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Paper Title: Virology

Unit 1 : Nature and Properties of viruses

Module Name : Concept of viroids, virusoids, satellite viruses and Prions.

Module Number : 2

Name of the Presenter: Dr.Rasika Desai Gaokar

Notes

VIROIDS:

- Viroids are infectious agents that consist only of naked RNA without any protective layer such as a protein coat.
- Viroids usually infect plants (but no other forms of life) and are replicated at the expense of the host cell.
- Viroid genomes are small single-stranded circles of RNA that are only 250–400 bases long.
- They are small, circular RNA molecules without a protein coat. VIR=virus and OID= is basis of their origin.
- They are sub-viruses composed exclusively of a single circular strand of nucleic acid that codes for a single protein.
- They are approximately 20 nm long
- More than 40 viroid species and many variants have been characterized.
- They are capable of autonomous replication and induction of disease.
- Viroids differ from viruses and prions in that viruses, at their most basic level, consist of genetic material (DNA or RNA) contained within a protective protein shell.
- First discovered by pathologist Dr. Theodor Diener
- “Viroid” means virus-like

- Potato spindle tuber viroid was the first viroid to be discovered
- Viroids are generally plant parasites
- Viroids can be dispersed mechanically during crop maintenance, vegetative reproduction & possibly via seeds and insects
- Results in severe loss of important food crops
- Viroids are usually transmitted by seed or pollen, but may be transported by farm implements as well. Infected plants can show distorted growth and sometimes are killed by the viroid.
- Not all viroids are known to be pathogenic, but some are serious pathogens of plants.
- Some viroids are ribozymes, having RNA enzyme properties that allow self-cleavage and ligation of unit- size genomes from larger replication intermediates.

Transmission

- Most mechanically transmitted.
- Some seed or pollen transmitted.
- Tomato planta macho viroid-aphid transmitted
- The only human disease known to be caused by a viroid is Hepatitis D.
- This disease was previously described to a defective virus called the delta agent. However, it now is known that the delta agent is a viroid enclosed in a Hepatitis B virus capsid.

Viriod Diseases

- Tomato plant macho viroid (TPMVd) – infects tomato plants and causes loss of chlorophyll, disfigured brittle leaves, and very small tomatoes.
- Avocado sunblotch viroid (ASBVd) - results in lower yield & poorer-quality fruit.
- Peach latent mosaic viroid (PLMVd) – causes necrosis of flower buds & branches, and wounding of ripened fruit, infects plums, apricots and cherries.

- Viroids in total results in loss of commercially important agricultural food crops (coconut & apple trees).

Genus and the Diseases

1. Genus Pospiviroids: PSTVd Potato spindle tuber
2. Genus Hostuviroids: HSVd hop stunt
3. Genus Cocadviroids: CCCVd coconut cadang-cadang
4. Genus Apscaviroids: ASSVd apple scar skin
5. Genus Coleviroids: CbVd 1 coleus blumei 1
6. Genus Avsunviroids: ASBVd avocado sunblotch
7. Genus Pelamoviroids: PLMVd (peach latent mosaic

Virusoids

- Nonself-replicating ssRNAs.
- RNA replication of virusoids is similar to that of viroids but, unlike viroids, virusoids require that the cell also be infected with a specific “helper” virus.
- There are currently only five described types of virusoids and their associated helper viruses.
- The virusoid genomes are small, only 220 to 388 nucleotides long
- The helper viruses are all from the family of Sobemoviruses.
- An example of a helper virus is the subterranean clover mottle virus, which has an associated virusoid packaged inside the viral capsid.
- Once the helper virus enters the host cell, the virusoids are released and can be found free in plant cell cytoplasm, where they possess ribozyme activity.
- The helper virus undergoes typical viral replication independent of the activity of the virusoid.
- A virusoid genome does not code for any proteins, but instead serves only to replicate virusoid RNA.

- Virusoids belong to a larger group of infectious agents called satellite RNAs, which are similar pathogenic RNAs found in animals.
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Satellite viruses

- Satellite viruses are particles that contain nucleic acid genomes encoding a structural protein that encapsulates the satellite genome.
- Satellite RNAs do not encode capsid protein, but are packaged by a protein encoded in the helper virus genome.
- Satellite genomes may be single-stranded RNA or DNA or circular RNA, and are replicated by enzymes provided by the helper virus.
- The origin of satellites remains obscure, but they are not derived from the helper virus.
- Satellite viruses may infect plants, animals, or bacteria.
- Satellite RNAs do not encode a capsid protein and therefore require helper virus proteins for both genome encapsidation and replication.
- Satellite tobacco necrosis virus and Y-satellite RNA of cucumber mosaic virus are examples of satellite viruses.
- Most known satellites are associated with plant viruses, but hepatitis delta satellite virus is associated with a human helper virus, hepatitis B virus.

Basic structure

- Satellite RNA genomes range in length from 220-1500 nucleotides, and have been placed into one of three classes.
- Class 1 satellite RNAs are 800-1500 nucleotide linear molecules with a single open reading frame encoding at least one non-structural protein.
- Class 2 satellite RNAs are linear, less than 700 nucleotides long and do not encode protein.

- Class 3 satellite RNAs are 350-400 nucleotide long circles without an open reading frame.

Prions

- In 1982 Dr. Stanley Prusiner coined the term "prion".
- They are Proteinaceous Infectious Particles.
- Prions are proteins that are unique in their ability to reproduce on their own and become infectious.
- Prions are misfolded proteins with the ability to transmit their misfolded shape onto normal variants of the same protein
- They cause fatal and transmissible neurodegenerative diseases in humans and many other animals.
- Prions do not contain nucleic acid; they don't have DNA or RNA.
- They are extremely resistant to heat and chemicals.
- Prions are very difficult to decompose biologically; they survive in soil for many years.

Basic Structure

- They contain about 200-250 amino acids twisted into three telephone chord-like coils known as helices, with tails of more amino acids.
- An another structure which is known as mutated form is built from the same amino acids but take a different shape. 100 times smaller than the smallest known virus.

Types

- They can occur in two forms called PrP-sen and PrP-res.
- Both PrP-sen and PrP-res are made up of the exact same string of amino acids, the building blocks that make up proteins.
- However, the two forms have different shapes. PrP-sen is produced by normal healthy cells. The sen stands for "sensitive" because this version of the protein is sensitive to being broken down.

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- PrP-sen is present mainly in neurons in the brain, but is also found in other cell types.
- The exact function of PrP-sen is unknown, but there is evidence that it may be involved in communication between neurons, cell death, and controlling sleep patterns.
- The second type of prion protein, known as PrP-res, is the disease-causing form. Organisms with it develop spongiform disease. “res” stands for “resistant” because this version of PrP is resistant to being broken down.
- Highly purified PrP-res is shown to be infectious.

Diseases caused

1. Scrapie in English sheep.
 2. Spongiform Diseases.
 3. Creutzfeldt-Jakob disease. The most prevalent of the spongiform diseases Occurs spontaneously in 1 out of a million people.
 4. Bovine Spongiform Encephalopathy. Also known as "Mad Cow Disease".
- Necrosis
 - Systemic chlorosis
 - Reduced chlorophyll production.
 - Hepatitis B