

Review article on DNA and RNA virus

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Abstract

RNA Viruses multiply their genome using virally encrypted RNA dependent RNA polymerase (RdRp)— genome is the template for formation of the additional RNA strands. During replication of RNA viruses there are 3 types of RNA that must be arrange genome, copy of the genome and mRNAs. Some RNA Viruses also arrange copies of subgenomic mRNAs. RdRp is main process. RdRp of RNA viruses probably arise from common progenitor. The RdRp, other protein require for viral genome blend are known as replicase complex. The Recombination, Mutation Rate, Replication was studied virus are tiny intracellular parasites, which contain RNA or DNA genome covered by protective virus-coded protein coat. The viral genome frequently related basic protein is packaged inside a symmetric protein capsid. Also studied about the classification of the RNA and DNA virus, Genome instability in DNA virus.

Keywords

RNA Viruses, Genome, mRNA, Recombination, Mutation.

INTRODUCTION

Virus –A virus is small parasite that cannot reproduce by itself. If it infects susceptible cell. A virus can control the cell machinery to produce more virus. Most of the virus are RNA or DNA as owned genetic material. The nucleic acid is single or double stranded. The infectious virus is known as virions, contain nucleic acid and exterior carapace made up of protein. The uncomplicated virus contains only sufficient RNA or DNA to encrypt 4 proteins. The most complicated can encrypt 100-200 proteins. The work on plant virus stimulate the 1 experiment in molecular biology. In 1935 Wendell Stanley refine and partly solidify tobacco mosaic virus. (TMV).

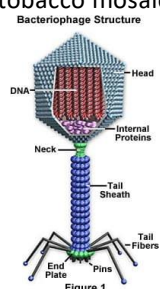


Figure 1

A virus is made of central of genetic material, either DNA or RNA, surrounded by a protective coat called a capsid which is made up of protein. Sometime the mirid is surrounded by an additional jagged coat called the envelope. Viruses are capable of fasten onto host cells and getting inside them. Viruses only exist to make more viruses. The virus particle attaches to the host H3N2 viruses are able to infect bird and mammals as well as humans. They often cause more severe infections in the young and elderly than other flue strain and can lead to increase in hospitalizations and death.

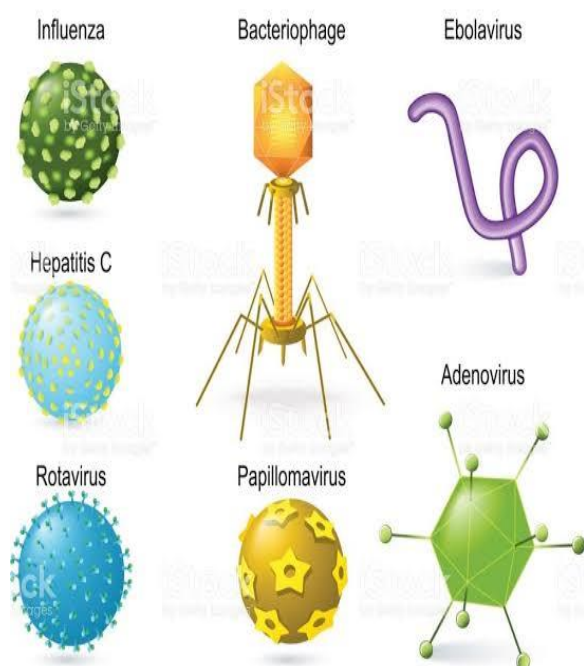
BUDDING

As the newly formed viral particle pushes against the host cell plasma membrane a portion adheres to it. The plasma membrane envelops. The virus and become the viral envelop.

LYSIS

The virus particle rupture out of the host cell into the extracellular space resulting in the death of the host cell once the virus has escaped from the host cell it is ready to enter a new cell and multiply

VIRUSES

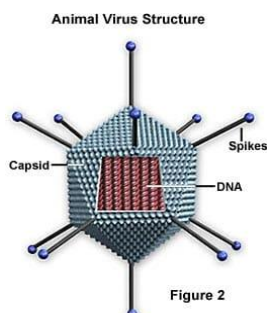


1. Kingdom-Virae
2. Phylum-Viricota
3. Class-Viricetes
4. Order-Virales
5. Family-Viridae
6. Genus-Virus

Virion- Total virus particle; nucleic acid +protein coat, which can be surrounded by an envelope. It is the form in which the virus moves between cell and host.

Viral Genome –Any RNA or DNA genome covered by a protective virus coded protein coat (capsid).

Configuration of Virus – The DNA or RNA Genome can be single stranded or double stranded. Genome can be +ve sense – It is identical to viral mRNA and can immediately translated into protein by host cell. -ve sense – It is complementary to mRNA and thus converted to +ve sense RNA polymerase before translation.



Viriods and Prions –

Viroids –

- ssRNA genome and the smallest known pathogens
- affect plants

Prions-

- Infectious particle that are fully protein
- No nucleic acid
- Highly heat resistant
- Animal disease that affects nervous tissue

Viral Structure -3types of capsid symmetry

- a. Cubic- (icosahedral) has 20 face, each an equilateral triangle

Example-adenovirus

- b Helical –Protein bind around DNA /RNA in a helical fashion

Example- Coronavirus

- c Complex- Not any cubic nor helical

Example-Poxvirus

Viral Replication - Viruses are intracellular require parasites which means they cannot replicate. A single virus particle (virion) is can't able. It lacks needed component cells to reproduce. when virus infect a cell, it gathers the cell ribosome, enzymes and much of cellular machinery to reproduce.

Process of Viral Replication -

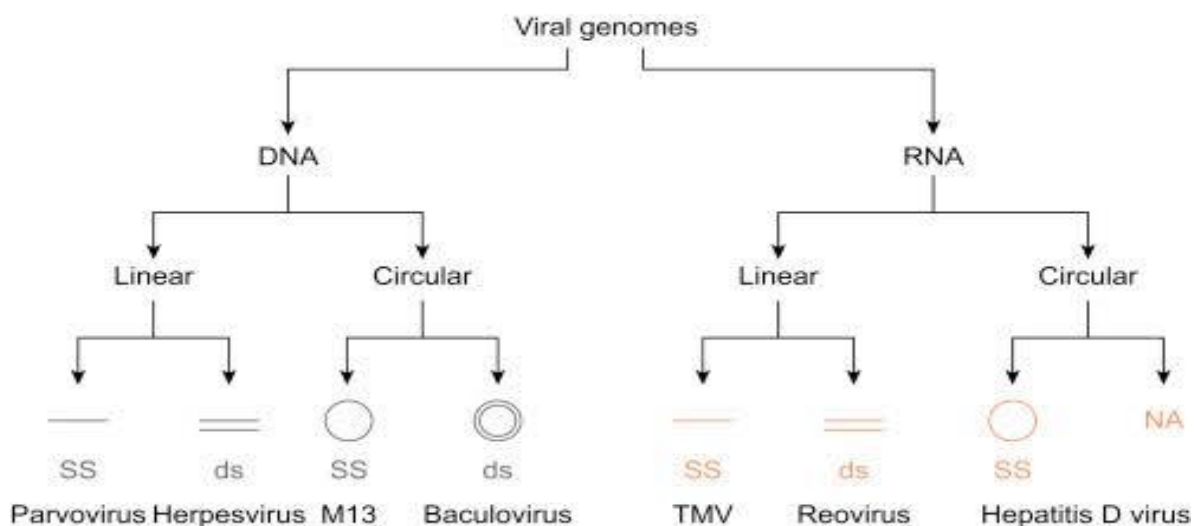
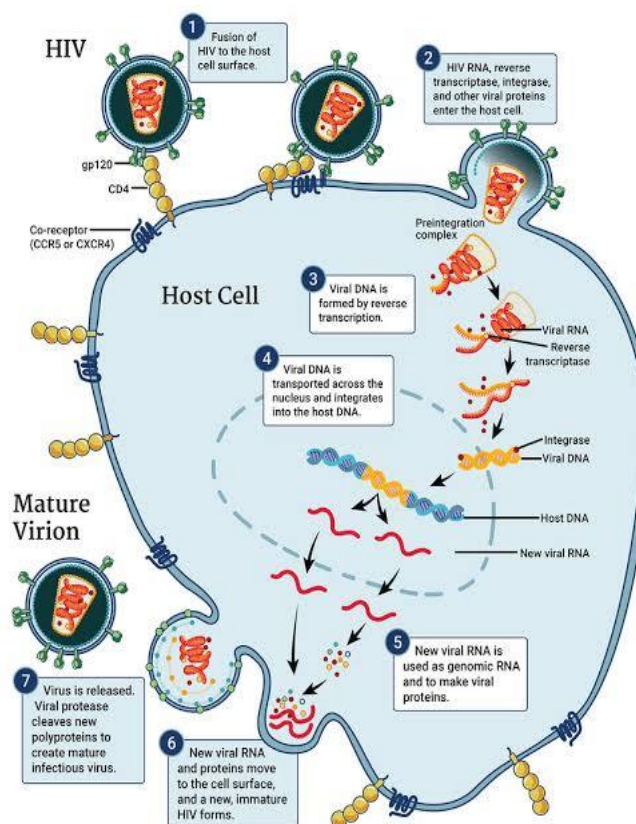
Once the virus infects its host and viral progeny components are produced by the host cellular machinery, viral capsid is a non- enzymatic process. It is usually a spontaneous process. virus can only affect limited number of hosts. The lock and key mechanism are most common explanation for this certain protein on the Viruses particle must fit certain receptor sites on particular host's cell surface.

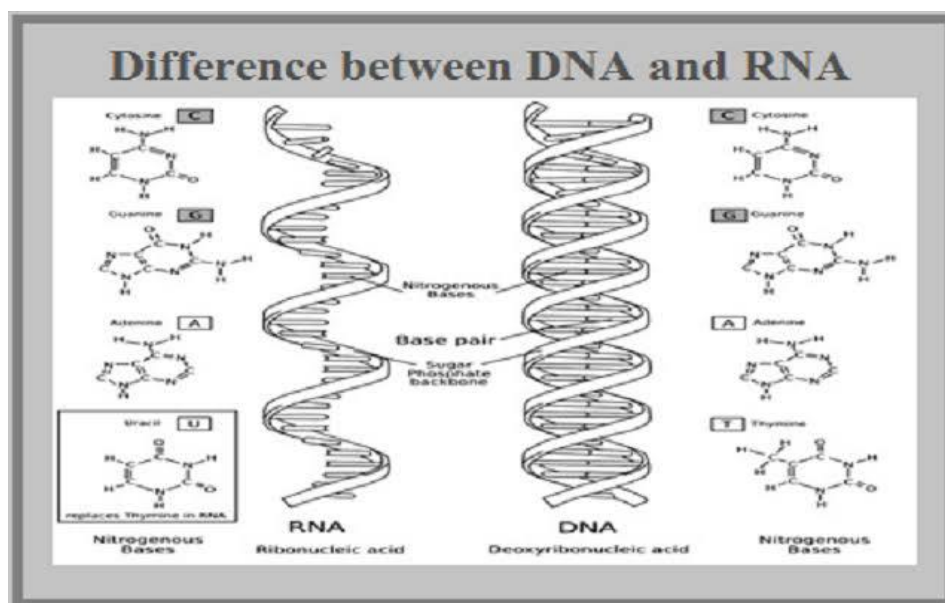
Viral Replication –when a virus infects a cell, nucleic acid must be uncoated and gain access to metabolic machinery of cell. Virus life cycle is characterized by attachment, penetration, early expression of virus gene, replication of virus nucleic acid, synthesis of new virion component, packaging and assembly of new virus and exit from cell. Viral Capsid are systematic arrangement of one or more kinds of protein.

The Nucleic acid of virion is surround with a protein coat or capsid is made up of multiple copies of 1protein or a few proteins each of one is encrypted by viral gene. A virus is able to encode all information for making a large capsid in a small number of gene. A. capsid surround nucleic acid is called Nucleocapsid. Another major class of virus, called Icosahedrons or quasi-spherical viruses based on icosahedron. solid object made up of 20 identical faces each of equilateral triangle. The simplest

icosahedral virion each of 20 triangular faces made up of 3 identical capsid protein. Making a total 60

subunit per capsid. At each of the 12 vertices, 5 subunits make contact symmetrically.

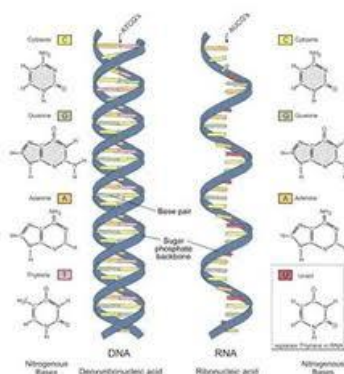




DNA vs. RNA viruses

DNA

- Very stable
- B-form double helix
- dsDNA is rigid
- Accurate replication
 - large genomes
- Protected by cell
- **VIRAL DNA IS USUALLY PACKAGED INTO PREFORMED CAPSID SHELLS (PROCAPSIDS)**



RNA

- Less stable
- Mixture of ss and ds forms; extensive secondary structure
- ssRNA is flexible; dsRNA is rigid
- Error-prone replication
 - small genomes
- dsRNA actively degraded by cell
 - **RNA MUST BE PROTECTED DURING REPLICATION AND ASSEMBLY!**
- **VIRAL RNA USUALLY CO-ASSEMBLES WITH CAPSID PROTEIN**

WHAT IS RNA VIRUS

The genetic material is RNA in Virus. The RNA may be either double or single-stranded. There are a six class of viruses. The DNA virus viruses constitute classes I and II. The RNA virus makes up the remaining classes. Class III viruses have a double-stranded RNA genome. Class IV viruses have a positive single-stranded RNA genome, the genome itself acting as mRNA. Class V virus has a negative single stranded RNA genome use as template for mRNA synthesis. Class VI viruses has a +ve single-stranded RNA genome but with DNA intermediate not only in replication but also in mRNA synthesis. Human diseases cause ny RNA includes the common cold, influenza SARS, COVID-19, Hepatitis C, Hepatitis

C, Hepatitis, West Nile fever, Ebola virus, polio and measles.

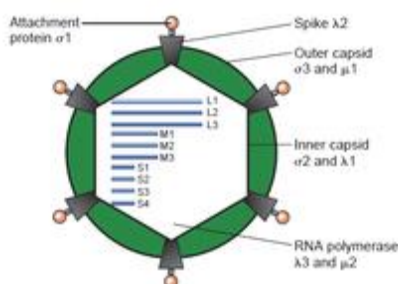
Viruses are the smallest of all the microbes. They are said to be so small that 500 million rhinoviruses could fit on to the head of a pin. They are unique because they are only alive and able to multiply in is called the host cell.

CHARACTERSTICS

Single Stranded RNA viruses and RNA sense –RNA viruses classified according to the sense or contradiction of their RNA I into negative –sense and positive –sense or aura RNA viruses. Positive-sense viral RNA is close to mRNA and thus can be interpret by the host cell. (-) negative -sense viral RNA is

supportive to mRNA and thus must be change to positive-sense RNA by an RNA depending on RNA polymerase prior to relocation. Purified RNA of a positive-sense virus can straight cause infection though it may be less infectious or whole virus particle. In disparity, purified RNA of negative-sense virus is not contagious by itself as it needs to be duplicate into positive-sense RNA; each viroin can be reproduce to some Positive-sense RNAs. RNA viruses look like negative-sense RNA viruses, except they also interpret genes from the positive strand.

Double- Stranded RNA Viruses-



Structure of the reovirus virion

The double stranded virus(ds) contain a various group of viruses that are broadly in host range (humans, animals, plants, fungi,), Genome segment number (one to twelve), and virion organization (Capsid layers, spikes, turrets, etc.). Limb of this group consist the Rotaviruses, which are the most common cause of Gastroenteritis in young children, and Picobirnaviruse which are the most common virus in fecal samples of both humans and animals with or without signs of diarrhea. Bluetounge virus is an economically main pathogen of cattle and sheep. In some years, progression has been made in dictate, at atomic and subnanometeric levels, the structures of a number of key viral proteins and of the virion capsids of some dsRNA viruses, highlighting the notable parallels in the structure and replicative processes of many of these viruses.

Group 3-dsRNA Viruse (Double –Stranded RNA viruses)

This group consist of 12 families and a number of unassigned genera, species in this group.

1. Family-Amalgaviridae'
2. Family- Birnaviradae
3. Family –Chrysoviridae
4. Family – Cystoviridae
5. Family--Endornaviridae
6. Family- Hypoviridae
7. Family- Megabirnaviridae
8. Family –Partitiviridae
9. Family- Picobirnaviridae
10. Family –Reoviridae

11. Family- Totiviridae

12. Family- Quadriviridae

Genus – Botybirnavirus

Unassigned species – Botrytis porri RNA Virus 1

Spissistilus festinus virus 1,

Curcubit yellow associated virus

Group 4 Positive ssRNA viruses

Group 4 consist of three odour and 34 families. There are number of unclassified species and genera.

1. Order-Nidovirales

1.1- Family – Arteriviridae

1.2- Family – Coronaviridae includes corona virus, SARS-CoV

1.3- Family- Mesoniviridae

1.4- Family – Roniviridae

2. Order- Picornavirales

2.1- Family- Dicistroviridae

2.2- Family- Ifaviridae

2.3- family- Picornaviridae include poliovirus, Hepatitis A

3. Order – Tymovirales

3.1- Family-Alphaflexiviridae

3.2- Family- Betaflexiviridae

3.3 Family- Tymoviridae

Satellite Virus

Family – Sarthroviridae

Genus- Albetovirus

Genus-Aumaivirus

Genus- Papanivirus .

Group 5 – (-ve) negative sense ssRNA viruses

With the Hepatitis D virus ,this group is placed into single phylum –Negarnaviricota . this phylum , divided into 2 sub phylum-1.Haploviricotina

2.Polyploviricotina

Haploviricotina have 4 classes –

A. Chunquiviricetes

B. Milneviricetes

C. Monjiviricetes

D. Yunchangviricetes

Polyploviricotina have 2 classes

a. Elioviricetes

b. Insthoviricetes

6 classes and 24 families ,7 order identified in this group.

CLASSIFICATION OF VIRUSES -

A.DNA VIRUSES –

1. SINGLE STRANDED

1.1 Unenveloped- Parvoviruses (I)

B. DOUBLE STRANDED

1. Enveloped –Hepadna viruses ©, Poxviruses (L)

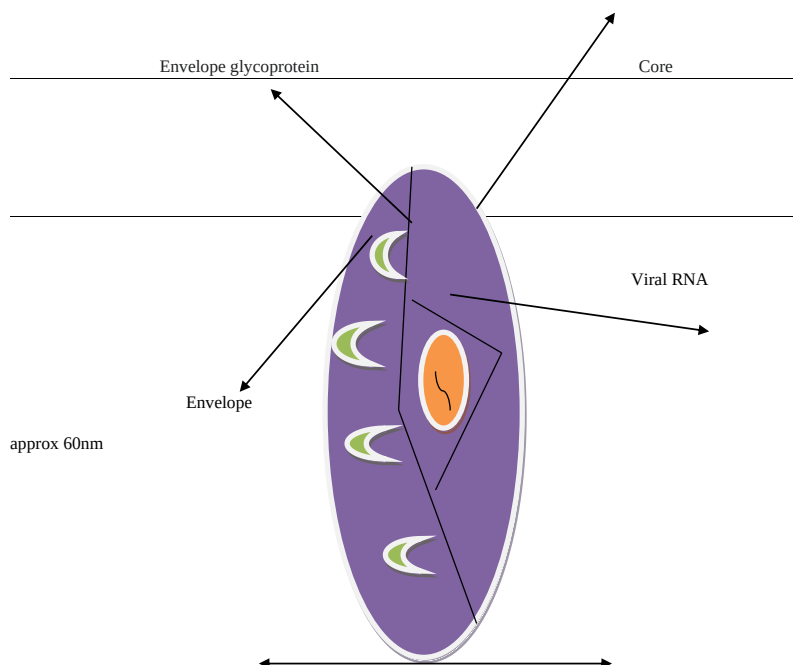
2. Unenveloped –Adenoviruses, (I),

CLASSIFICATION OF RNA VIRUSES

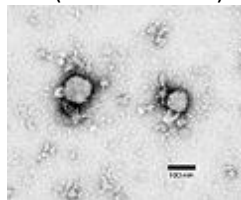
A. (+) RNA –

- 1.-Unenveloped –Calciviruses,
 - 2.-Enveloped –Coronaviruses ,Flaviviruses
- B. (-) RNA –
1. Enveloped –Bunyaviruses

- A.. (+/-) RNA
- 1.- DOUBLE CAPSID –Reoviruses
- B.. (+) RNA via DNA
1. Enveloped- Retroviruses

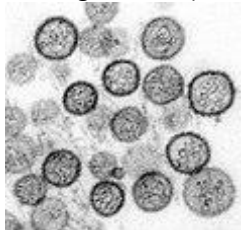


Lassa Virus (Arenaviridae)



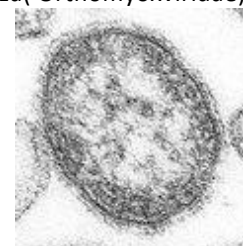
1. Ebola Virus(Filoviridae)

Lymphocytic choriomeningitis virus (Arenaviridae)



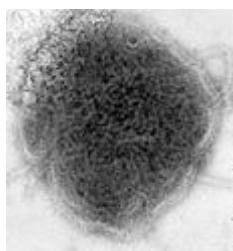
Influenza(Orthomyxoviridae)

Hantavirus (Bunyaviridae)

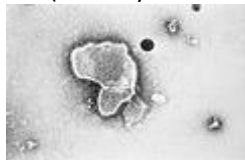


Measles (Paramyxoviridae)

1. Malburg Virus (Filoviridae)



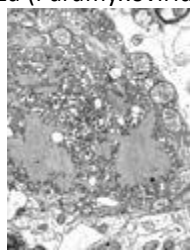
Mumps Virus (Paramyxoviridae)



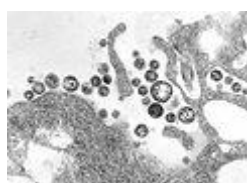
Human Respiratory Syncytial Virus (Paramyxoviridae)



Parainfluenza (Paramyxoviridae)



Rabies (Rhabdoviridae)



Vesicular Stomatitis Virus (Rhabdoviridae)

How RNA viruses maintain their genome integrity – RNA genome is risk to alteration by a range of activities, plus inexact replication by the error-prone replicase, damages from environmental factors, and attack by nuclease and other RNA modifying enzymes that comprise the cellular intrinsic or innate immune response. Anguish to coding response regions and dropping of critical cis-acting signal inevitably impair genome fitness; as a consequence, RNA viruses have evolved a variety of mechanism to protect their genome integrity.

These include mechanism to promote replicase, fidelity, recombination activities that allow exchange of sequence between different RNA templates, and

mechanism to repair the genome termini.

REPLICATION –

Animal RNA viruses are classified by the ICTV. There are three groups of RNA viruses depending on their genome and mode of replication.

1. Double-stranded viruses IV (group III) contain from one to a dozen different RNA molecules, each coding for one or more viral protein

2. Positive sense ssRNA viruses (group IV) Genome directly make use of mRNA, with host ribosome translating it into protein that is altered by host and viral proteins to form the various proteins needed for replication.

3. Negative-sense ssRNA (Group-V) Genome copy by a RNA replicase to form positive sense RNA. This means that the viruses must bring along with it the enzyme RNA replicase. The positive sense RNA molecule acts as viral mRNA, which is translated into protein by the host's ribosome.

RECOMBINATION

In Modern Genetic analysis, the main test for recombination is to regulate if two genes are related based on the concept of recombination. Recombination is perceived in a variety of situations but, for the present, in relation to meiosis.

Meiotic recombination is a process that causes a haploid product with a genotype that differs from both haploid genotypes that form the meiotic diploid cell.

The result of meiosis so caused is called a RECOMBINANT.

A recombinant rate of occurrence importantly less than 50% shows genes are linked. A recombinant rate of occurrence 50% means genes are unlinked on separate chromosomes.

MUTATION RATE

A clone of ribovirus whose chromosome is collected of single-stranded RNA follows a plan-A cell is infected with one or further virus. One and all infecting genomes are duplicated repetitively such that supportive and gather. Subsequently the supportive strand are themselves copied repetitively, producing final strands of same polarity as the infecting strand and these final strands are packaged and free.

DNA VIRUS –

DNA virus has its DNA genome that are replicated by any host or virus (DNA Polymerase), between DNA Virus genome and strength of DNA allows for genomes much bigger in comparison of RNA viruses. Genome of DNA Virus infecting animal range in size from less than 2kb of single-stranded DNA approx

375 kb of double stranded DNA. There is uniform bigger DNA virus infect the eukaryotic microorganism.

A usual thing about DNA viruses is detachment of gene expression into early and late phase. Early transcription happens prior to before DNA synthesis to supply the protein result require for DNA Replication. K/A 'early genes'. Succeeding DNA Replication, the gene utterance changes to utterance of structural proteins require to package DNA and form virions. Known as "late gene".

GENOME INSTABILITY IN DNA VIRUSES

DNA Viruses contain main pathogens as "herpesviruses, smallpox viruses, adenoviruses" and numerous DNA viruses are split into categories

1. Double –Stranded DNA Viruses. - (e.g. – Poxviruses)
2. Single- Stranded DNA Viruses - (e.g.- Parvoviruses)-which copy their genome through an RNA midway. Large DNA Viruses (<10kb) has double –stranded DNA cause small DNA Viruses have circular single, double stranded DNA.

These wide viral group vary in their rates of unforced mutation, expound as the prospect that an

unrepaired genetic change is move on to viral progeny in one and all cell infection cycle (m/n/c).

MEDICATION OF RNA VIRUS –

Some Anti – RNA Virus Drugs are Adapromine, Amantadine, CMX521, DRACO, FGI-106, Favipiravir, IDX-184, MK-608, NITD008, Ziresovir.

Anti-hepatic C Agents (3C,3P)

Anti-Influenza agents (1C,10P)

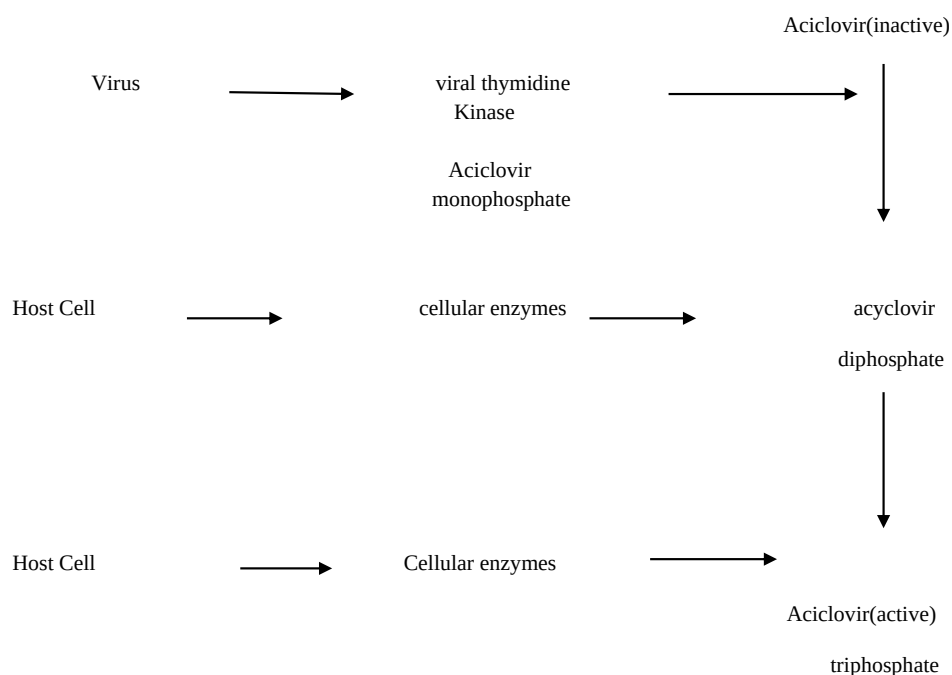
Mode of Action of Favipiravir- Favipiravir (T-705; 6-fluoro-3-hydroxy-2-pyrazinecarboxamide) is anti – viral agent that critical and strong hinder the RNA dependent RNA polymerase (RdRp) of RNA virus. Favipiravir was locating by screening chemical library for anti-viral activity.

Anti-Viral that first stop entry and exit of the virus from cells. The active (FAVPIRAVIR –RTP) inhibit RNA polymerase and stop replication of the viral genome.

ANTI- DNA VIRUS AGENTS –

Anti- DNA virus agents inhibit to replication of DNA viruses.

The main medication is Anti- Viral Drugs. Example – acyclovir, [9-(2hydroxyethoxymethyl) guanine]-as a specific antiherpetic agent.



- metabolism and activation of acyclovir

Satellite Viruses-

A Virus that require the collaboration of another virus to fulfil their lifecycle. For positive – sense single stranded RNA satellite virus infect plant

1.Albetovirus

2.Aumaivirus

3. Papanivirus

4. *Virtovirus A*; Family- *Sarothoviridae*; Genus – *Macrovirus* has been given for the positive sense single stranded RNA satellite Viruses which infect the Arthropods

CONCLUSION

We studied about the RNA Virus and DNA virus and the Recombination, replication and mutation rate in RNA virus. Genome Instability in DNA virus refers to aspect of high frequency of alteration in single genome. As well as transformation/deletion. DNA viruses normally show greater genome stability than RNA viruses. Smallpox caused by variola virus is a devastating disease with high case fatality and transmission rates. Inoculation with vaccine virus is highly protective against natural infection with variola virus.

In this study, an initial system-level understanding of viral infection mechanism through PHI network was compared by differentiating DNA and RNA viruses. Ongoing studies and increasing amounts of

experimentally-verified PHI data will further improve our understanding of the interplay between pathogens and human.

REFERENCE

- Wagner, Edward K, Martinez J. (1999). Basic virology. Malden, MA, Blackwell science, Inc, P249, Retrieved 30 March 2020
- Wolf YL, Kazlauskas D, Iranzo J, Lucia-sanz A, Kuhn JH, Krupovic M, Dolja VV, Koonin EV (November 2018) 'Origin and evaluation of the Global RNA Genome.
- Zeman MK, Cimprich KA, 2014 cause and consequence of replication stress Nat cell biology 16;2-9
- Goff SP (2007) Host Factor exploited by retroviruses. Nature 5, 253-263.
- Zhou H, Jin and Wong L (2013) protein interaction network as starting point to identify novel anti-microbial drug target.
- Nagy PD and Pogany J (2012) The dependence of viral replication on coopted host factors. Nat Rev Microbiol 10, 137-149 [PMC free article]