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Togaviridae

Togaviruses owe their name to the envelope (Latin toga = cloak) which surrounds the isometric nucleocapsid core. The Togaviridae family at present consists of the four genera Alphavirus, Rubivirus, Pestivirus and Arterivirus; the flaviviruses have recently been assigned an independent family status. There are some 25 members in the Alphavirus genus, whereas the Rubivirus and Arterivirus genera contain one virus only (rubella virus and equine arteritis virus, respectively). The Pestivirus genus is represented by mucosal disease/bovine diarrhea virus, the very closely related border disease virus of sheep and hog cholera virus.

Togaviruses are small enveloped animal RNA viruses (40–70 nm). The envelope tightly surrounds a spherical nucleocapsid 25–37 nm in diameter whose icosahedral symmetry has been proven only for alphaviruses. Surface projections are demonstrable in most togaviruses.

The nucleic acid is a single molecule of positive-sense, single-stranded RNA with a mol. wt. of about $4 \times 10^6$. Genomic nucleotide sequence data of alphaviruses and recently also of pestiviruses have been obtained. The virion contains three or four polypeptides, one or more of which are glycosylated.

The virion buoyant density is about 1.25 g/cm$^3$ in CsCl and varies between 1.13 and 1.24 g/cm$^3$ in sucrose. Sedimentation coefficients between 150 (pestiviruses) and 300 S have been reported.

Togaviruses replicate in the cytoplasm and mature by budding of either pre-assembled (alphaviruses) or assembling nucleocapsids through the plasma membrane. During the replication of alphaviruses and rubiviruses a subgenomic 26 S RNA is synthesized which contains the information for the virion structural proteins. Arteriviruses produce five subgenomic mRNAs as a nested set.

With recent data on the genomic organization and transcription strategies accumulating, inclusion of the pestiviruses and arteriviruses into the Togaviridae family becomes untenable. In contrast to alphaviruses, pestiviruses lack polyadenylation of the genomic RNA as well as a subgenomic mRNA species, and have their virion protein coding sequences near the 5' end of the genome. From these data, it would appear that pestiviruses are more related to flaviviruses than to togaviruses. The coronavirus-like transcription strategy of arteriviruses should be a reason to eliminate them from their present taxonomic cluster.

In ruminants, the non-arthropod-borne togaviruses are bovine viral diarrhea virus (BVDV) and border disease virus (BDV). It appears as if BDV is a BVDV adapted to sheep; both are antigenically closely related to hog cholera (swine fever) virus. These three viruses from the genus Pestivirus.

BVDV is the causative agent of bovine viral diarrhea (BVD) and mucosal disease (MD) but may also participate in the etiology of acute respiratory/enteric disease in calves. Both BVDV and BDV are teratogenic and show a trend to viral persistence. The teratogenicity of BVDV and BDV is expressed by congenital conditions of the newborn, first described in lambs from the borders of Wales. Later it became evident that intrauterine infection mostly
after transplacental transfer may result in "late onset" disease of cattle, with
the majority aged 6 months to 2 years. In a few cases BVDV may persist for life
without obvious clinical signs. A late onset MD-like syndrome has also been
described in sheep recovered from clinical border disease.

FLAVIVIRIDAE

Yellow fever virus (Latin flavus = yellow) is the type species of this recently
established monogeneric family. Most of the 50 viruses are either mosquito-
borne or tick-borne, but there are also flaviviruses without arthropod trans-
mission.

The enveloped spherical virions measure 40–50 nm in diameter and consist
of a core particle surrounded by a projection-bearing membrane. Fuzzy surface
projections have been visualized.

The virus particle contains a single molecule of a single-stranded RNA with
positive polarity and a mol. wt. of 4–4.6 \times 10^6. The nucleocapsid protein (mol.
wt. 14 k) and a small additional polypeptide (mol. wt. 8 k) as well as one
glycosylated envelope protein (mol. wt. 53–63 k) constitute the structural poly-
peptides.

The buoyant density of flaviviruses is 1.22–1.24 g/cm^3 in CsCl and 1.19 g/cm^3
in sucrose; sedimentation coefficients of around 200 S have been determined.

Flaviviruses replicate in the cytoplasm; maturation is presumed to occur by
budding through intracytoplasmic membranes (mostly endoplasmic reticulum)
but has only incidentally been visualized. Subgenomic mRNAs do not occur,
and posttranslational processing of one large precursor molecule is the mech-
anism involved.

The International Catalogue of Arboviruses 1985, published by the Ameri-
can Society of Tropical Medicine and Hygiene, San Antonio, TX, can be
recommended as a source of detailed information on alpha- and flaviviruses;
tables giving the numbers of viruses from different taxonomic clusters isolated
from naturally infected vertebrates are especially valuable for the epidemiolo-
gist.

There are two flaviviruses which have recognized associations with rumi-
nants: the louping-ill and the Wesselsbron disease virus. Louping-ill virus is
transmitted by ticks and can cause disease in most categories of domestic
animals as well as man but is most frequently associated with sheep and is
thought to be unique to the British Isles. Wesselsbron disease virus (WBV) is
transmitted by Aedes mosquitoes and causes abortion and death of young lambs
in South Africa.