Introduction to papers from the third meeting on the *Planctomycetes-Verrucomicrobia-Chlamydiae* bacteria: new model organisms in the omics era

Olga Maria Lage · Damien P. Devos

Received: 12 April 2018 / Accepted: 20 April 2018 / Published online: 25 April 2018
© Springer International Publishing AG, part of Springer Nature 2018

The *Planctomycetes-Verrucomicrobia-Chlamydiae* (PVC) super-phylum contains, in addition to the three name-giving phyla, the *Lentisphaerae* and *Kirimatiellaeota*, as well as some uncultured candidate phyla, such as the *Candidatus* Omnitrophica. PVC bacteria have recently attracted attention from the scientific community for the peculiar characteristics that they display. For the third time, the PVC scientific community met recently at their bi-annual conference (<http://pvcbacteria.org/pvcmeeting17/>). In this special section, we would like to share some of the exciting results that were presented at this meeting.

If PVC bacteria have raised interest for their particular features, some of the “paradigms” in the field have recently been overturned. Rivas-Marín and Devos (2018) provide an historical perspective on PVC bacteria research, summarise recent results and develop on how these have corrected erroneous concepts such as the lack of peptidoglycan or regarding the compartmentalisation of the cytoplasm. They

conclude with some suggestions about the directions that the field might take in the future. For sure, these are exciting times for the PVC researcher community.

One of the characteristics of PVC bacteria is their diversity and ubiquity. Two publications report new species adding to understanding of the diversity of these bacteria. Storesund et al. (2018), report on the diversity patterns and isolate new Planctomycetes from metaliferous deposits from hydrothermal vent fields along the Valu Fa Ridge in the SW pacific. This study shows that the deep-sea Planctomycetes, present in the range of 0.4–11% of the all community, represent a very heterogeneous group with a high phylogenetic diversity (uncultivated members of the classes *Planctomycetacia* and *Phycisphaerae*, and other deep branching lineages) and that there is a substantial potential for novel organism discovery in these deep ocean environments. Ivanova et al. (2018a) report on the diversity patterns of Planctomycetes associated with the freshwater macrophyte *Nuphar lutea* (L.) Smith. The high abundance of Planctomycetes associated with floating plant leaves suggest their involvement in the degradation of plant-derived organic matter. Planctomycetes are also increasingly interesting for their extended metabolic capabilities, related to the peculiar environments they live in. Ivanova et al. (2018b) report a metatranscriptomics analysis revealing the hydrolytic potential of peat-inhabiting Planctomycetes. Their analysis confirmed the specific response of *Gemmata*-related

O. M. Lage (✉)
Departamento de Biologia, Faculdade de Ciências,
Universidade do Porto, Rua do Campo Alegre s/n,
4169-007 Porto, Portugal
e-mail: olga.lage@fc.up.pt

D. P. Devos
Centro Andaluz de Biología del Desarrollo, CSIC, Junta de
Andalucía, Pablo de Olavide University, Carretera de
Utrera, Km. 1, 41013 Seville, Spain

Planctomycetes to chitin amendment, suggesting the presence of chitinolytic capabilities in these bacteria.

Members of the PVC superphylum are also of interest for their effects on our health, from the pathogenic *Chlamydiae* to the beneficial Verrucomicrobia *Akkermansia muciniphila*. Chia et al. (2018) report on the trophic interaction between *A. muciniphila* and the gut commensal *Anaerostipes caccae* using a metatranscriptomic approach. They showed an increased expression of mucolytic enzymes by *A. muciniphila* induced by the presence of the gut commensal. This could indicate the role of this Verrucomicrobium as a keystone species that supports the microbial community in the mucosal environment by increasing the availability of mucin sugars.

Finally, the adequacy of Planctomycetes as supplementary food source for *Daphnia magna* is explored by Marinho et al. (2018). On supplementing the conventional *Daphnia* diet, the microalga *Raphidocelis subcapitata*, with the planctomycete *Rhodopirellula rubra*, a decrease in the age of first reproduction, a significant increase in reproductive output, in somatic growth and in rate of population increase was found for the highest cell densities of bacteria tested. Moreover, *Daphnia* and offspring take on the planctomycetes' pink coloration. This study shows the importance of planctomycetes in *Daphnia* breeding and colour development, providing yet another exciting application of these wonderful bacteria.

We thank the authors of these papers for contributing their interesting work to this special section and thank again the delegates for participating in the

exciting 3rd meeting of the *Planctomycetes-Verrucomicrobia-Chlamydiae* superphylum research community—and we look forward to a 4th meeting.

Conflict of interest The authors declare that they have no conflict of interest.

References

- Chia LW, Hornung BVH, Aalvink S, Schaap PJ, de Vos WM, Knol J, Belzer C (2018) Deciphering the trophic interaction between *Akkermansia muciniphila* and the butyrogenic gut commensal *Anaerostipes caccae* using a metatranscriptomic approach. *Antonie Van Leeuwenhoek*. <https://doi.org/10.1007/s10482-018-1040-x>
- Ivanova AA, Philippov DA, Kulichevskaya IS, Dedysh SN (2018a) Distinct diversity patterns of Planctomycetes associated with the freshwater macrophyte *Nuphar lutea* (L.) Smith. *Antonie Van Leeuwenhoek*. <https://doi.org/10.1007/s10482-017-0986-4>
- Ivanova AA, Wegner CE, Kim Y, Liesack W, Dedysh SN (2018b) Metatranscriptomics reveals the hydrolytic potential of peat-inhabiting *Planctomycetes*. *Antonie Van Leeuwenhoek*. <https://doi.org/10.1007/s10482-017-0973-9>
- Marinho MC, Lage OM, Catita J, Antunes SC (2018) Adequacy of planctomycetes as supplementary food source for *Daphnia magna*. *Antonie Van Leeuwenhoek*. <https://doi.org/10.1007/s10482-017-0997-1>
- Rivas-Marín E, Devos DP (2018) The paradigms they are a-Changin': past, present and future of PVC bacteria research. *Antonie Van Leeuwenhoek*. <https://doi.org/10.1007/s10482-017-0962-z>
- Storesund JE, Lanzn A, Garca-Moyano A, Reysenbach A-L, vres L (2018) Diversity patterns and isolation of Planctomycetes associated with metalliferous deposits from hydrothermal vent fields along the Valu Fa Ridge (SW Pacific). *Antonie Van Leeuwenhoek*. <https://doi.org/10.1007/s10482-018-1026-8>