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► **To cite this version:**

David Prangishvili, Mart Krupovic, Ictv Report Consortium. ICTV Virus Taxonomy Profile: Ampullaviridae. *Journal of General Virology, Microbiology Society*, 2018, 99 (3), pp.288-289. 10.1099/jgv.0.001023 . pasteur-01977340

HAL Id: pasteur-01977340

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Submitted on 10 Jan 2019

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ICTV Virus Taxonomy Profile: *Ampullaviridae*

David Prangishvili*, Mart Krupovic* and ICTV Report Consortium

Abstract

The family *Ampullaviridae* includes viruses with linear dsDNA genomes that replicate in hyperthermophilic archaea from the genus *Acidianus*. The virions have a unique champagne bottle-shaped morphology and consist of a nucleoprotein filament condensed into a cone-shaped core, which is encased by an envelope, with the base of the 'bottle' decorated with a ring of 20 filaments. Genome replication is presumably carried out by the virus-encoded protein-primed family B DNA polymerase. The bottle-shaped morphology is unprecedented among viruses of bacteria and eukaryotes and represents a group of archaea-specific virion morphotypes. This is a summary of the International Committee on Taxonomy of Viruses (ICTV) Report on the taxonomy of the *Ampullaviridae*, which is available at www.ictv.global/report/ampullaviridae.

Table 1. Characteristics of the family *Ampullaviridae*

Typical member:	Acidianus bottle-shaped virus (EF432053), species <i>Acidianus bottle-shaped virus</i>, genus <i>Ampullavirus</i>
Virion	Bottle shaped; 230 nm long, 4–75 nm wide; the flat terminus is decorated with 20 nm-long filaments; the envelope encases a cone-shaped nucleoprotein core
Genome	Linear, dsDNA (23 814 bp) with 590 bp terminal inverted repeats
Replication	Virus-encoded protein-primed family B DNA polymerase
Translation	Not characterized
Host range	Hyperthermophilic archaea from the genus <i>Acidianus</i> ; non-lytic
Taxonomy	Single genus with a single species; two related genomes have been obtained from metagenomics studies

VIRION

The distinctive bottle-shaped virions are 230 ± 20 nm long, and vary in width from 75 nm at the broad end, tapering to 4 ± 1 nm. The twenty thin filaments at the broad end are each 20×3 nm, regularly spaced and interconnected via a basal disc or ring (Table 1, Fig. 1) [1].

A 9 nm-thick virion envelope encases a cone-shaped core formed by a torroidally supercoiled nucleoprotein filament, which is 7 nm in width.

GENOME

The genome is a linear double-stranded DNA molecule of 23 814 bp with 590 bp inverted terminal repeats. It has a base composition of 35% GC and is predicted to encode 57 proteins [2] (Fig. 2). Three genes contain

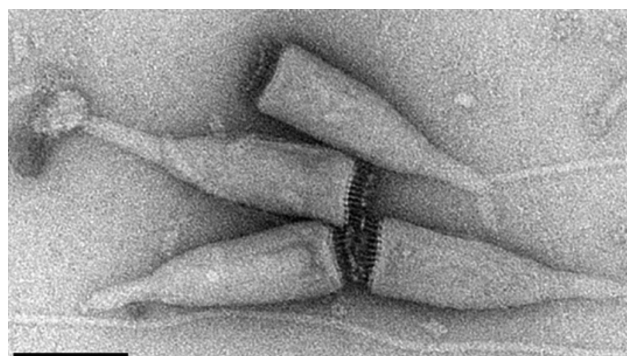


Fig. 1. Negative-contrast electron micrographs of virions of an isolate of *Acidianus bottle-shaped virus*. The scale bar represents 100 nm. (Modified with permission from [1]).

Received 11 January 2018; Accepted 25 January 2018

Author affiliation: Department of Microbiology, Institut Pasteur, 25 rue du Dr Roux, 75015 Paris, France.

***Correspondence:** David Prangishvili, david.prangishvili@pasteur.fr; Mart Krupovic, mart.krupovic@pasteur.fr

Keywords: *Ampullaviridae*; ICTV Report; Taxonomy; *Acidianus bottle-shaped virus*.

Abbreviations: DNAP, DNA polymerase; Cas4-like, Cas4-like nuclease; TK, thymidylate kinase; RHH, ribbon-helix-helix motif; GTase, glycosyltransferase; WHTH, winged helix-turn-helix motif.

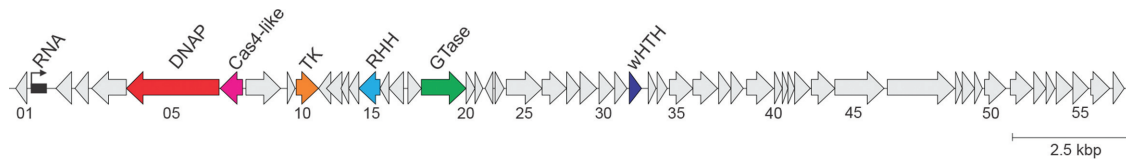


Fig. 2. Genome organization of *Acidianus* bottle-shaped virus, showing the location, size and direction of putative genes. The black square indicates the position of a putative non-coding RNA gene. Functionally annotated genes are highlighted with different colours. Numbers below the genome diagram are ORF identifiers. Abbreviations: DNAP, DNA polymerase; Cas4-like, Cas4-like nuclease; TK, thymidylate kinase; RHH, ribbon-helix-helix motif; GTase, glycosyltransferase; wHTH, winged helix-turn-helix motif.

putative internal start codons with ribosome-binding sites. The genome encodes a DNA polymerase, a putative glycosyltransferase, a thymidylate kinase, a Cas4-like endonuclease and two putative DNA-binding proteins with winged helix-turn-helix and ribbon-helix-helix motifs, respectively. All of these proteins are conserved in two other ampullavirus genomes described from metagenomics studies [3]. The other predicted proteins have no known homologues. The genome also encodes a putative non-coding RNA, hypothesized to be involved in genome packaging [2].

REPLICATION

The viral DNA polymerase is homologous to protein-primed family B DNA polymerases and is apparently responsible for genome replication [2]. Virus adsorption appears to occur through the pointed end of the virion [1]. The virions are released without apparent host cell lysis.

TAXONOMY

The single genus *Ampullavirus* includes the single species *Acidianus bottle-shaped virus*. Related, unclassified, viruses have been identified by metagenomics studies of material from hot springs in Iceland, Italy and the USA [3]. Protein-primed DNA polymerases homologous to that encoded by *Acidianus* bottle-shaped virus have also been described in members of the archaeal virus genera *Gammapleolipovirus* (family *Pleolipoviridae*) and *Salterprovirus*, as well as in bacterial and eukaryotic viruses of the families *Tectiviridae*, *Podoviridae* (subfamily *Picovirinae*), *Adenoviridae* and *Lavidaviridae* (genus *Mavirus*) [4–6].

RESOURCES

Full ICTV Online (10th) Report:
www.ictv.global/report/ampullaviridae.

Funding information

Production of this summary, the online chapter, and associated resources was funded by a grant from the Wellcome Trust (WT108418AIA).

Acknowledgements

Members of the ICTV Report Consortium are Elliot J. Lefkowitz, Andrew J. Davison, Stuart G. Siddell, Peter Simmonds, Sead Sabanadzovic, Donald B. Smith, Richard J. Orton and Andrew M. Kropinski.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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