Tikrit University
College of Veterinary Medicine

Lect. 8-Virology

Subject name: RNA Viruses families: Paramyxoviridae and Reovirida
Subject year:2024-2023

Lecturer name: Assist.Prof.Dr. Agharid Ali Hussein and Prof. Dr. Nihad Abdul-Hussain Jafar
Academic Email:
agharidalrasheed@tu.edu.iq
nihadabid73@tu.edu.iq

SCAN ME
Lecturers link

III. Paramyxoviridae: *Paramyxo*: from Greek *para*, “by the side of”, and *myxa*, “mucus”.

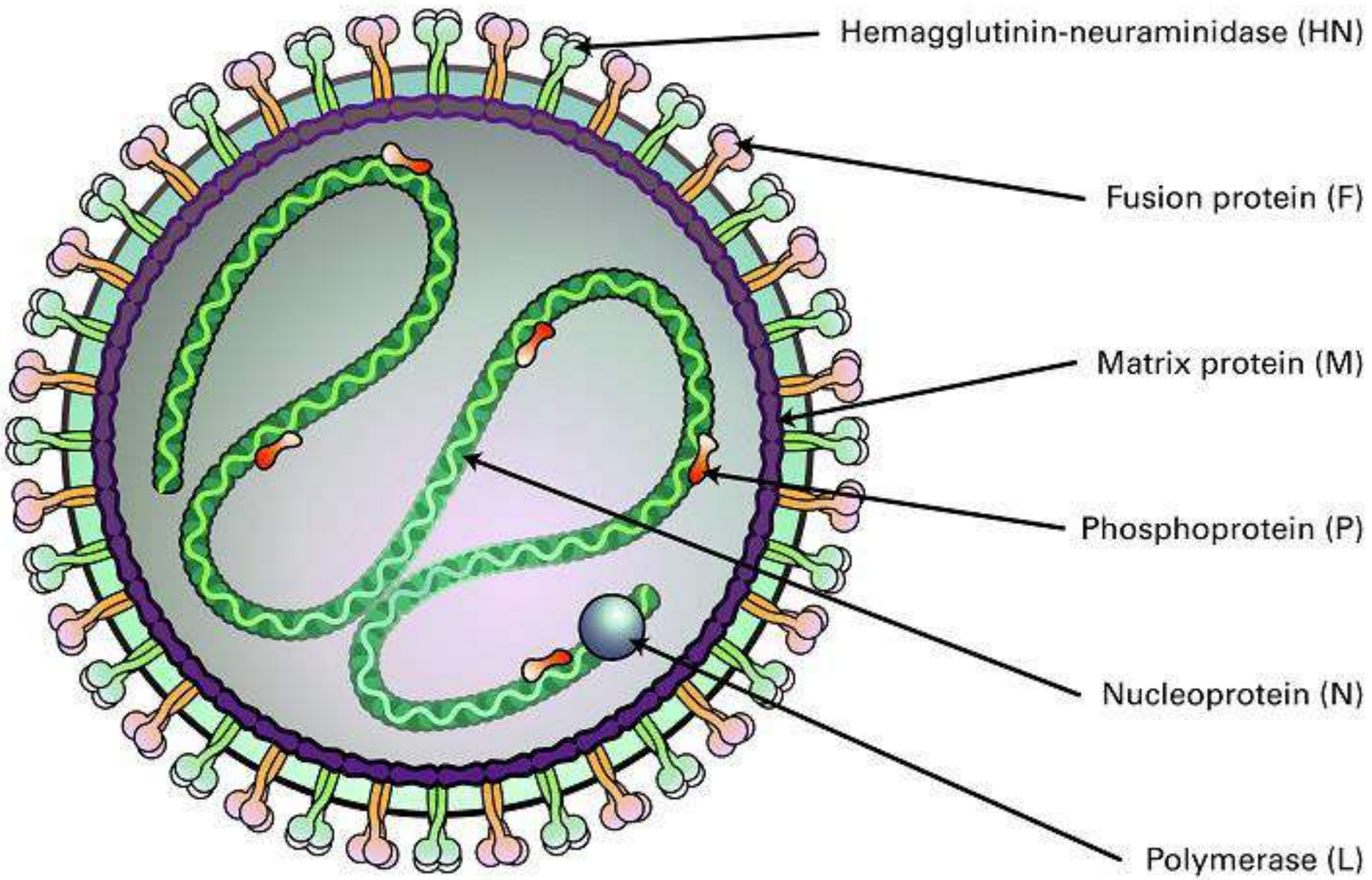
The family Paramyxoviridae includes pathogens that cause some of the most devastating human and veterinary diseases. In particular, rinderpest, canine distemper, Newcastle disease, measles, and mumps viruses have possibly resulted in more morbidity and mortality than any other single group of related viruses. The use of vaccines in both humans and, often in combination with depopulation and movement restrictions, in animals, has dramatically reduced the impact of these diseases, and even resulted in the eradication of rinderpest virus in 2011

1. **Genera of Paramyxoviridae:**
2. Respiro virus: Bovine parainfluenza virus 3.
3. Morbillivirus : Rinderpest virus.
4. Rubella virus : Newcastle disease virus.-Avian parainfluenza virus.
5. Pneumovirus : Bovine respiratory syncytial virus.
6. Meta pneumovirus: Turkey rhinotracheitis virus.

❖ Some of common virion properties of viruses within the paramyxoviridae family:

1. **Shape and Size**: Paramyxoviridae virions are typically pleomorphic or spherical in shape and vary in size from approximately 150 to 300 nanometers in diameter.
2. **Envelope**: Like other viruses in the order Mononegavirales, paramyxoviruses have an envelope derived from the host cell membrane. This lipid envelope surrounds the viral nucleocapsid and contains viral glycoproteins embedded in it.
3. **Nucleocapsid:** Inside the envelope, paramyxoviruses possess a helical nucleocapsid, which consists of the viral RNA genome (single-stranded, negative-sense RNA) tightly bound to nucleoprotein (N protein).
4. Genome: The genome of paramyxoviruses is non-segmented and consists of a single molecule of negative-sense RNA. This RNA molecule encodes the viral proteins necessary for replication, transcription, and assembly. Genome replication and transcription are cytoplasmic.
5. **Surface Glycoproteins**: Paramyxoviruses possess two major surface glycoproteins: . These are visualized as spikes extending 8-12 nm from the envelope
   A. **Attachment Protein** Hemagglutinin-Neuraminidase (HN): **This protein is responsible for binding to host cell receptors, facilitating viral attachment and entry into the host cell.**
   B. **Fusion Protein (F): The fusion protein mediates the fusion of the viral envelope with the host cell membrane, allowing the release of the viral nucleocapsid into the host cell cytoplasm**
6. **Matrix Protein (M)**: The matrix protein lies beneath the viral envelope and plays a role in maintaining the shape of the virion and in viral assembly and budding. Immunogenicity of The Matrix protein can elicit immune responses in infected hosts and is a target for host immune recognition

7. **Lipid Bilayer**: The lipid bilayer of the virion envelope contains viral proteins and host-derived lipids.


Hemagglutinin-neuraminidase (HN)
Fusion protein (F)
Matrix protein (M)
Phosphoprotein (P)
Nucleoprotein (N)
Polymerase (L)

Rinderpest virus

Rinderpest virus, also known as cattle plague virus, is a member of the Paramyxoviridae family, specifically belonging to the genus Morbillivirus. Rinderpest is a highly contagious viral disease that primarily affects cattle and other cloven-hoofed animals such as buffalo, sheep, goats, and wild ruminants.

Here are some key points about Rinderpest virus:

1. Genome and Structure: Rinderpest virus has a single-stranded, negative-sense RNA genome enclosed within a lipid envelope. The genome consists of six genes that encode for essential structural and non-structural proteins. The virus particle is pleomorphic in shape and typically measures around 150-300 nanometers in diameter.

2. Transmission: Rinderpest virus is transmitted primarily through direct contact between infected and susceptible animals. It can also spread through contaminated feed, water, and fomites. The virus can remain viable in the environment for a certain period, contributing to its persistence and spread within susceptible populations.

3. Clinical Manifestations: Rinderpest infection in cattle typically presents with high fever, depression, loss of appetite, nasal and ocular discharge, oral erosions, and diarrhea. The disease progresses rapidly, and mortality rates can be as high as 90% in susceptible populations. In wildlife, such as buffalo and wild ruminants, the disease may manifest similarly but with varying severity.

4. Epidemiology: Rinderpest was once widespread and caused devastating losses in cattle populations worldwide. However, concerted international efforts led to the successful eradication of the disease through mass vaccination campaigns and strict control measures. The last confirmed case of Rinderpest in the world occurred in 2001, leading to the declaration of global eradication by the World Organization for Animal Health (OIE) in 2011.

5. **Impact: Rinderpest has had profound socio-economic impacts, particularly in regions where cattle are vital for agriculture, food security, and livelihoods. The eradication of Rinderpest has led to significant improvements in animal health, productivity, and food security in affected regions.**
6. **Vaccination and Control: Vaccination played a crucial role in the successful eradication of Rinderpest. The live attenuated vaccine, based on the strain of the virus, was widely used in mass vaccination campaignsAdditionally, strict biosecurity measures and surveillance were implemented to prevent reintroduction of the virus.**
7. **One Health Perspective: The eradication of Rinderpest represents one of the most significant achievements in veterinary medicine and public health. It underscores the importance of collaborative efforts between veterinary and human health sectors, as well as international cooperation, in combating infectious diseases with zoonotic potential.**

.

Diagnosis:

1.Clinical Signs:

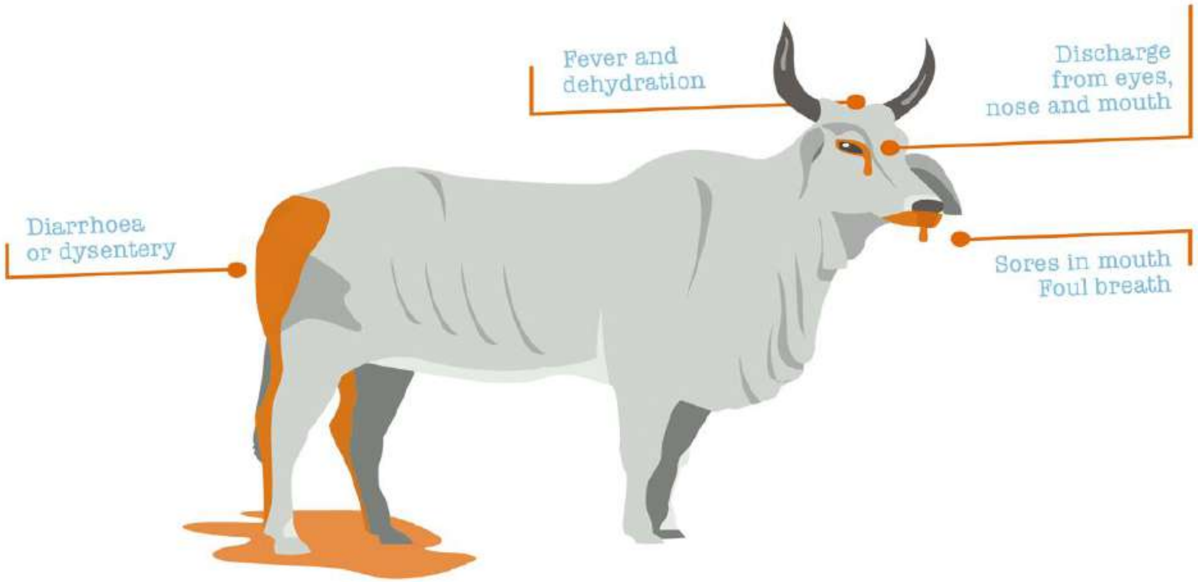
2.Post-Mortem Examination: Examination of carcasses can reveal typical lesions associated with rinderpest, such as necrotic lesions in the gastrointestinal tract, enlarged lymph nodes, and congestion of internal organs. These findings can support the diagnosis, particularly in areas where rinderpest is endemic or suspected.

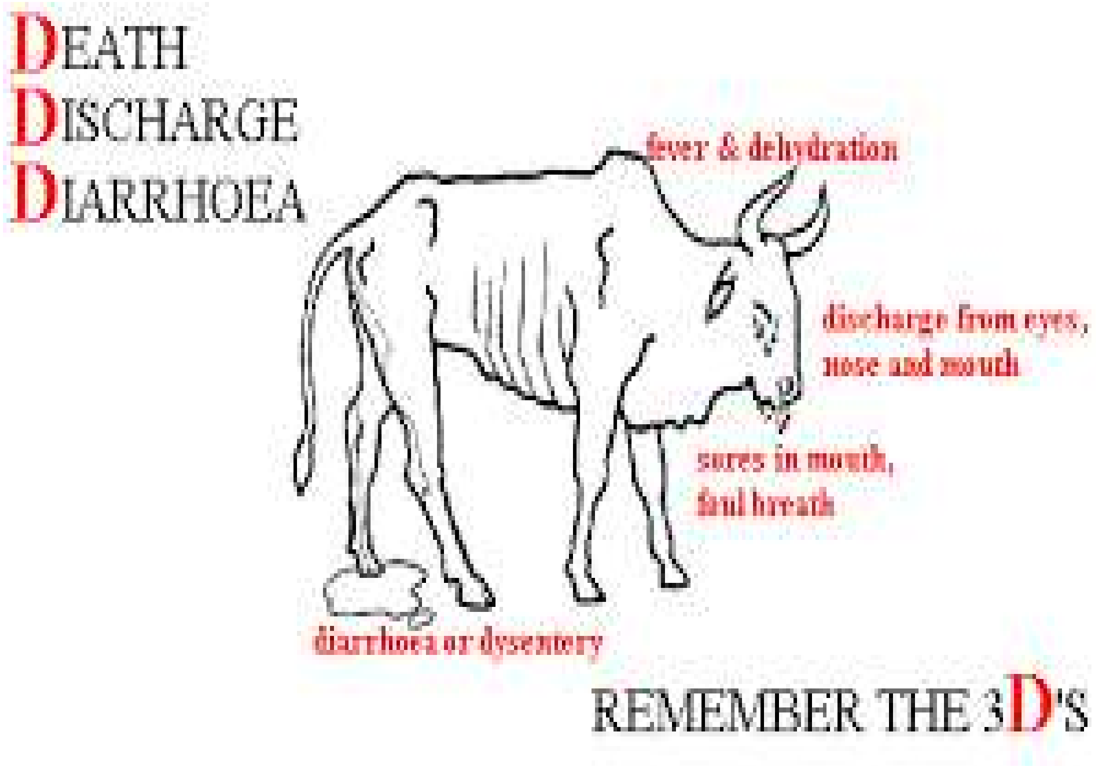
3.Serological Tests: Various serological tests, such as enzyme-linked immunosorbent assay (ELISA) and virus neutralization tests (VNT), can be used to detect antibodies against rinderpest virus in serum samples from infected or vaccinated animals. Serological testing is useful for confirming exposure to the virus and monitoring the immune status of animal populations.

4.Molecular Tests: Polymerase chain reaction (PCR) assays can detect rinderpest viral RNA in clinical samples, such as nasal swabs, blood, or tissues. PCR-based methods offer rapid and sensitive detection of the virus and can differentiate rinderpest from other similar diseases.

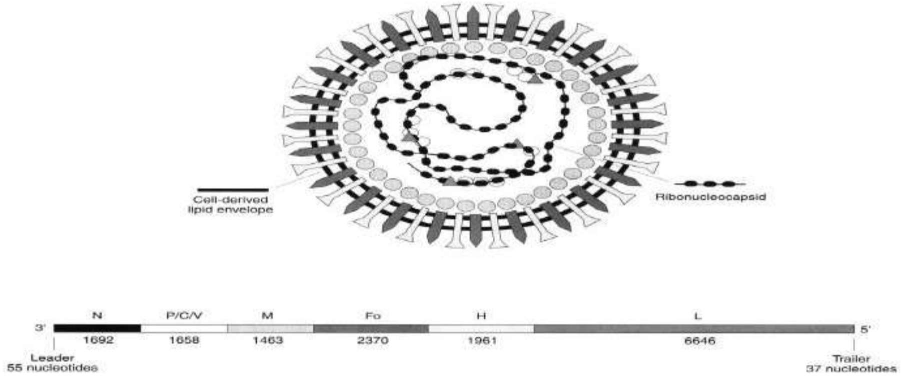
5.Epidemiological Investigation: Epidemiological investigation, including history-taking and surveillance(Monitoring) of animal populations, can provide valuable information about the presence and spread of rinderpest. Factors such as recent contact with infected animals, movement of livestock, and vaccination status can aid in the diagnosis and control of outbreaks.

6.Differential Diagnosis: Rinderpest shares clinical signs with other diseases, such as bovine viral diarrhea (BVD), foot-and-mouth disease (FMD), and contagious bovine pleuropneumonia (CBPP). Differential diagnosis is essential to distinguish rinderpest from these other diseases and implement appropriate control measures.





Sores in mouth or ulcer

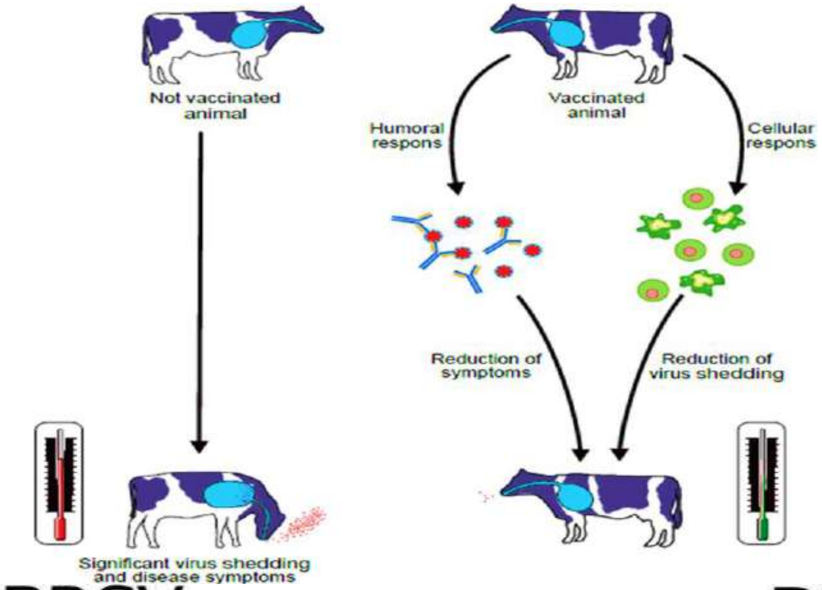


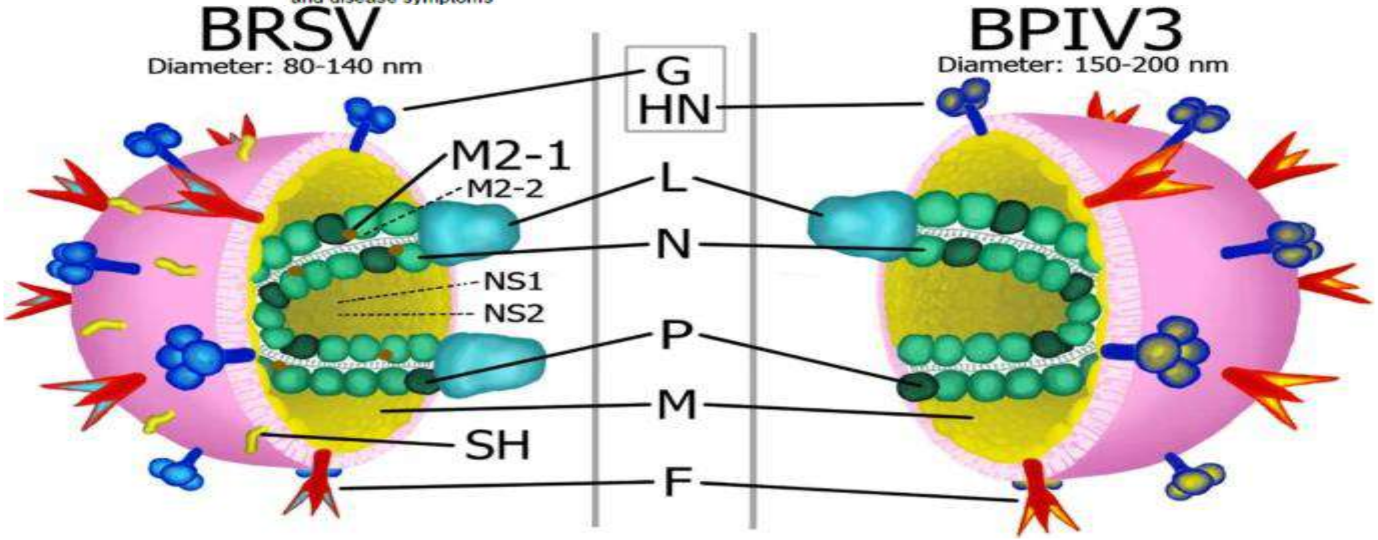
Bovine Parainfluenza-3 Virus (PI3)

Bovine Parainfluenza-3 Virus (PI3) is a member of the Paramyxoviridae family and belongs to the genus Respirovirus. It is a common respiratory pathogen affecting cattle worldwide, particularly young calves, and is a significant cause of bovine respiratory disease (BRD).

Here are some key characteristics and information about the Bovine Parainfluenza-3 Virus (PI3)

1. **Structure**: PI3 virus particles are enveloped and roughly spherical in shape. The envelope contains glycoproteins on its surface, including the fusion (F) and hemagglutinin-neuraminidase (HN) proteins, which are involved in viral attachment, entry, and fusion with host cells.
2. **Genome**: The genome of PI3 virus consists of a single molecule of negative-sense RNA, which encodes the viral proteins necessary for replication and assembly. It is non-segmented and typically around 15,000 nucleotides in length.
3. **Transmission**: Bovine PI3 virus is transmitted primarily through respiratory secretions from infected animals. Direct contact between infected and susceptible animals, as well as airborne transmission via respiratory droplets, are common routes of transmission. The virus can also persist on fomites and in the environment, contributing to its spread within herds.
4. **Clinical Manifestations**: Bovine Parainfluenza-3 Virus primarily infects the respiratory tract of cattle, causing symptoms such as coughing, nasal discharge, fever, and difficulty breathing. In young calves, particularly those less than six months old, PI3 infection can lead to severe respiratory disease, pneumonia, and even death. PI3 virus often acts as a predisposing factor for secondary bacterial infections, exacerbating the severity of BRD.





Makoschey, B., & Berge, A. C. (2021). Review on bovine respiratory syncytial virus and bovine parainfluenza–usual suspects in bovine respiratory disease–a narrative review. BMC veterinary research, 17(1), 261.

Newcastle disease virus

Newcastle Disease (ND) is a highly contagious viral disease that affects various species of birds, including poultry such as chickens and turkeys. It is caused by Newcastle disease virus NDV belongs to the family Paramyxoviridae, genus Avulavirus. There are ten serotypes of avian paramyxoviruses named APMV-1 to APMV-10; NDV is known as APMV-1. Depending upon the disease signs and lesions in chicken, NDV can be classified into four groups/pathotypes: apathogenic (avirulent), low virulent (lentogenic), moderately virulent (mesogenic), highly virulent (velogenic).

Here are some key points about Newcastle Disease in poultry:

1. **Transmission**: Newcastle Disease virus spreads rapidly among birds through direct contact with infected birds, contaminated equipment, feces, respiratory secretions, and aerosols. Wild birds, particularly waterfowl, can also serve as carriers of the virus, contributing to its spread.

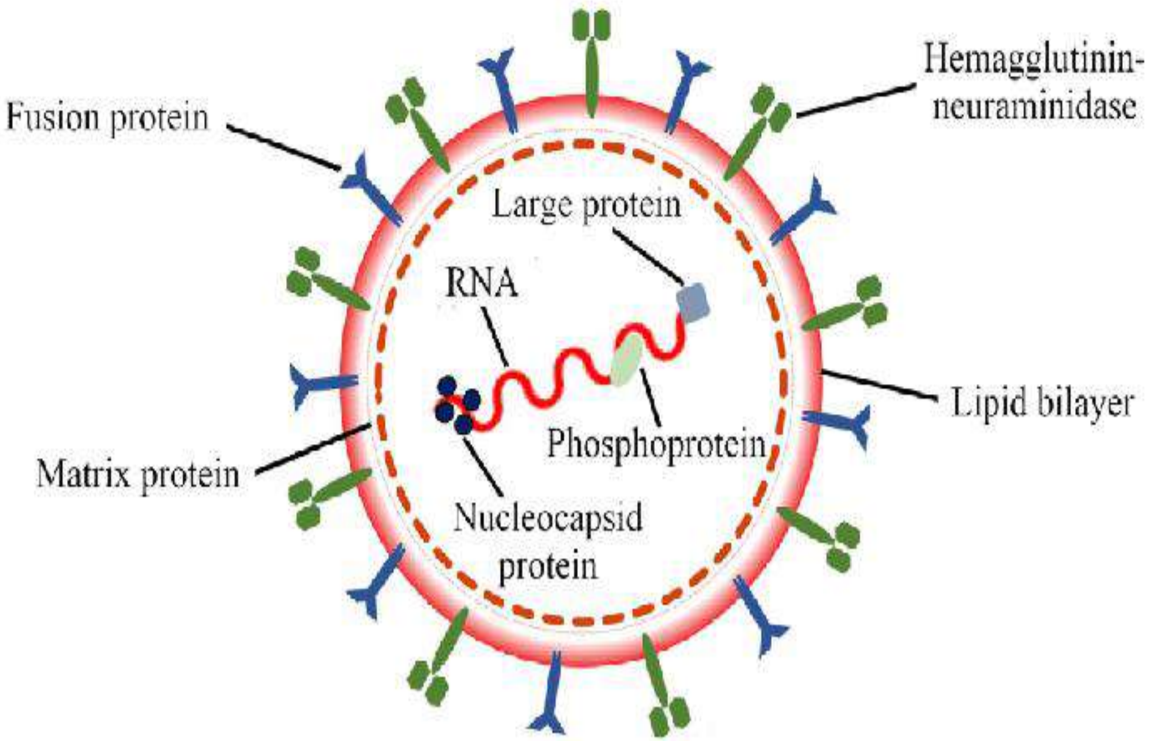
2. Clinical Signs: Clinical signs of Newcastle Disease in poultry vary depending on the virulence of the virus strain and the species and age of the birds. Affected birds may exhibit respiratory signs such as coughing, sneezing, nasal discharge, and difficulty breathing. Additionally, neurological signs such as tremors, paralysis, twisting of the head and neck (torticollis), and circling may occur. Egg production may also decrease, and eggshells may become thin or misshapen.

3. Pathogenesis:Newcastle Disease virus primarily targets the respiratory, gastrointestinal, and nervous systems of infected birds. The virus replicates in the respiratory and gastrointestinal tracts, leading to respiratory and digestive symptoms. In some cases, the virus may spread to the central nervous system, causing neurological signs.

4. Diagnosis: Diagnosis of Newcastle Disease in poultry typically involves a combination of clinical signs, post-mortem examination, and laboratory tests. Laboratory tests may include virus isolation, molecular techniques such as reverse transcription-polymerase chain reaction (RT-PCR), and serological assays to detect antibodies against NDV

5. Prevention and Control:** Prevention and control measures for Newcastle Disease in poultry include biosecurity practices to prevent introduction of the virus into poultry flocks, vaccination of susceptible birds **with live attenuated or inactivated vaccines,** and culling(اعدام) of infected or exposed birds during outbreaks. Proper disinfection of poultry houses and equipment is also important to reduce the spread of the virus.

6. Impact: Newcastle Disease can have significant economic impacts on the poultry industry due to loss of birds, decreased egg production, and trade restrictions imposed during outbreaks. It is considered a reportable disease by many countries, and outbreaks must be reported to veterinary authorities for surveillance and control measures.



Newcastle disease virus infects poultry and a variety of other avian species causing a disease of considerable agricultural and economic significance.

Reoviridae :

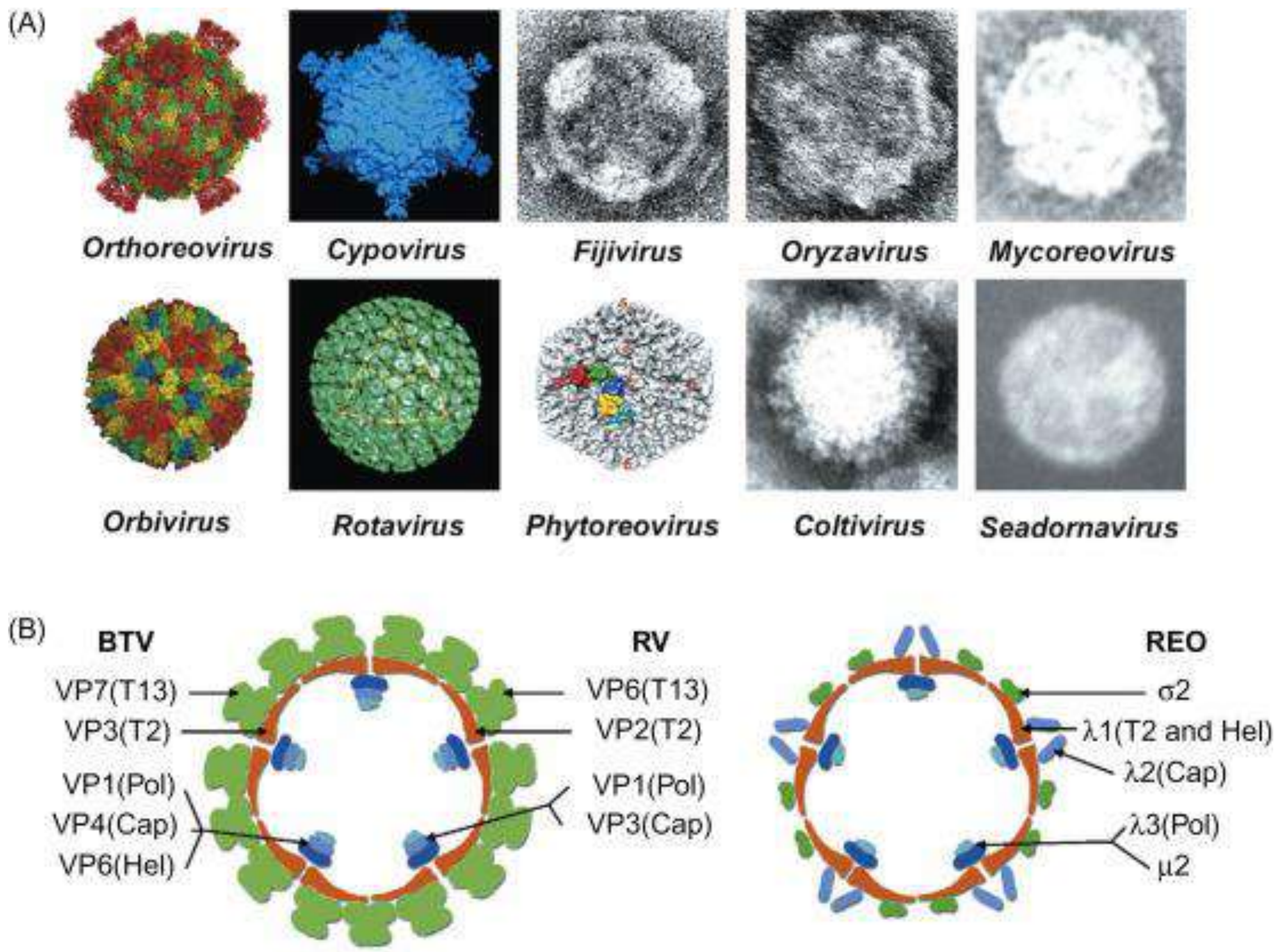
General characters of Reoviridae

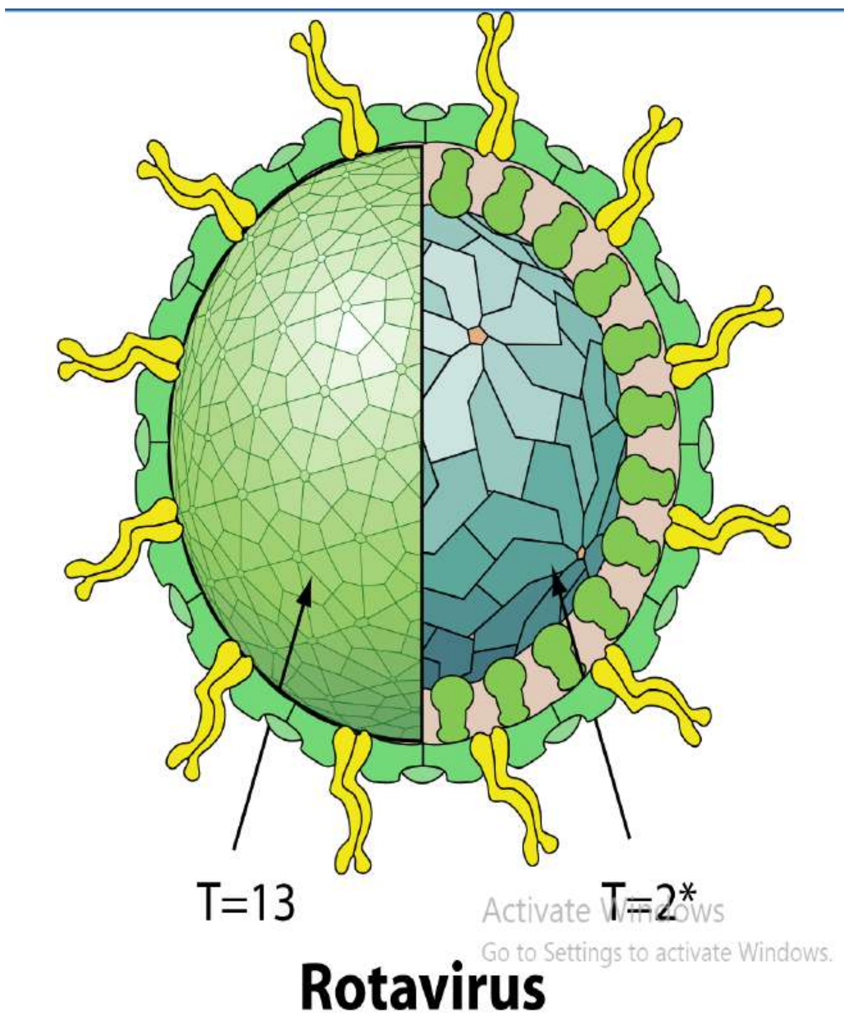
1. dsRNA genomes The number of genome segments ranges from 9 to 12.
2. Reovirus replication is cytoplasmic and a unique feature of these viruses is that transcription takes place from within capsids.
3. Virions are unenveloped, with two or three capsid layers (double or triple layer capsids). Middle and outer capsid layers are T=13 icosahedral lattices. The inner capsids or cores are T = 1.
4. Genetic reassortment readily takes place.
5. Resistant to heat, organic solvents.
6. Replicate in cytoplasm with intracytoplasmic inclusion bodies.

As a group, reoviruses are very successful with a wide host range that includes fungi, plants, invertebrates, and vertebrates

Genera of Reoviridae :

1. Orthoreovirus: cause arthritis & tenocynovitis in poultry.
2. **Rotavirus : cause enteritis in neonatal farm animals**.
3. **Orbivirus:Arthropods- borne infections (Arbo), cause:African horse sickness inhorses, Bluetongue disease in sheep, and in other domestic & wild ruminants**.
4. Avian orthoreovirus is a virus of the **Reoviridae family** and causes **most importantly arthritis and tenosynovitis** in poultry but can also be a cause of respiratory disease.


(A)
Orthoreovirus
Cypovirus
Fijivirus
Oryzavirus
Mycoreovirus
Orbivirus
Rotavirus
Phytoreovirus
Coltivirus
Seadornavirus
(B)
BTV
VP7(T13)
VP3(T2)
VP1(Pol)
VP4(Cap)
VP6(Hel)
RV
VP6(T13)
VP2(T2)
VP1(Pol)
VP3(Cap)
REO
σ2
λ1(T2 and Hel)
λ2(Cap)
λ3(Pol)
μ2


T=13
T=2*
Rotavirus

Rotavirus : cause enteritis in neonatal farm animals.

Rotavirus is a leading cause of enteritis (inflammation of the intestines) in neonatal farm animals, including calves, lambs, and piglets. Here are some key points about rotavirus infections in neonatal farm animals:

1. Causative Agent: Rotavirus is a double-stranded RNA virus belonging to the Reoviridae family. It is classified into different groups (A, B, C, etc.), with group A being the most common and clinically significant in animals.

2. Transmission:** Rotavirus infections are typically transmitted through the fecal-oral route. Neonatal animals become infected by ingesting the virus present in contaminated feces, feed, water, or the environment. The virus can survive for extended periods in the environment, facilitating its transmission.

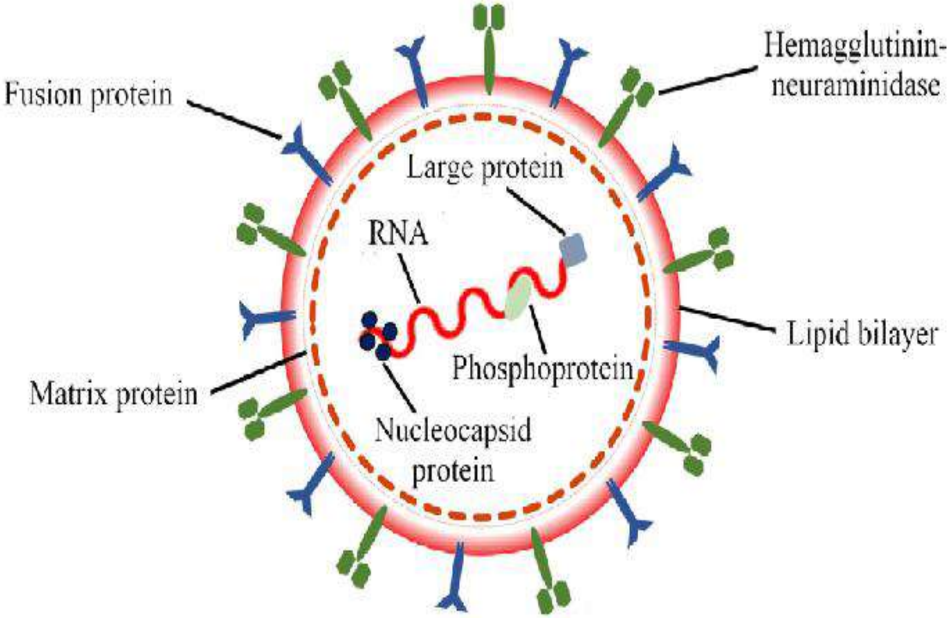
3. Clinical Signs: Rotavirus infection in neonatal farm animals manifests as acute diarrhea, often with onset within the first few days of life. Affected animals may exhibit watery or pasty diarrhea, dehydration, lethargy (tiredness) , and reduced suckling or nursing behavior. In severe cases, dehydration and electrolyte imbalances can lead to death, especially in young, immunocompromised, or malnourished(suffering from malnutrition) animals.

4. Pathogenesis: Following ingestion, rotavirus infects and replicates within the epithelial cells lining the small intestine, leading to villous atrophy and malabsorption. This results in diarrhea and nutrient malabsorption, contributing to dehydration and electrolyte imbalance.

5. Diagnosis: Diagnosis of rotavirus enteritis in neonatal farm animals is based on clinical signs, fecal examination for the presence of viral particles (using electron microscopy or enzyme immunoassays), and molecular techniques such as reverse transcription-polymerase chain reaction (RT-PCR) to detect viral RNA.

6. Prevention and Control: Prevention of rotavirus infections in neonatal farm animals involves implementing management practices to minimize exposure to the virus, including maintaining clean and hygienic housing conditions, optimizing colostrum intake from immune dams, and promoting passive immunity transfer. Vaccination of pregnant animals with inactivated or modified-live vaccines can also help reduce the severity and incidence of disease in newborns.

7. Treatment: Treatment of rotavirus enteritis in neonatal farm animals focuses on supportive care to manage dehydration, electrolyte imbalances, and nutritional deficiencies. This may include oral or intravenous fluid therapy, electrolyte supplementation, and nutritional support. Antibiotics are not effective against rotavirus infections but may be used to control secondary bacterial infections if present.



Rotavirus : cause enteritis in neonatal farm animals.

Bluetongue

Bluetongue is a viral disease primarily affecting domestic and wild ruminants, particularly sheep, but also cattle, goats, and certain wild ungulates.

Here are some key points about Bluetongue:

1. Causative Agent: Bluetongue virus (BTV) is the causative agent of Bluetongue disease. It belongs to the genus Orbivirus within the family Reoviridae. BTV is transmitted primarily by Culicoides biting midgesالبراغيش القارضة, which serve as vectors for the virus.

2.Transmission: Bluetongue virus is transmitted primarily by Culicoides biting midges, particularly species within the Culicoides imicola complex. Biting midges belonging to Culicoides imicola, Culicoides obsoletus complex and Culicoides pulicaris complex

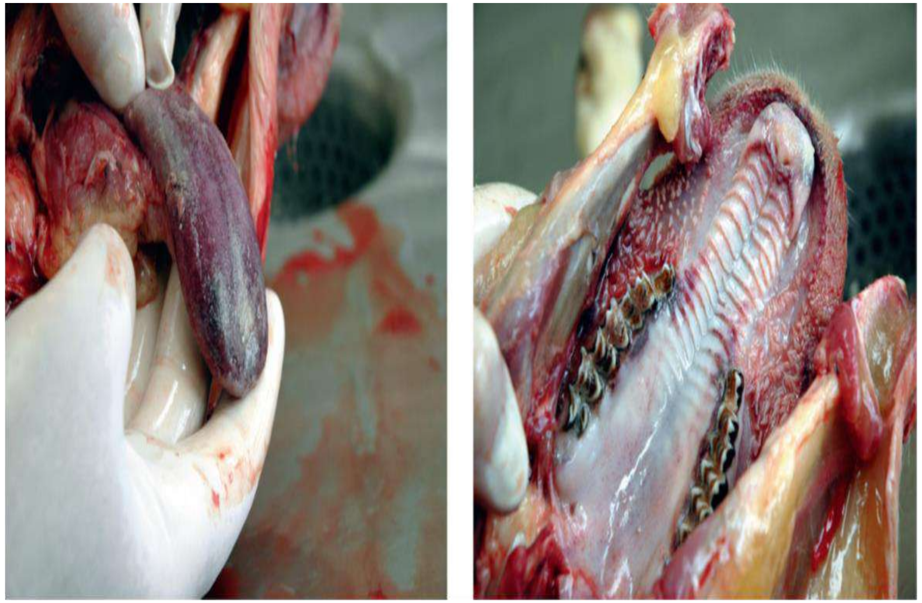
These insects become infected by feeding on viremic animals(presence of viruses in the blood) and can subsequently transmit the virus to susceptible animals during subsequent blood meals. BTV can also be transmitted vertically (from mother to offspring) in some cases.

3. Clinical Signs: Clinical signs of Bluetongue in affected animals vary depending on the species, breed, and strain of virus. In sheep, typical signs include fever, swelling and cyanosis (blue discoloration) of the lips, tongue, and oral mucosa, excessive salivation, lameness, and coronitis (inflammation of the coronary band). In severe cases, affected animals may exhibit respiratory distress, abortion in pregnant ewes, and high mortality rates.

4. Geographical Distribution: Bluetongue occurs in many parts of the world, including Africa, the Middle East, Asia, Australia, and the Americas. The distribution of the disease is closely linked to the presence and activity of Culicoides vector species, which are influenced by factors such as climate, habitat, and animal movements.
5. Economic Impact: Bluetongue can have significant economic consequences for affected livestock industries due to decreased production, trade restrictions, and control measures. Outbreaks of Bluetongue can lead to reduced fertility, increased mortality, loss of export markets, and costs associated with vaccination and surveillance programs.

6. Diagnosis: Diagnosis of Bluetongue in animals is based on clinical signs, post-mortem examination findings, and laboratory tests. Laboratory diagnosis typically involves the detection of viral nucleic acid using molecular techniques such as reverse transcription-polymerase chain reaction (RT-PCR) and virus isolation from blood or tissue samples. Serological tests, such as enzyme-linked immunosorbent assay (ELISA), can also detect antibodies against BTV.

7. Prevention and Control: Prevention and control of Bluetongue primarily involve vaccination of susceptible animals with commercially available inactivated vaccines. Other control measures include vector control strategies to reduce Culicoides populations, movement restrictions, quarantine measures, and biosecurity practices to prevent introduction and spread of the virus.



(A) Cyanosis and focally extensive mucosal necrosis and ulceration of the tongue in a sheep with bluetongue.
(B) Acute hemorrhage, necrosis, and ulceration of the oral cavity in a sheep with bluetongue

Bluetongue virus (BTV) is transmitted primarily by Culicoides biting midges