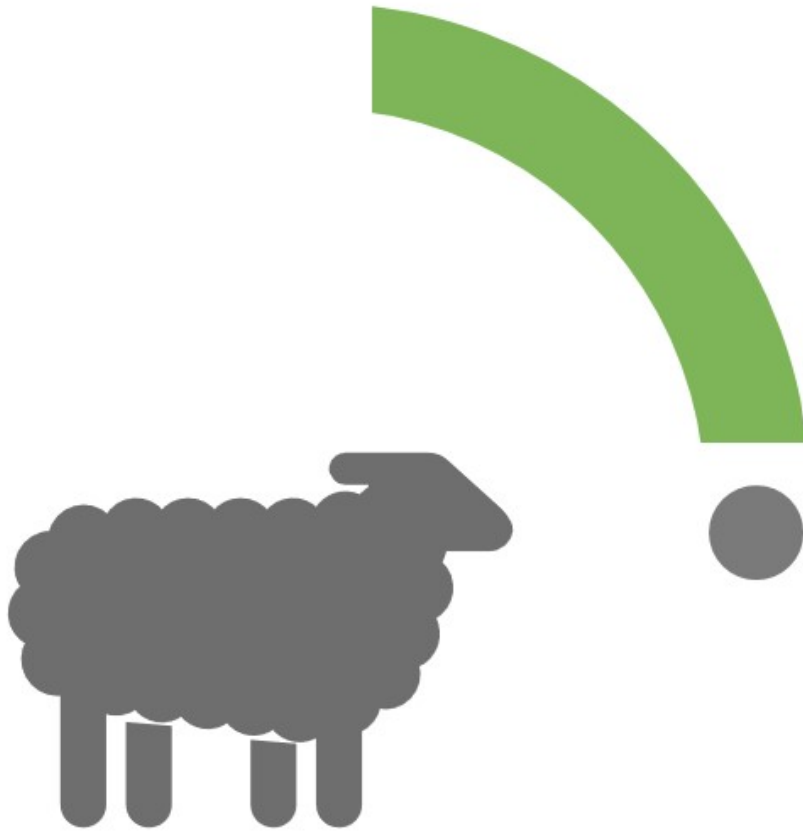
- **BTV infected BHK 21 cells**



Growth of BTV in chicken embryo

- Congestion and stunted growth





Bluetongue

Etiological agent:

Bluetongue virus

Epidemiology

- Bluetongue (BT) is an insect-borne endemic disease in India.
- observed in domestic and wild ruminants
- clinical disease and mortality are observed only in sheep
- difference in disease patterns - due to
 - varied climatic conditions
 - sheep population density
 - susceptibility of the sheep breeds to BT.
- outbreaks occurs every year in India.



HOST

- Domestic cattle
 - Bison
 - Deer
 - Goats and sheep
- Bluetongue virus can also affect wild animals such as:
- Bighorn sheep
 - Elk
 - Mountain goats
 - Mules
 - Deer
 - Pronghorn antelopes
 - White-tailed deer and most other even-toed hoofed animals

Reservoir of BTV

Cattle are the main mammalian reservoir of the virus



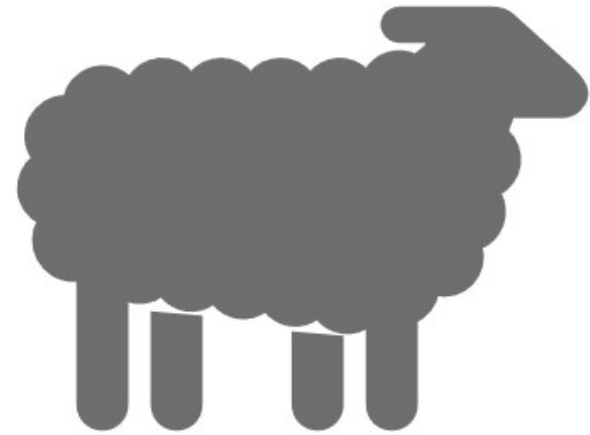
Transmission of BTV

- Mediated through the bite of infected midges
- BTV is typically transmitted by the bite of *culicoides*.
 - *Culicoides imicola* in Africa and Asia
 - *Culicoides brevitarsis* in Australia
 - *Culicoides sonorensis* in America
- are thought to be the main vectors in disease spread



Bluetongue

in Sheep



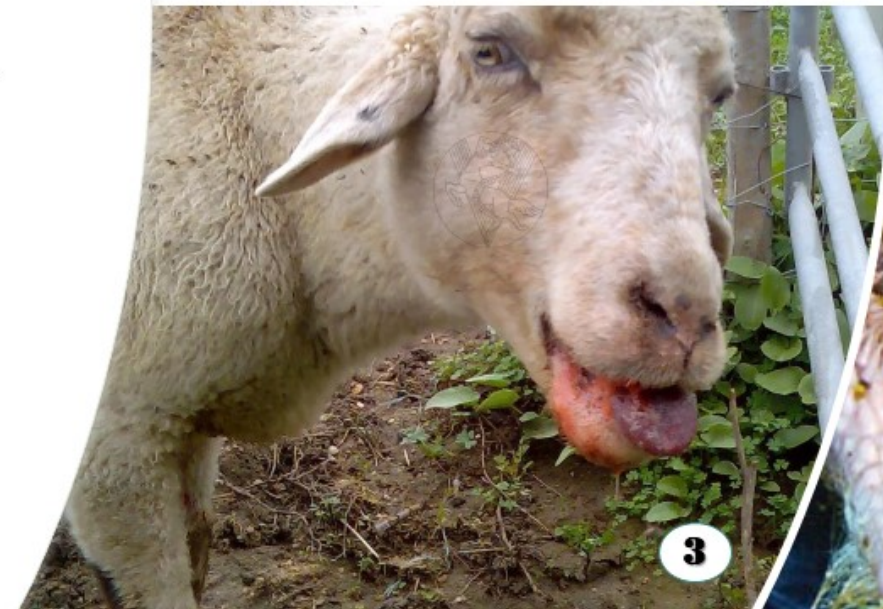


Clinical signs in sheep

- Fever
- Conjunctivitis
- Lacrimation,
- Congestion and reddening of nasal and oral mucosa
- Edema of the face and lips.
- swollen, purple-coloured tongue (hence, the name bluetongue)
- lameness

Lesions due to BTV infection in sheep

1. Swelling & reddening of lips and nose.
2. Mucopurulent discharge from nose.
3. Inflammation & reddening of lips.
4. Erosion of tongue epithelium



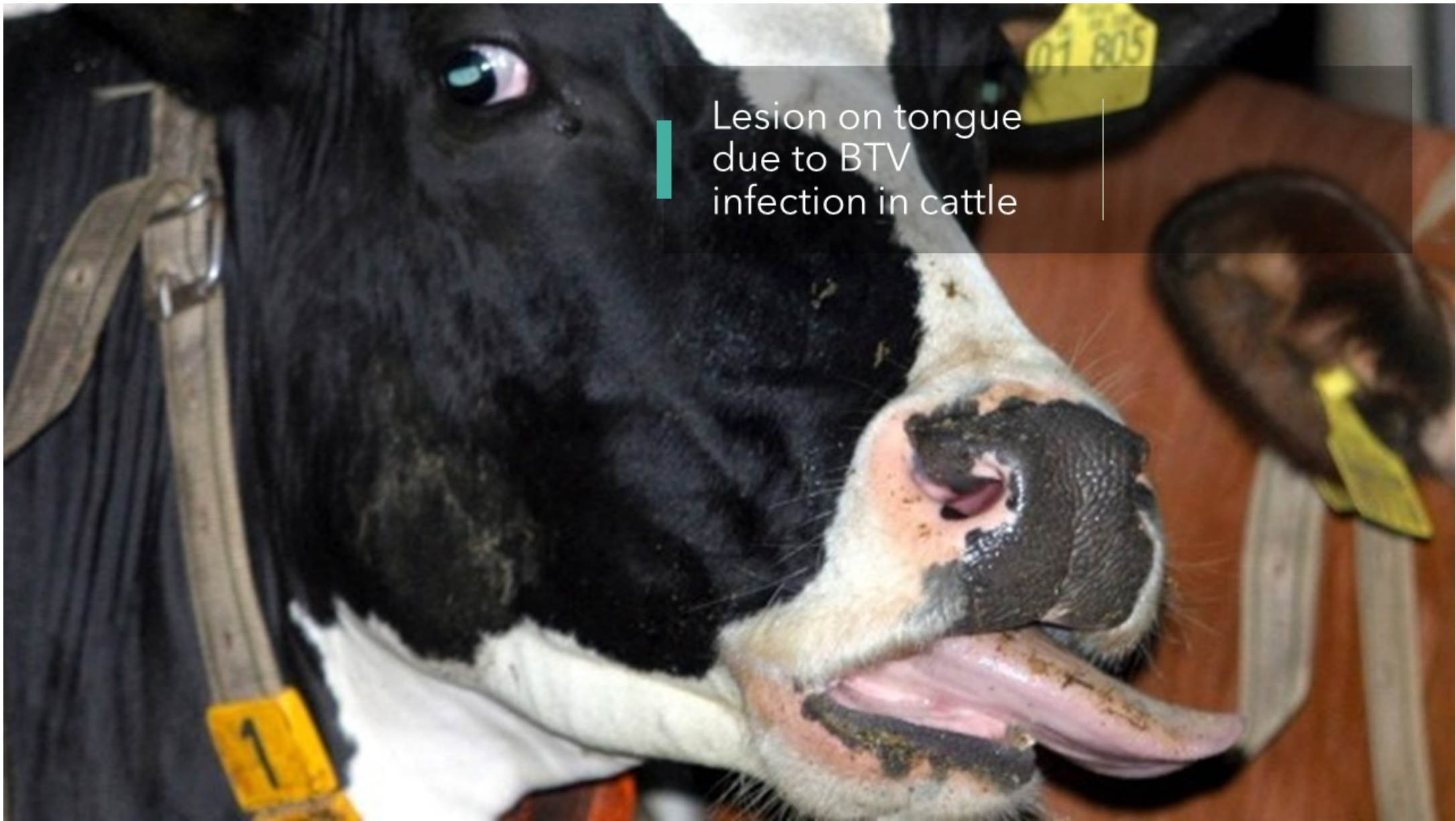


Bluetongue in Cattle

Clinical symptoms in cattle



- Fever up to (40.0°C)
- Nasal discharge
- Swelling of the head and neck
- Conjunctivitis (runny eyes)
- Swelling in, and ulceration of the mouth
- Swollen teats
- Saliva drooling out of the mouth
- Abortion



Lesion on tongue
due to BTV
infection in cattle



Typical foot lesion :

BTV infected cattle involving coronitis and inflammation of the whole claw region

No formation of blisters



Lesion of BTV infection in cattle

Affected cattle appear stiff due to swelling of the coronary band at the top of the hooves



—
Serous to
mucopurulent
nasal discharge
due to BTV
infection in
cattle





lacrimation
without
obvious eye
lesions.

Oedema
(swelling) of
the face



Extensive teat erosions may develop in some cattle.



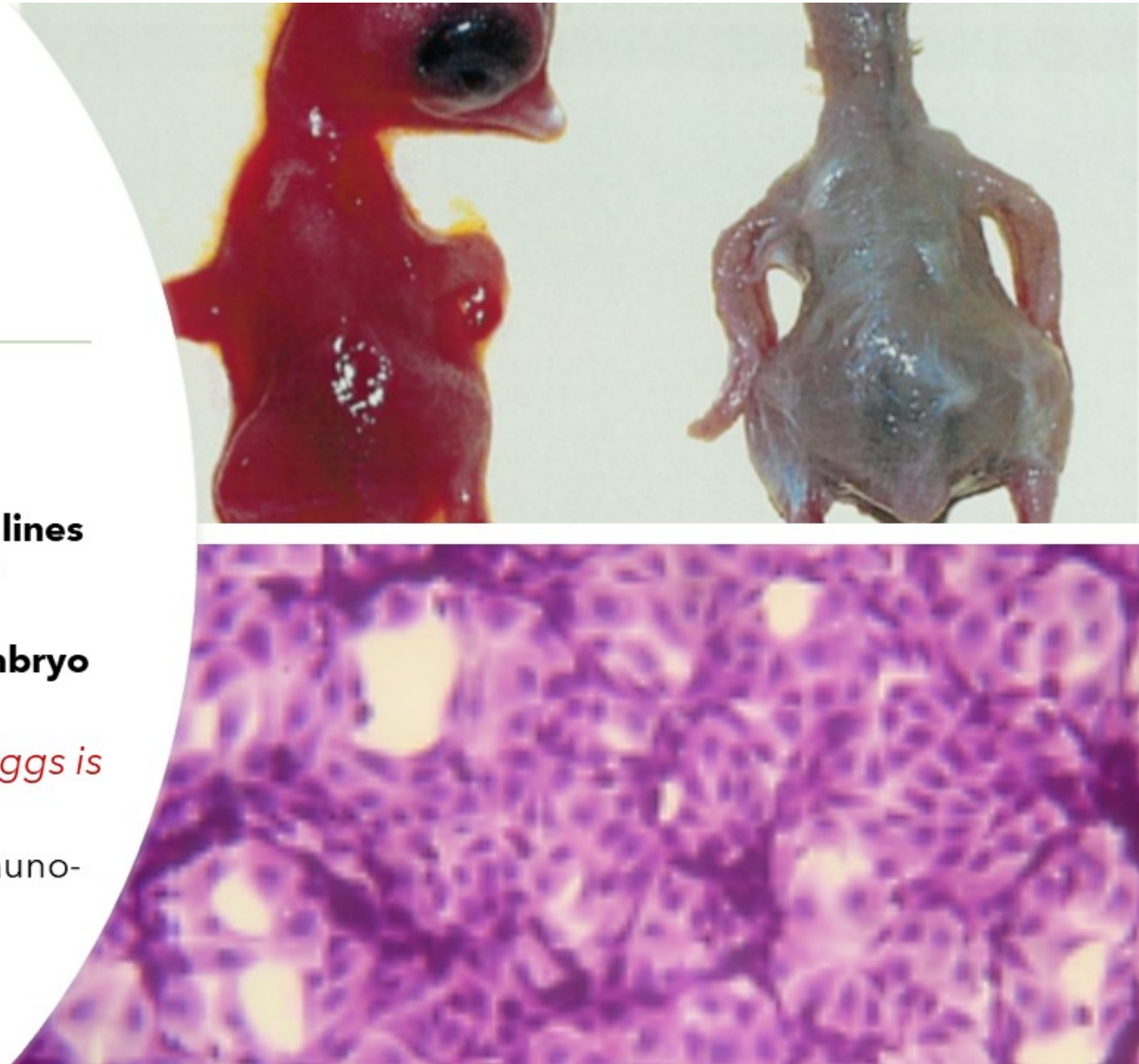
DIAGNOSIS

BLUE TONGUE



Diagnosis

- Clinical **signs and symptoms**
- Isolation and identification of BTV in
 - **Cell culture - BHK 21, Vero cell lines** followed by immunoperoxidase & immunofluorescence test.
 - **Isolation of virus in chicken embryo** through I/V or yolk sac route
- *Isolation in embryonating chicken eggs is more sensitive than cell culture*
- **Dot immunobinding assay** and immunoelectron microscopy



Serodiagnosis

A laboratory setting with a pipette dropping liquid into test tubes. The background is a blurred image of several test tubes in a rack, with a pipette tip positioned above one of them, releasing a drop of liquid. The overall color palette is cool and clinical, with blues and greys.

Agar Gel Immunodiffusion (AGID) assay

Competitive ELISA (C-ELISA)

Double recognition ELISA (DR-ELISA)

Serum neutralization test (SNT)

Antigen-capture enzyme-linked immunosorbent assay (ELISA)

Nucleic acid based diagnosis

1

Reverse transcription-
polymerase chain reaction
(RT-PCR) assay for NS1
gene

2

Real Time RT-PCR Assays



Any
question
?????



THANKS

A photograph of a person's hands holding an open book, with a dark blue background. The person is wearing a dark blue shirt. There are decorative elements: a green circle in the top right and a brown shape with a green line in the bottom left. The text is overlaid on the book.

Further reading

Chapter 15 – Reoviridae. In: Fenner's Veterinary Virology, Fifth Edition. Boston: Academic Press. pp. 299-317. ISBN 978-0-12-375158-4