Structure of Virus,Viroids, Mycoplasma and Prions

Dr. R. Prasad,
Assistant Professor,
Department of Zoology,
Eastern Karbi Anglong College, Sarihajan

General characters of Virus

- Viruses are obligate parasites
- They are ultra microscopic particles and highly infectious
- Viruses are nucleoproteins
- They become inert chemical when brought outside the host cell.
- Viruses can be easily crystallized
- Viruses are metabolic inert
- Antibiotics have no effect on viruses
- They can undergo mutations
- Viruses do not have any energy producing system

- The study of viruses is called as '**Virology**'.
- Viruses (L. virus=poison) are simple, sub-microscopic, non-cellular entities, consisting of a proteinaceous covering around central nucleic acid (either DNA or RNA).
- They are self replicating within the living host, hence they are obligate intracellular parasites. Viruses are smaller than prokaryotic cells ranging from 0.02-0.3 μm.
- Now we know numerous diseases such as-Chicken pox, Influenza, Pneumonia, Polio, Measles, Rabies, Hepatitis, Common Cold and AIDS to name a few, which are caused due to viruses.

Structure of Viruses

- A fully assembled infectious virus is called as a "VIRION" (the intact virus unit).
- The main function of virion is to deliver its DNA or RNA genome into the host cell. Each viral species has a very limited host range.
- The term 'virus' and 'virion' bear the same connotation and are often interchangeable.

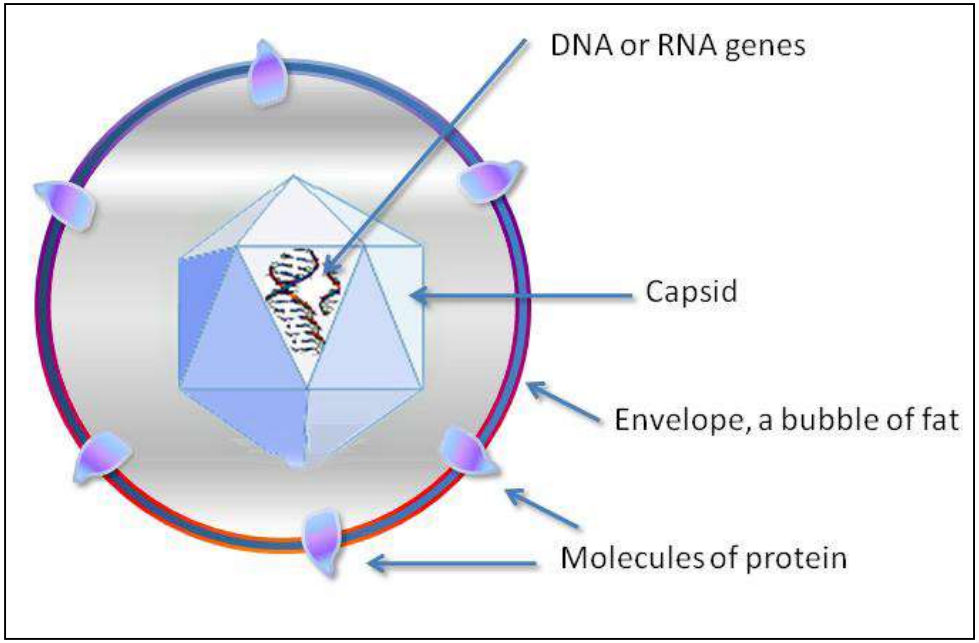


Figure: Structure of a Typical Virus

Each virion is composed of two or three parts: (i) the **genetic material** made from either DNA or RNA, (ii) a protein coat, called the **capsid**, (iii) an **envelope** of lipid (Figure 1). A protein coat functions as a shell to protect the viral genome from nucleases. The subunit of capsid is called as '**capsomere'**. The nucleic acid together with the capsid is known as nucleocapsid. Some viruses have membranous envelope that lies outside the nucleocapsid, and are referred as enveloped viruses, while one lacking them are called as naked viruses. In the enveloped viruses, nucleocapsid is surrounded by a lipid bilayer and glycoprotein. Enveloped viruses often exhibit a fringe of glycoprotein spikes called as **peplomers**.

Shapes and Symmetry in viruses

Viruses exhibit different shapes and symmetry. The symmetry refers to the way in which the capsomeres are arranged in the virus capsid. Accordingly following are the four categories:

Shapes of Virues	Polyhedral viruses	Helical viruses	Complex viruses	Enveloped viruses
	They are also called **icosahedral** viruses because of their symmetry.These viruses are composed of polyhedral protein shells. E.g.: Poliovirus, herpes simplex virus	The nucleic acid genome in these viruses, is wound inside a cylindrical protein capsid with helical symmetry. E.g.: TMV and M13	These viruses are composed of various proteins that functions to protect the genome, attach to cells, and introduce the nucleic acid inside. E E.g.: Vacinia virus	These viruses are surrounded by a membrane made up of glycoproteins that seek out cells to infect. E.g.: Influenza and HIV

Viral genomes are smaller in size. The genome of the virus may consist of DNA or RNA, which may be single stranded (ss) or double stranded (ds), linear or circular.

Viruses containing Double-stranded DNA (ds-DNA)

Viruses containing double-stranded DNA are called as "**Caulimoviruses**"

Smallpox (variola)	Herpesviruses	Adenoviruses
Vaccinia	Mirabilis Mosaic Virus (MMV)	Cauliflower Mosaic Virus (CaMV)

Viruses containing Single-stranded DNA (ss-DNA)

Viruses containing single-stranded DNA are called as "**Geminiviruses**"

Bacteriophage Phi X 174	M13
Bean Golden Mosaic Virus (BGMV)	Beat Curly Top Virus (BCTV)

Viruses containing Double-stranded RNA (ds-RNA)

Wound Tumor Virus (WTV)	Rice Dwarf Virus (RDV)
Rotavirus	Reovirus

Viruses containing Single-stranded RNA (ss-RNA)

Tobacco Mosaic Virus (TMV)	Potato Virus X (PVX)
Influenza Virus	Poliomyelitis Virus

VIROID

- Viriods are the smallest known agents of infectious disease.
- They are composed of short strand of circular, single-stranded RNA that has no protein coating.
- They are capable of self-replicating which use host machinery to replicate itself (Genome).
- Viroids are the infectious agent of plants that mainly cause disease in plants. Viriods only infect the plants. They are known as plant Pathogens.

DISCOVERY/ HI

- In 1971, Theodor Diener, a pathologist working at the Agriculture Research Service, discovered an acellular particle that he named a viroid, meaning "virus-like."
- Viroids consist only of a short strand of circular RNA capable of self-replication.
- The first viroid discovered was found to cause potato tuber spindle disease, which causes slower sprouting and various deformities in potato plants.

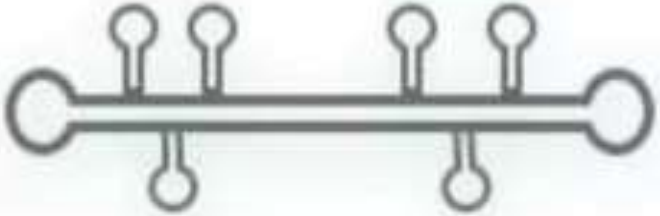
STRUCTURE OF VIROID

- Composed of small covalently closed, circular single-stranded RNA molecule.
- Range in size from 239 to 401 Nucleotides.
- Viroids have unique, thermodynamically stable structures that are composed of a series of helices and loops due to intra-molecular base pairing which results that they are partially double stranded and although they are circular molecules.
- Viroids have two different types of structures.

1) Rod-like
2) Multibranched

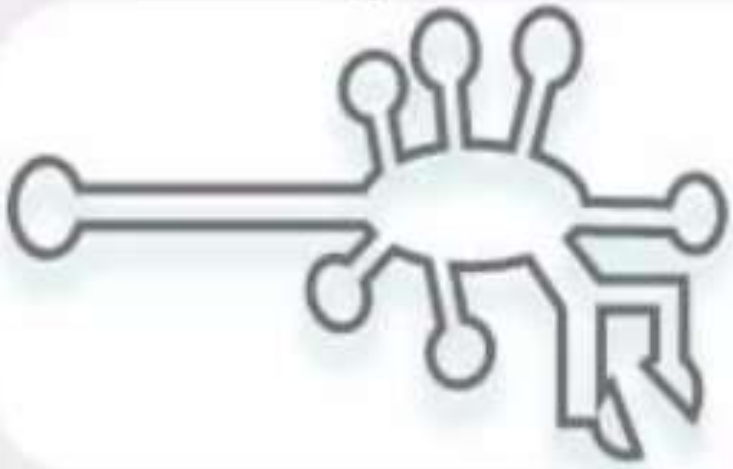
VIROID

Single - Stranded circle



Rod type viroid structure

Single - Stranded circle



Branched viroid structure

VIROID DISEASES

- *Potato-spindle Tuber Viroid* (PSTVd)
- *Hope Stunt Viroid* (HSVd)
- *Hope Latent Viroid* (HLVd)
- *Coconut codang-codang Viroid* (CCCVd)
- *Avacado Sun-blotch Viroid* (ASBVd)
- *Chrysanthemum Stunt Viroid.* (CSVd)
- *Peach latent Mossaic Viroid* (PLMVd)

POTATO-SPINDLE TUBER VIROID

HOPE STUNT VIROID

Mainly cause disease in citrus trees.

APPLE SCAR SKIN VIROID

- Scarcity of apple skin
- Discoloration
- Not Ripened
- Irregular shape

COCONUT CODANG-CODANG VIROID

- Every year one million coconut palms are killed by CCCVd and over 30 million coconut palms have been killed since Codang-codang was discovered.

Prions

- Prions are “infectious proteins”
- In 1982, **Stanley Prusiner**, a medical doctor discovered **prions** (received the Nobel Prize in Physiology or Medicine in 1997.)
- Proteins are acellular hence….
- Do not contain DNA or RNA.

Prions

- A prion is a misfolded rogue form of a normal protein (PrPc).
- PrPsc may be caused by a genetic mutation or occur spontaneously
- PrPsc can be infectious,
- They can stimulate other endogenous normal proteins to become misfolded.

Prion Diseases

Prions cause various forms of **transmissible spongiform encephalopathy (TSE)** in human and animals.

TSE affects the brain and nervous system.

It causes the brain tissue to become sponge-like

Kills brain cells

Forms holes in the tissue

Leads to brain damage, loss of motor coordination, and dementia.

Infected individuals are mentally impaired and become unable to move or speak.

There is no cure, and the disease progresses rapidly, eventually leads to death.

- TSEs in humans include **kuru**, **fatal familial insomnia**, **Gerstmann-Straussler-Scheinker disease**, and **Creutzfeldt-Jakob disease**.
- TSEs in animals include **mad cow disease**, **scrapie** (in sheep and goats), and **chronic wasting disease** (in elk and deer).

TSEs can be transmitted between animals and from animals to humans by eating contaminated meat or animal feed.

- Mycoplasma is a genus of **bacteria that lack a cell wall around their cell membrane.**

- Without a cell wall, they are unaffected by many common antibiotics such as penicillin or other beta-lactam antibiotics that target cell wall synthesis.

- They can be parasitic or saprotrophic.

- Several species are pathogenic in humans, including *M. pneumoniae*, which is an important cause of **atypical pneumonia** and other respiratory disorders.

- *M. genitalium,* which is believed to be involved in **pelvic inflammatory diseases.**

- ***M. hominis*** **(smallest bacteria) is also associated with pelvic inflammatory disease.**

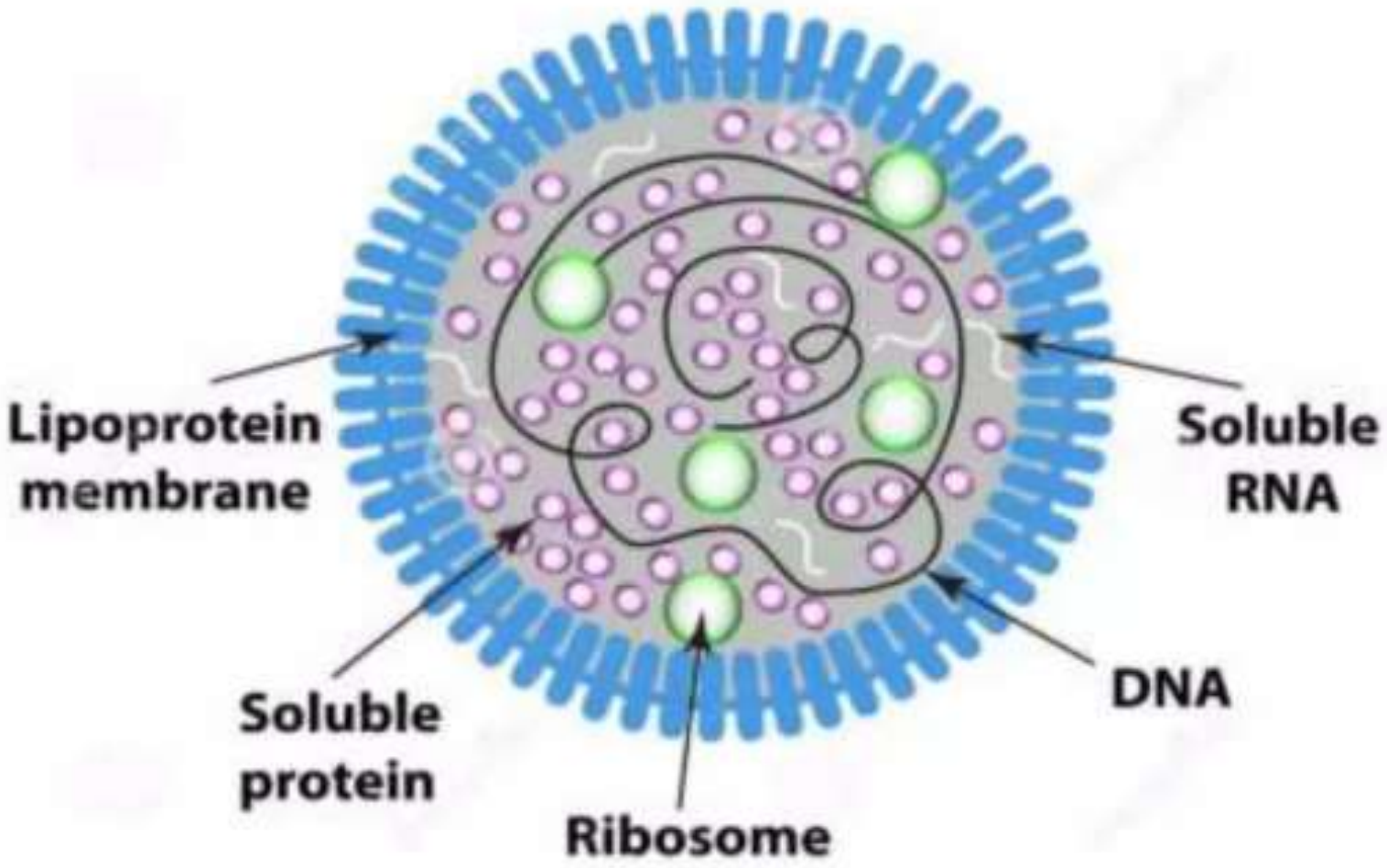
- Mycoplasma species are the **smallest bacterial cells** yet discovered, can survive without oxygen, and come in various shapes.

- Mycoplasma are prokaryotic microscopic **gram – Ve,** non-motile, **non spore forming,** pleomorphic, **filterable organism**.

- Mycoplasma also called **pleuropneumonia-like organisms (PPLO),** cause **contagious bovine pleuropneumonia.**

- Contagious bovine pleuropneumonia is a contagious bacterial disease that affect the **lungs of cattle**.

Mycoplasma


Lipoprotein membrane
Soluble RNA
Soluble protein
DNA
Ribosome

- Mycoplasma cell surrounded by three layer cell membrane, it is **lipoprotein in nature contain Sterols.**

- Only prokaryotic organism contain **sterols** in the membrane.

- Contain more number of 70s ribosomes and **circular ds DNA.**