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Springer

2022-04

Zerbini, F M, Siddell, S G, Mushegian, A R, Walker, P J, Lefkowitz, E J, Adriaenssens, E M, Alfenas-Zerbini, P, Duthil, B E, García, M L, Junglen, S, Krupovic, M, Kuhn, J H, Lambert, A J, Lobočka, M, Oksanen, H M, Robertson, D L, Rubino, L, Sabanadzovic, S, Simmonds, P, Suzuki, N, Van Doorslaer, K, Vandamme, A-M & Varsani, A 2022, 'Differentiating between viruses and virus species by writing their names correctly', *Archives of Virology*, vol. 167, pp. 1231-1234. <https://doi.org/10.1007/s00705-021-05323-4>

<http://hdl.handle.net/10138/353102>

10.1007/s00705-021-05323-4

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Differentiating between viruses and virus species by writing their names correctly

International Committee on Taxonomy of Viruses Executive Committeeⁱ

Abstract

Following the results of the International Committee on Taxonomy of Viruses (ICTV) Ratification Vote held in March 2021, a standard two-part "binomial nomenclature" is now the norm for naming virus species. Adoption of the new nomenclature is still in its infancy; thus, it is timely to re-iterate the distinction between "virus" and "virus species" and to provide guidelines for naming and writing them correctly.

Viruses are physical entities that infect living organisms, including plants, animals, and microbes [1]. Viruses may cause disease; further, they can be inoculated, purified, and their genomes can be cloned and sequenced in the laboratory. Viruses have replication cycles that exploit host cell systems, and the word "virus" may refer to the entirety of the cycle or just the extracellular virus particle ("virion" is also used to refer to the virus particle in its extracellular state).

In contrast, virus species are human-made taxonomic categories to which viruses are assigned when they satisfy a particular set of properties, known as "species demarcation criteria" [1]. A virus species is not an entity and cannot be isolated, cloned, sequenced, or make you ill. The notion of a virus species helps us to understand the relationships among viruses, their shared properties, and how they may have evolved.

In a text or presentation, the virus species will usually be mentioned only once, often following, and therefore next to the virus name when it is introduced for the first time. The virus species is referred to in the context of taxonomy, together with higher taxa, such as the genus and the family in which the virus species is included.

1. The names of viruses are written differently from the names of virus species.

Virus names are often those that are commonly used and known. The format of virus names lies outside the remit of the ICTV; virus names are not standardized as are the names of species. One and the same virus may have several names in the same language, different names in different languages, and may be written in different scripts. To ensure virus names can be clearly distinguishable from species names, advice and illustrative examples are provided below.

1.1. Naming viruses

In written communication, virus names should not be italicized, even when they include the name of a host species or genus. In English, all words in a virus name will be written in

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lowercase letters unless the name includes a proper nounⁱⁱ (e.g., place name) or an alphanumeric designation, which may include uppercase and/or lowercase letters. Virus names may be abbreviated, in which case the abbreviation can be written entirely in uppercase letters or may consist of a combination of uppercase and lowercase letters, with or without numbers. Importantly, how virologists name viruses is not affected by the recent changes in species names [2,3]. Therefore, the same practices used in the past can continue to be applied for naming new viruses.

1.2. Naming virus species

In contrast to the names of viruses, virus species names, like the names of higher taxa, are standardized and assigned through taxonomy proposals that are ratified by the ICTV. A virus species name is always written in italicsⁱⁱⁱ with the first element (the genus name) beginning with an uppercase letter. In the binomial format now mandated by the ICTV [2,3], the second element, which is the species epithet, is in free form. For example, the epithet may be in the "traditional" binomial format, as used in other taxonomies (usually a Latinized single lowercase word, e.g. *Vesiculovirus indiana*, see below), or the epithet may include a combination of uppercase and lowercase letters and numbers (e.g. *Triavirus phi2958PVL*, see below). Binomial species names must never be abbreviated and should never be translated or transliterated.

2. Examples of correct usage:

The symptomless decline of raspberry plants can be caused by raspberry bushy dwarf virus (RBDV), a member of the species *Idaeovirus rubi* (family *Mayoviridae*). *Idaeovirus rubi* is one of two species in the genus *Idaeovirus*.

Vesicular stomatitis Indiana virus (VSIV) is assigned taxonomically to the family *Rhabdoviridae*, genus *Vesiculovirus*, species *Vesiculovirus indiana*.

The genus *Pterovirus* includes the species *Pterovirus chulinense*.

The etiological agents of influenza (influenza virus A, B, C and D) are members of the species *Alphainfluenzavirus influenzae*, *Betainfluenzavirus influenzae*, *Gammainfluenzavirus influenzae* and *Deltainfluenzavirus influenzae*, respectively.

A new bacteriophage, included in the species *Triavirus phi2958PVL*, has been isolated.

Aphids transmit potato virus Y (PVY).

ⁱⁱ If used in a virus name, host genus names are treated as proper nouns (e.g., *Drosophila X virus*, *Corchorus golden mosaic virus*).

ⁱⁱⁱ Note that in virology, the names of taxa at all ranks are italicized. This differs from some other branches of biology, in which only the species and genus names are italicized.

3. Examples of incorrect or misguided usage:

Idaeovirus rubi was isolated from an asymptomatic raspberry plant grown in a commercial field in southern Italy. (Incorrect because a species cannot be isolated; the virus name should have been used instead)

Here we describe a new virus from corn for which we propose the name *Badnavirus maydis*. (Misguided because a virus name should not be italicized, nor binomial. Indeed, this is strongly discouraged by the ICTV)

Results of this study suggest that grapevine virus L (GVL) is a new species in the genus *Vitivirus*. (Incorrect because a virus cannot be a species; it should read "new virus" or "new member")

The etiological agents of influenza are members of the species *Alphainfluenzavirus influenzae*, *Betainfluenzavirus influenzae*, *Gammainfluenzavirus influenzae* and *Deltainfluenzavirus influenzae* (family *Orthomyxoviridae*). (Incorrect because species and family names should be italicized)

A. influenzae is the most common cause of influenza worldwide. (Incorrect because species do not cause disease, and because species names should not be abbreviated)

4. Virus names in non-English languages

Virus names, just like the names of animals and plants, are used in many languages and should be written following language-specific conventions (Tables 1, 2). For example, in German, all nouns, proper and common, are written with an initial uppercase letter and hence virus names always start with uppercase. In English, only proper nouns are written with an initial uppercase letter. On the other hand, virus species names are unique, are always written in Latin script, and are identical in all languages.

5. Useful resources

A complete list of all established virus species can be found at <https://ictv.global/taxonomy>, and a downloadable Master Species List (MSL) is located at <https://ictv.global/MSL>. The most recent version of the Virus Metadata Resource (VMR), which provides a list of exemplar (prototype) viruses for each established virus species and links to their genomic sequences, is located at <https://ictv.global/vmr>.

NOTE: Binomial nomenclature is now the official format for naming virus species in the ICTV virus taxonomy. Although a binomial format has to be used for the naming of new virus species, the current MSL and VMR versions include many species names defined before March 2021, that do not conform to this new format. All virus species names will be gradually changed to binomials over the next three years following ICTV-approved procedures.

Compliance with Ethical Standards

Conflict of Interest

The authors declare that they have no conflicts of interest.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Data availability statement

This manuscript has no associated data.

Funding

Research reported in this publication was supported by the National Institute of Allergy and Infectious Diseases of the National Institutes of Health under Award Number U24AI162625 to E.J.L. This work was supported in part through Laulima Government Solutions, LLC prime contract with the US National Institute of Allergy and Infectious Diseases (NIAID) under Contract No. HHSN272201800013C. J.H.K. performed this work as an employee of Tunnell Government Services (TGS), a subcontractor of Laulima Government Solutions, LLC under Contract No. HHSN272201800013C. B.E.D. is supported by the European Research Council (ERC) Consolidator grant 865694: DiversiPHI, and the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under Germany's Excellence Strategy – EXC 2051 – Project-ID 390713860. E.M.A. gratefully acknowledges the support of the Biotechnology and Biological Sciences Research Council (BBSRC); this research was funded by the BBSRC Institute Strategic Program Gut Microbes and Health BB/R012490/1 and its constituent projects BBS/E/F/000PR10353 and BBS/E/F/000PR10356. H.M.O. was supported by University of Helsinki funding for FINStruct and Instruct-ERIC research infrastructure. S.S. acknowledges partial support from the Special Research Initiative (MAFES), Mississippi State University, and from the National Institute of Food and Agriculture, US Department of Agriculture, Hatch Project 1021494. A.R.M. is a Program Director at the U.S. National Science Foundation (NSF); the statements and opinions expressed herein are made in a personal capacity and do not constitute endorsement by NSF or the government of the United States. D.L.R. is supported by the U.K. Medical Research Council (MC_UU_1201412). F.M.Z. is supported by grants from Capes (Finance code 01), CNPq and Fapemig. P.A.Z. is supported by Suzano Papel e Celulose and Capes (Finance code 01).

References

1. Van Regenmortel MHV (2003) Viruses are real, virus species are man-made, taxonomic constructions. *Arch Virol* 148: 2481–2488
2. Siddell SG, Walker PJ, Lefkowitz EJ, Mushegian AR, Dutilh BE, Harrach B, Harrison RL, Junglen S, Knowles NJ, Kropinski AM, Krupovic M, Kuhn JH, Nibert ML, Rubino L, Sabanadzovic S, Simmonds P, Varsani A, Zerbini FM, Davison AJ (2020) Binomial nomenclature for virus species: a consultation. *Arch Virol* 165:519-525
3. Walker PJ, Siddell SG, Lefkowitz EJ, Mushegian AR, Adriaenssens EM, Alfenas-Zerbini P, Davison AJ, Dempsey DM, Dutilh BE, Garcia ML, Harrach B, Harrison RL, Hendrickson RC, Junglen S, Knowles NJ, Krupovic M, Kuhn JH, Lambert AJ, Lobočka M, Nibert ML,

Oksanen HM, Orton RJ, Robertson DL, Rubino L, Sabanadzovic S, Simmonds P, Smith DB, Suzuki N, Van Doorslaer K, Vandamme AM, Varsani A, Zerbini FM (2021) Changes to virus taxonomy and to the International Code of Virus Classification and Nomenclature ratified by the International Committee on Taxonomy of Viruses (2021). Arch Virol 166:2633-2648

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Table 1. Nomenclature for a virus host and host species

Language	Host name	Host species name
English	maize	
Arabic	الذرة	
Chinese	玉米	
French	maïs	<i>Zea mays</i>
Japanese	トウモロコシ	
Russian	кукуруза	
Spanish	maíz	
Swahili	mahindi	

Table 2. Nomenclature for a virus infecting maize and for the virus species

Language	Virus name	Virus species name
English	maize mosaic virus	
Arabic	فيروس موزاييك الذرة	
Chinese	玉米花叶病毒	
French	virus de la mosaïque du maïs	<i>Alphanucleorhabdovirus maydis</i>
Japanese	トウモロコシモザイクウイルス	
Russian	вирус мозаики кукурузы	
Spanish	virus del mosaico del maíz	
Swahili	virusi vya Batobato ya mahindi	