Back to Latin and tradition: a proposal for an official nomenclature of virus species

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Background

The taxonomy of viruses (i.e the classification of viruses into well defined clusters) has dramatically improved in the recent years, in particular due to the action of International Committee on Taxonomy of Viruses (ICTV). The current scheme of classification includes four hierarchical levels: species, genus, family (with the possibility of an intermediate taxon, the subfamily) and order. So far, the ICTV has approved 3 orders, 56 families, 9 subfamilies, 223 genera and 1550 virus species [10]. This taxonomy is developing but the taxa already approved by ICTV remain largely stable (only minor changes have occurred among these taxa between the 6th and 7th ICTV Reports) and are well accepted by most, if not all, virologists.

In parallel, an official virus nomenclature has been established to provide distinctive scientific names to these well accepted taxa. Orders, families, subfamilies, and genera have been given official names ending by *-virales*, *-viridae*, *-virinae* and *-virus,* respectively. These names are written in italics and with a capital initial letter. The only remaining question is that of official names for virus species. This issue is not simple, has already been the subject of numerous attempts and is currently the subject of a debate, often polemical, among virologists [1–5, 7–9]. All virus species have vernacular (common) names derived from the name of their host, virus-induced disease in this host, geographical site of their discovery and/or other particular characteristics. These names are considered common words: they are written in roman characters without capitalization (except for proper names that keep a capital initial when included within common species names) and differ according to each national language. For instance, "measles virus" in English and "virus de la rougeole" in French designate the same virus, which is responsible for measles in humans. In the revised version of the International Code of Virus Classification and Nomenclature published in 1998 [4], novel rules indicated that species names (i.e. vernacular names since no official name had been defined so far) that were previously exempted from italicization and capitalization, should be printed in italics and have the first letter of the first word capitalized (Rule 3.40), provided they were "accepted names" as approved by ICTV (Rule 3.8). Concomitantly, the examples given in the Rule 3.40 of the code were vernacular English names and, as a matter of fact, conferred the status of official species names to these

English names. This decision appeared questionable for several reasons: (i) it had not been widely debated among the community of virologists; (ii) it might be a real obstacle in terms of pronunciation and orthography for those whose first language is not English; (iii) it made impossible the distinction between a common English name (which refers to virus as a physical entity) and the official species name (which refers to an abstract classification cluster), except by means of typography: for instance, *Tobacco mosaic virus* and tobacco mosaic virus. This typographic distinction was conceptually and scientifically difficult to understand and to explain; it was an obvious source of confusion for virologists and even more for non-virologists. Nevertheless, this rule was further confirmed since "English has replaced Latin as the language of communication in science and English names for viruses have actually become an international standard also in publications written in other languages" [7], a questionable statement that remains to be demonstrated. For instance, this is not true in virology articles written in French.

Some virologists made critical comments [1–3] and mentioned the well known advantages of a binomial system for scientific names: inclusion of genus affiliation within the name, which adds a considerable amount of information, and clear distinction between vernacular and official scientific names. Unfortunately, this correct statement has resulted in a hybrid solution which consists of adding the name of genus to the end of vernacular English name to obtain the scientific name. In the previous example, the common name is tobacco mosaic virus and the scientific one would be *Tobacco mosaic tobamovirus*. In this form, the genus epithet remains in italics, which permits a typographic homogeneity [7], but its capital initial is lost, another source of confusion and typographic mistakes. Moreover, the scientific name, which appears as a curious hybrid name made of English and latinized words, is not much different from the common one (the first part is identical), which also may result in confusion. Last but not least, this system will create long names with useless redundancy and pronunciation difficulties such as *Influenza A alphainfluenzavirus or Human varicella-zoster varicellovirus*. The question of turning these complex hybrid names into official names is now under debate and many French colleagues look very reluctant to support this idea [6]. This question will be discussed by all virologists attending the 12th International Congress of Virology to be held in Paris, 28th July–1st August 2002 [8].

Proposal for a simplified latinized binomial nomenclature of virus species

As recalled previously [1], the classification-based binary nomenclature, initially established by Linnaeus, has been successfully applied to all domains of biology, except for virology. The first part of a species name is the genus affiliation and the second part is a species epithet, both parts being printed in italics with a capital initial. Numerous examples demonstrate that this nomenclature is universally present, widely accepted and correctly used by scientists as well as other specialists of human culture: *Homo sapiens, Mus musculus, Arabidopsis thaliana, Escherichia coli, Plasmodium falciparum* … etc. As suggested by others [1], the present proposal is simply to apply this system to virus species. This solution is simple because the nomenclature of virus genera now is stable and fits virus taxonomy. Official virus species names thus can easily be derived from genus names as shown in Table 1. These names would fit exactly both the typography and pronunciation of official species names used in other domains such as bacteriology, parasitology, botany and

zoology. They also fit nicely the nomenclature of virus orders, families, subfamilies and genera. The idea of a binomial latin nomenclature is not novel. It has already been discussed and has had to face criticisms from some virologists. It would be worthwhile to review these criticisms (underlined below) and see if they are well founded.

Table 1. Examples of possible species names according to a binomial Latin nomenclature

Common name	Species name[a]
tobacco mosaic virus	*Tobamovirus tabaci*
cowpea mosaic virus	*Comovirus vignae*[b]
pea early-browning virus	*Tobravirus pisi*[b]
tobacco ringspot virus	*Nepovirus tabaci*
tomato leaf curl virus	*Begomovirus esculenti*[c]
tomato leaf curl Taiwan virus	*Begomovirus esculenti taiwani*
tomato leaf curl Tanzania virus	*Begomovirus esculenti tanzaniae*
tomato leaf curl Senegal virus	*Begomovirus esculenti senegalis*
rabies virus	*Lyssavirus rabie*
hepatitis C virus	*Hepacivirus hominis*
hepatitis B virus	*Orthohepadnavirus hominis*
hepatitis A virus	*Hepatovirus hominis*
herpes simplex virus	*Simplexvirus hominis*
varicella-zoster virus	*Varicellovirus hominis*
human herpesvirus 6	*Roseolovirus hominis*
human herpesvirus 7	*Roseolovirus hominis orphanus*
human herpesvirus 8	*Rhadinovirus hominis*
influenzavirus A	*Alphainfluenzavirus hominis*
measles virus	*Morbillivirus hominis*
bovine rotavirus	*Rotavirus bovis*
bovine viral diarrhoea virus	*Pestivirus bovis*
canine distemper virus	*Morbillivirus canis*
spider monkey herpesvirus	*Simplexvirus ateles*[d]
herpesvirus tamarinus	*Simplexvirus tamarinus*[d]
herpesvirus papio 2	*Simplexvirus papio*[d]
infectious bovine rhinotracheitis virus	*Varicellovirus bovis spiritalis*
bovine encephalitis virus	*Varicellovirus bovis cerebrosi*
simian varicella virus	*Varicellovirus pygerythrus*[d]
african green monkey cytomegalovirus	*Cytomegalovirus aethiops*[d]
rhesus monkey cytomegalovirus	*Cytomegalovirus rhesus*[d]
herpesvirus papio	*Lymphocryptovirus papio*[d]
african green monkey EBV-like virus	*Lymphocryptovirus aethiops*[d]
herpesvirus ateles	*Rhadinovirus ateles*[d]
herpesvirus saimiri	*Rhadinovirus saimiri*[d]

[a] These names are only proposals to illustrate the feasibility of such nomenclature. [b] Previously suggested by L. Bos to show the feasibility of such names [1]. [c] If necessary, to prevent any confusion, this name could be *Begomovirus esculenti retorrescentis.* [d] To be written in accordance with Latin declensions (genitive case).

(i) **In the past, advocating the use of Latin impeded progress in viral taxonomy and this use was abolished in previous ICTV Reports:** the temporary renunciation or omission of a system is not a definite proof that this system is wrong, unless this is demonstrated in a scientific way. The histories of biology and medecine contain numerous examples of concepts that were initially left and then later revealed to be efficient when based on new grounds.

(ii) **The use of Latin would give rise to a tremendous variety of extravagant names:** the classical example given to support this opinion is that of tobacco mosaic virus, which was given numerous names in the past, such as *Marmor tabaci*, *Phytovirus nicomosaicum*, *Vironicotum maculans*. This is unambiguously a failure of taxonomy, not of nomenclature. Since the genus *Tobamovirus* is now well accepted, the only remaining question is to find a consensual epithet and for that purpose, *tabaci* seems acceptable, but other proposals may be made. In this context, the role of ICTV is to define the most widely acceptable epithet, according to its rules of nomenclature.

(iii) **The use of Latin is only a matter of linguistic convention, tradition and orthodoxy:** it is clear that the concept of a Latin nomenclature is not modern and revolutionary. However, this concept has proved to be fully efficient over years, just like art and human culture. One may wonder why this concept has been preserved in all other domains of biology, even the most "modern" ones such as genetics and genomics.

(iv) **Virologists are not yet ready to adopt this nomenclature because they are not truly confident with the stability of the present taxonomic system:** for years, the taxonomy of viruses has been getting more and more robust and the concept of virus species, the last taxon to be defined, seems fully accepted now. Moreover, the classification into virus genera is currently established from the study of viral genome sequence and organization, which is generally considered the gold standard in the field of taxonomy. Ultimately, for the virologists whose age is between 25 and 50 years, the current taxonomic approach is the only classification system they have ever known and there is no reason for them to have some dreadful doubts about it.

(v) **A Latin nomenclature would not follow the rules of the ICTV Code:** the properties of a binomial Latin nomenclature satisfy the principles of nomenclature indicated in this Code [4]. As far as specific rules are concerned, a Latin nomenclature would perfectly fulfil the criteria of easiness and euphony (Rule 3.12), lack of duplication of names (Rule 3.14), lack of priority for an older name (Rule 3.10), universality irrespective of national origin (Rule 3.19), lack of ambiguity (Rule 3.24) and, of course, italicization and capitalization (Rule 3.40). The only possible divergence concerns the Rule 3.9 "existing names of taxa and viruses shall be retained whenever feasible". Indeed, the binomial Latin nomenclature will create names *de novo*, exactly as the current proposal of associating vernacular species names with genus ones. However, it must be acknowledged that the first part of the Latin species name (genus) is already defined and its second part (species epithet) would frequently consist of words such as *hominis*, *canis*, *tabaci*, *perdifficilis* whose novelty is not unbearable.

(vi) **Viruses are not microorganisms and do not deserve a Latin nomenclature like other biological organisms:** the question of virus life or status as microorganisms is not a major concern. As André Lwoff said, viruses are viruses. They are simple transmissible agents, having the capacity of self-replication within a host cell and the

ability to induce disease in their hosts (animals, plants, bacteria etc.). As biological entities, they can be involved in the general system of biological nomenclature without virologists losing their soul and originality.

(vii) **The creation of a binomial Latin nomenclature for viruses would require a tremendous amount of work:** this aspect cannot be neglected. However, the names of the 223 accepted genera are now defined. Consequently, half of the work has already been done and, in most cases, the species epithet will be simply derived from the name of host, disease or location. The real work will be that of ICTV to make the final decision when many possibilities are to be considered and only one selected.

(viii) **Long established virus names would have to be abandoned:** this is not the case since, in most situations, they will be used as vernacular names (see below).

(ix) **In some families, there is no genus name or the genus name is atypical:** that is true and, in this case, the definition of official species names should be delayed until a proper conventional name is found for the genus.

(x) **The binomial Latin nomenclature would change the alphabetic listing of virus species names:** the listing of vernacular names will be maintained and a novel index, indicating the correspondence between vernacular an official names can be built within a few seconds using modern software.

(xi) **The alphabetic listing of official species names would change whenever viruses were reassigned to other genera:** this occurs infrequently and this is the same picture at any level of virus classification, as it is the case in other fields of biology.

Use of the binomial Latin nomenclature for virus species

The adoption of a Latin nomenclature for virus species would not modify substantially the current practices for communication among virologists. In most cases, viruses are designated as physical entities by their vernacular names written in roman characters without a capital initial. This common name is written in the language of the text and the national communities of virologists have the duty to homogeneize as much as possible these common names to avoid any confusion. For instance, in French, it would be helpful to define a common consensus name for herpes simplex virus and to chose definitively between “virus herpes”, “virus herpes simplex”, “virus de l’herpes simplex”, “herpes simplex virus” (in this case, identical to the common English name), and “virus de l’herpes”. In any case, the use of “herpesvirus” as the common French name of herpes simplex virus must be discouraged since it provides a major confusion with the generic common name of members of the family *Herpesviridae*. Since many journals, mainly those with the highest impact factors, are written in English, it is expected that virologists of all nationalities will frequently use the common English virus names in their articles written in the same language. This is perfectly accepted by all virologists. Alternatively, the viruses may be designated by approved acronyms, such as HSV for herpes simplex virus. Although each national language has its own common names for virus species, it would be useful if the acronyms derived from common English names were given the status of internationally approved abbreviations. Indeed, the English abbreviations have the advantage of presenting the capital V (for virus) at their end, which immediately permits their recognition as virus acronyms amongst many other abbreviations usually present in a scientific paper written in any language. The absolute requirement is to provide these acronyms with a sufficient

number of letters to avoid any confusion. As an example, BPV currently designates both bovine parvovirus and bovine papillomavirus, which is not acceptable for an extended international use of this abbreviation.

In that general context, the use of an official species name belonging to a binomial Latin nomenclature is expected to be limited. Indeed, the reference to a taxonomic entity is not frequent in a scientific publication and is generally made once, for instance in the Material and methods section [7], in order to designate the virus species under study unambiguously. An example would be the sentence: "we have isolated measles viruses (*Morbillivirus hominis*, genus *Morbillivirus*, subfamily *Paramyxovirinae*, family *Paramyxoviridae*) in rhinopharyngeal samples from eight children …", which would be translated in French as "nous avons isolé des virus de la rougeole (*Morbillivirus hominis*, genre *Morbillivirus*, sous-famille *Paramyxovirinae*, famille *Paramyxoviridae*) dans les prélèvements rhinopharyngés de huit enfants …". In spite of its limited use, this binomial Latin nomenclature has to be considered a hallmark of virus taxonomy and virology identity. Without any risk of confusion with other taxonomic or vernacular names, it would reflect precisely both the state of the art of virus classification and the common contribution of virologists to scientific knowledge in harmony with all other domains of biology. For these reasons, I propose that the principle of a binomial Latin nomenclature for virus species is again discussed alongside other taxonomic proposals, at the 12th International Congress of Virology in next July, in Paris.

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