VIRUS

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INTRODUCTION :

- Virus is a Latin word which means Poison.
- viruses are infectious agents with simple, acellular organization which possess only one type of nucleic acid, either DNA or RNA but never both
- They can reproduce only within living cells.
- Among the viruses the poxviruses are one of the largest viruses and parvoviruses are the smallest viruses

HISTORY:

- Adolf Mayer described for the first time a disease of tobacco plant.

- Dimitri Ivanowski, a Russian botanist in 1892 demonstrated experimentally that sap of mosaic tobacco plant was capable of inducing the mosaic disease in healthy tobacco plants after it had been passed through bacteria proof filter.

- Beizerinck, a Dutch microbiologist in the year 1898 confirmed the observation of Ivanowski and named as ‘contagium vivum fluidium’ referred it as virus.

- Stanley (1935) isolated a crystalline protein from the diseased tobacco leaves.
- Bawden and Pirie (1937) established that viruses are nucleoproteins.
- Marcham (1949) isolated tobacco mosaic virus (TMV).

DEFINITION OF VIRUS:

Viruses are ultra-microscopic, non-cellular living particles, composed solely of a nucleic acid (DNA or RNA) core, surrounded by a protein envelope called capsid.

- Viruses are infectious particles about 100 times smaller than bacteria and can only be observed by electron microscopy.
- A virus is a small parasite that cannot reproduce by itself.
- Most viruses have either RNA or DNA as their genetic material.
- Once it infects a susceptible cell, however, a virus can direct the cell machinery to produce more viruses.
- The simplest viruses contain only enough RNA or DNA to encode four proteins.
- The most complex can encode 100 – 200 proteins.

STRUCTURE OF VIRUSES:

- Viruses have simple morphology.
- They consist of two distinct parts: a core of nucleic acid and the protein coat.
- The protein coat is known as capsid.
- The protein coat or capsid is composed of several closely packed morphological unit called capsomeres .
- In this respect viruses differ from typical bacterial cells which are made up of proteins, carbohydrates, lipids, nucleic acids etc.
- Some viruses, e.g. Myxoviruses have additional membranous envelope containing proteins, lipids and carbohydrates outside the usual protein coat. They do not have plasma membrane.
- Viruses lack cytoplasm and thus cell organelles such as mitochondria, golgi bodies, ribosomes and lysosomes as well as enzyme systems are absent.

CHARACTERISTICS OF VIRUSES:

1.They are non-cellular and very simple in structure, consisting mainly of a nucleic acid surrounded by a protein envelope called capsid.

2.Therefore, a unit of virus is referred to as ‘a virus particle’ rather than ‘a virus cell’.

3.They are devoid of the sophisticated enzymatic and biosynthetic machinery essential for independent activities of cellular life.

4.Therefore, they can grow only inside suitable living cells.

5.That is why they are cultivated in the laboratory only inside living cells, unlike bacteria and fungi, which can be cultivated in the laboratory on non-living matter like nutrient agar.

6.They are ultra-microscopic and can only be visualized under electron microscope.

7.They do not increase in size.

8.They can pass through filters, through which bacteria cannot pass.

9.A virus is called either ‘DNA virus’ or ‘RNA virus’ depending on whether it contains the nucleic acid DNA or RNA.

10.A virus cannot have both DNA and RNA.

SIZES AND SHAPES OF VIRUSES:

- Viruses are much smaller than bacteria and their size is variable.
- The larger viruses may be about 300 A in diameters, i.e., they may be as large as some of the small bacteria.
- The majority of the viruses are about 200 Å in diameters.
- The shape of some of the important viruses has been revealed by electron microscope.
- All of them cause different diseases in plants and animals.
- The bacteriophages infect bacteria cells.

Figure 8.2: Shape of some common viruses

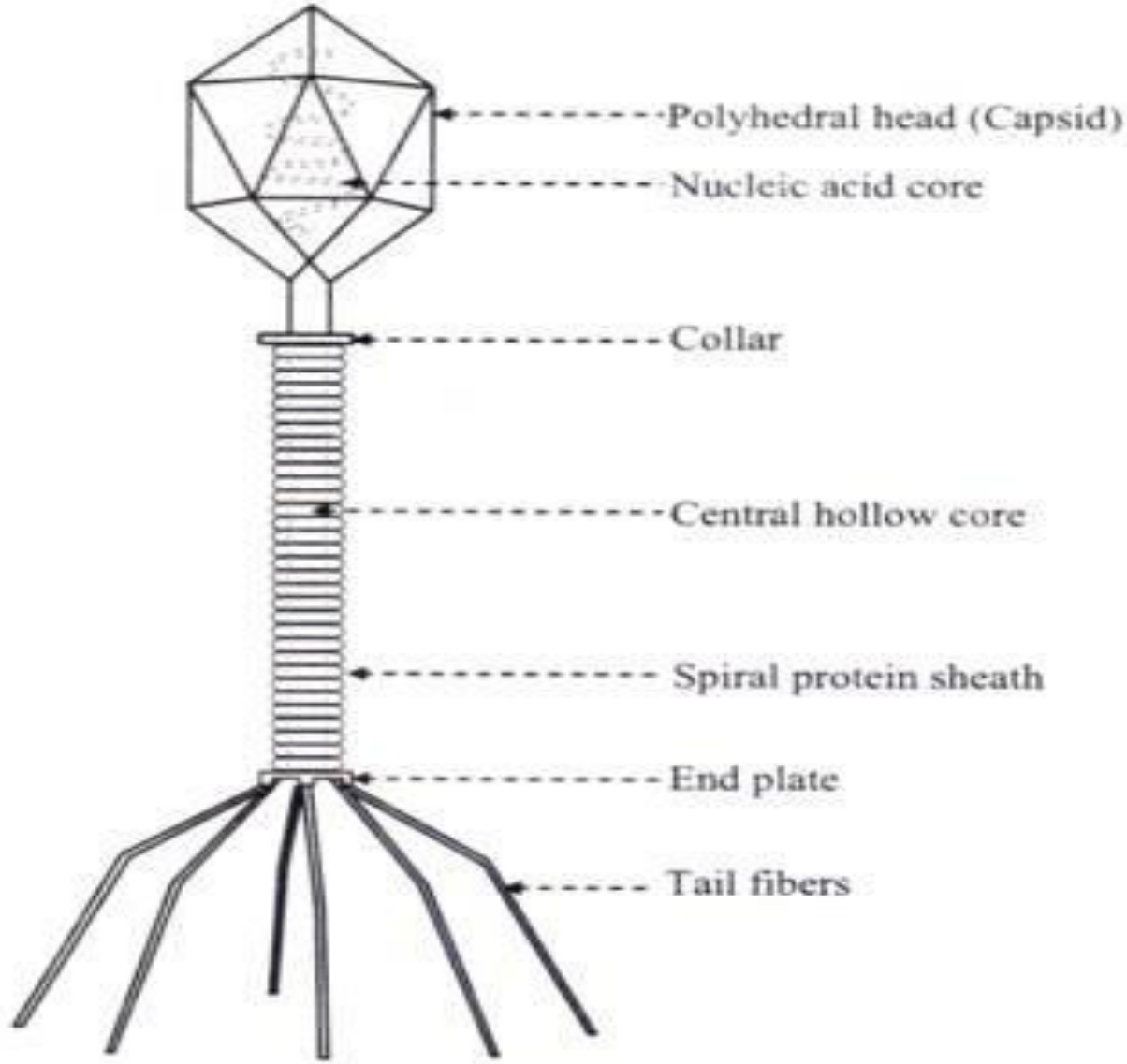

Figure 8.1: Structure of T-even bacteriophage

The functions of its structural components are as follows:

1. Capsid (Protein Coat): Protection of nucleic acid from destruction by DNase.
2. Nucleic Acid Core: Phage genome carrying genetic information necessary for replication of new phage.
3. Spiral Protein Sheath: Retracts, so that nucleic acid can pass from capsid into host cell's cytoplasm.
4. End Plate and Tail Fibers: Attachment of phage to specific receptor sites on a susceptible host's cell wall.

TYPES OF VIRUSES :

With respect to nucleic acid, the viruses are three types:

1.RNA virus

2. DNA virus

3.DNA-RNA virus.

1.RNA viruses

- RNA viruses contain only RNA as their genetic material.
- To replicate their genomes in the host cell, the RNA viruses encode enzymes that can replicate RNA into DNA, which cannot be done by the host cell.
- These RNA polymerase enzymes are more likely to make copying errors than DNA polymerases and, therefore, often make mistakes during transcription.
- For this reason, mutations in RNA viruses occur more frequently than in DNA viruses.
- This causes them to change and adapt more rapidly to their host.
- Human diseases caused by RNA viruses include hepatitis C, measles, and rabies.

2.DNA viruses

- In DNA viruses, the viral DNA directs the host cell's replication proteins to synthesize new copies of the viral genome and to transcribe and translate that genome into viral proteins.

- DNA viruses cause human diseases, such as chickenpox, hepatitis B, and some venereal diseases, like herpes and genital warts.

3.DNA-RNA virus

- Most bacteriophages (viruses infecting bacteria) contain only DNA (some bacteriophages like MS-2, F_2 coliphages, R-17 are the exceptions which contain RNA).
- Animal viruses contain RNA or DNA or rarely both DNA-RNA.
- The nucleic acid component of viruses may be composed of either single stranded or double stranded RNA or double stranded DNA or single stranded DNA.
- Viruses usually have either DNA or RNA whereas the typical cell contains both DNA and RNA.
- Certain animal viruses, e.g. Rous sarcoma virus (RSV) have both DNA and RNA.

- **Table shows the type of nucleic acid and the number of strand(s) in different**

Table 1.1

	Viruses	*Nucleic acid*	*Number of strands*
1.	Pox virus	DNA	2
2.	Coliphages T-even series (T_2, T_4, T_6)	DNA	2
3.	Coliphage T-odd series (T_3, T_7)	DNA	2
4.	Coliphage Lambda (λ) virus	DNA	2
5.	Adeno viruses	DNA	2
6.	Papilloma virus	DNA	2
7.	Polyoma virus SV–40	DNA	2
8.	Herpes viruses	DNA	2
9.	Bacteriophages ϕ X174	DNA	1
10.	M13	DNA	1
11.	Reo virus	RNA	2
12.	Wound tumour virus	RNA	2
13.	Rice dwarf virus	RNA	2
14.	Tobacco mosaic virus (TMV)	RNA	1
15.	Influenza virus	RNA	1
16.	Poliomyelitis virus	RNA	1
17.	Bacteriophage MS-2	RNA	1
18.	Bacterial virus F_2	RNA	1
19.	Avian Leukemia virus	RNA	1

Infection consists of the virus in following sequential events:

1.Adsorption:

Tail portion of the phage particle binds to receptor sites on host's cell wall.

2.Penetration (Infection):

Spiral protein sheath retracts and an enzyme, early muramidase, perforates the bacterial cell wall enabling the phage nucleic acid to pass through the hollow core into the host cell's cytoplasm.

The empty protein shell remains attached to the cell wall and is called the protein ghost.

3.Replication:

The phage genome subverts the synthetic machinery, which is then used for the production of new phage components.

4.Maturation:

The new phage components are assembled and form complete, mature virulent phage particles.

5.Release:

Late muramidase lyses the cell wall, liberating infectious phage particles that are now capable of infecting new susceptible host cells, thereby starting the cycle over again.

THANK YOU