

Horia Leonard BANCIU

Habilitation thesis

Microbial physiology and diversity in extreme aquatic ecosystems

ABSTRACT

The author of the present habilitation thesis, **Horia Leonard Banciu** has conducted his scientific activity, professional and academic works in the field of **Microbiology**, beginning with the completion of Ph.D. thesis (2004) until present (2015). The habilitation thesis entitled **Microbial physiology and diversity in extreme aquatic ecosystems** presents original results derived from research performed in the last eleven years, most of the information being reported in research articles published in highly-ranked ISI journals and chapters in books edited at prestigious publishers.

The main part of this habilitation thesis consists of the chapter 2 that describes the most relevant scientific contributions and is ordered according to the following subfields: 1. Microbial physiology and 2. Microbial diversity.

The personal contributions in the subfield of **microbial physiology** were focused on the isolation and description of novel bacterial taxa in relation to their physiology and adaptive strategies to overcome adverse environmental conditions. The main achievements of this research were as follows:

- Isolation and taxonomic identification of a novel haloalkaliphilic sulfur-oxidizing bacterium from a soda lake;
- Physiological investigations of haloalkaliphilic, obligately chemolithoautotrophic sulfur-oxidizing bacteria that revealed pivotal differences between haloalkaliphilic and natronophilic ways of life;
- Bioinformatic analysis of relatedness among membrane transporters with vital roles in haloalkaliphilic adaptations;
- Description of a novel microaerobic, sulfur-oxidizing strain of *Magnetospirillum* sp. (strain J10) capable of autotrophic metabolism.

These findings obtained either as main author or as contributor were published in peer-reviewed journals under the form of research articles and in book chapters as:

- **Banciu HL**, Sorokin DY, Tourova TP, Galinski EA, Muntyan MS, Kuenen JG, Muyzer G (2008). Influence of salts and pH on growth and activity of a novel facultatively alkaliphilic, extremely salt-tolerant, obligately chemolithoautotrophic sulfur-oxidizing

Gammaproteobacterium *Thioalkalibacter halophilus* gen. nov., sp. nov. from South-Western Siberian soda lakes. *Extremophiles* **12** (3):391-404.

- Banciu HL, Sorokin DY (2013). Adaptation in haloalkaliphiles and natronophilic bacteria. In: *Polyextremophiles: Life Under Multiple Forms of Stress* (Seckbach J, Oren A, Stan-Lötter H., Eds.), Cellular Origin, Life in Extreme Habitats and Astrobiology 27, pp. 121–178, Springer Science+Business Media, Dordrecht. ISBN 978-94-007-6487-3.
- Geelhoed JS, Sorokin DY, Epping E, Tourova TP, **Banciu HL**, Muyzer G, Stams AJ, Van Loosdrecht MCM (2009). Microbial sulfide oxidation in the oxic-anoxic transition zone of freshwater sediment: involvement of lithoautotrophic *Magnetospirillum* strain J10. *FEMS Microbiol Ecol* **70** (1):54-65.

Microbial diversity was the second area of interest and author mainly explored the structure and composition of microbial communities in extreme aquatic environments both by culture-dependent (“traditional”) and culture-independent (molecular) approaches. The author’s main achievements in this field were as follows:

- Assessment of spatio-temporal distribution of archaeal communities in a perennially stratified salt lake in the Transylvanian Basin;
- Evaluation of culturable diversity of aerobic halophilic archaea (Fam. *Halobacteriaceae*) inhabiting meromictic Transylvanian salt lakes;
- Polyphasic analysis of physico-chemical stratification and taxonomic profiles of microbial communities in two hypersaline lakes;
- Characterization of microbial diversity of modern microbialites associated to a hot spring in NW Romania;

The main results obtained in the subfield of microbial diversity were published in the following research articles:

- Baricz A, Coman C, Andrei A-Ş, Muntean V, Keresztes ZG, Păusan M, Alexe M, **Banciu HL** (2014). Spatial and temporal distribution of archaeal diversity in meromictic, hypersaline Ocnei Lake (Transylvanian Basin, Romania). *Extremophiles* **18** (2):399-413.
- Baricz A, Cristea A, Muntean V, Teodosiu G, Andrei A-Ş, Molnár I, Alexe M, Rakosy-Tican E, **Banciu HL** (2015). Culturable diversity of aerobic halophilic archaea (Fam. *Halobacteriaceae*) from hypersaline, meromictic Transylvanian lakes. *Extremophiles* **19** (2):525-537.
- Andrei A-Ş, Robeson MS, Baricz A, Coman C, Muntean V, Ionescu A, Etiope G, Alexe M, Sicora CI, Podar M, **Banciu HL** (2015). Contrasting taxonomic stratification

of microbial communities in two hypersaline meromictic lakes. ISME J. DOI:10.1038/ismej.2015.60.

- Coman C, Chiriac CM, Robeson MS, Ionescu C, Dragoş N, Barbu-Tudoran L, Andrei A-Ş, **Banciu HL**, Sicora C, Podar M (2015). Structure, mineralogy and microbial diversity of geothermal spring microbialites associated with a deep oil drilling in Romania. *Front. Microbiol* **6**:253.

In the time interval between the defence of Ph.D. thesis (2004) and present (2015), the author wrote one book (**Biophysics**, authors: C. Tarba and H.L. Banciu, 2010) for students and professionals and three chapters in internationally edited books, one (**Adaptation in haloalkaliphiles and natronophilic bacteria**, H.L. Banciu and D.Y. Sorokin, 2013) as main author.

The teaching (academic) activity consisted of courses and laboratory activities of **Biophysics**, **Nucleic acid biochemistry and introduction to genomics**, **Energy metabolism**, **Protein biochemistry and introduction to proteomics**, **Modern Biochemistry and Biophysics Methods**, **Bionanotechnology**, **Cell Biology**, **General biochemistry** and **Cytology** for undergraduate and Master students. It is worth mentioning that the author's teaching competences are strongly supported by the following research achievements and skills: investigations on growth physiology and energetics (including doctoral research on bacterial growth parameters under continuous cultivation; doctoral and postdoctoral research on energetic challenges of life at high salinity and pH) support the competence to teach *Biophysics* and *Energy metabolism*; biochemical and biophysical investigations of cytochromes, fatty acids, compatible solutes (as main author) and of yellow pigments employed in salt-stress adaptation (as contributor) support the capability to teach general and different specialized *Biochemistry* courses alongside *Modern Biochemistry and Biophysics Methods*; exploration of molecular diversity of microbial communities in hypersaline lakes as well as employment of bioinformatic tools to reveal adaptive features of haloalkaliphiles (as main author) support the ability to teach *Nucleic acid biochemistry and introduction to genomic*, *Protein biochemistry and introduction to proteomics*.

Additionally, between 2004 and 2015, the author has been director of four research grants funded by Romanian National Authority for Scientific Research (CNCS–UEFIS-CDI) and collaborated as member in other six Romanian grants. In 2006, the author was awarded by Romanian National Authority for Scientific Research with “*In Hoc Signo Vinces*” prize.

The author's plans for future scientific development in the field of **Microbiology** will be focused on similar research directions with emphasis on exploring the microbial diversity of extreme environments found on Romanian territory and elsewhere by using a multifaceted

approach (classic or bacteriological, molecular, bioinformatics and ecological experimental methods).

In the field of teaching activity, the author intends to update the courses of **Biophysics, Nucleic acid biochemistry and introduction to genomics, Energy metabolism, Modern Biochemistry and Biophysics Methods** and **Cell Biology** with new scientific and applicative aspects. The author envisages the writing of an original book dealing with extremophilic microorganisms and their adaptive mechanisms by incorporating his own scientific results. An updated edition of Biophysics handbook and a volume (in collaboration) on general principles and applications of modern biophysical and biochemical methods for biology students are also planned to be written.