ICTV Virus Taxonomy Profile: Avsunviroidae

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Abstract

Members of the family Avsunviroidae have a single-stranded circular RNA genome that adopts a rod-like or branched conformation and can form, in the strands of either polarity, hammerhead ribozymes involved in their replication in plastids through a symmetrical RNA–RNA rolling-circle mechanism. These viroids lack the central conserved region typical of members of the family Pospiviroidae. The family Avsunviroidae includes three genera, Avsunviroid, Pelamoviroid and Elaviroid, with a total of four species. This is a summary of the ICTV Report on the taxonomy of the family Avsunviroidae, which is available at http://www.ictv.global/report/avisunviroidae.

Table 1. Characteristics of the family Avsunviroidae

| Typical member: avocado sunblotch viroid (J02020), species Avocado sunblotch viroid, genus Avsunviroid | Genome | Single-stranded circular RNA of 246–401 nt that can form hammerhead ribozymes in the strands of either polarity |
| Host range | Plants (dicots) |
| Replication | A nuclear-encoded plastid RNA polymerase generates complementary oligomeric RNAs that are co-transcriptionally self-cleaved by the hammerhead ribozymes. The resulting monomeric RNAs are circularized by a tRNA ligase |
| Taxonomy | Three genera, collectively containing four species |

GENOME

Members of the family Avsunviroidae have a circular single-stranded RNA genome of 246 to 401 nt, which may assume rod-like, quasi-rod-like or branched conformations in silico or in vitro, with indirect or direct evidence supporting similar conformations in vivo (Table 1, Fig. 1). Viroid G+C content is >50% except for avocado sunblotch viroid (38%). RNAs of (+, arbitrarily the most abundant strand in vivo) and (−) polarity can form active hammerhead ribozymes (Fig. 2) that are involved in replication [1, 2].

REPLICATION

Replication takes place in plastids, mostly chloroplasts, through a symmetrical rolling-circle mechanism. A nuclear-encoded plastid RNA polymerase, conscripted to transcribe RNA templates instead of its physiological DNA template, synthesizes oligomeric viroid RNAs of both polarities. These oligomers are self-cleaved co-transcriptionally by the embedded hammerhead ribozymes, thereby generating linear monomeric RNAs that are subsequently circularized by a tRNA ligase. This enzyme, like the nuclear-encoded plastid RNA polymerase, is encoded in the nucleus and translocated into plastids.

TAXONOMY

The type of hammerhead structure, the genome G+C content and its solubility in 2 M LiCl, together with clustering in phylogenetic trees derived from whole genome sequences, are used as genus demarcation criteria.
Avsunviroid

Members of the single species in the genus, *Avocado sunblotch viroid*, have a genome that adopts a rod-like conformation, has G+C content of 38%, and is soluble in 2 M LiCl (Fig. 1). Hammerhead structures formed by either strand are thermodynamically unstable with a short helix III (Fig. 2); thus double-hammerhead structures may be involved in self-cleavage. Avocado is the only known natural host [3].

Pelamoviroid

Members of the two species included in this genus (*Peach latent mosaic viroid* and *Chrysanthemum chlorotic mottle viroid*) have circular RNA genomes that are insoluble in 2 M LiCl and assume branched conformations stabilized by a kissing-loop interaction in the (+) strand (Fig. 1). Stable single-hammerhead structures (Fig. 2) mediate replication [4, 5]. Host range is restricted to the original hosts and some closely related species.

Elaviroid

Members of the single species in this genus, *Eggplant latent viroid*, have a genome that assumes a quasi rod-like conformation (Fig. 1) and is soluble in 2 M LiCl. Both strands form stable single-hammerhead structures involved in replication. Host range is restricted to several eggplant cultivars [6].

RESOURCES


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Conflicts of interest

The authors declare that there are no conflicts of interest.

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