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Annex No. 10 to the MU Directive on Habilitation Procedures and Professor Appointment Procedures

HABILITATION THESIS REVIEWER'S REPORT

Masaryk University

Applicant	Mag. biol. M. biol. Dr. techn. Simon Karl-Maria Rasso Rittmann, Bakk. biol.
Habilitation thesis	Physiology and biotechnology of archaea
Reviewer	Prof Sonia Heaven BA BSc PhD CEng MICE MCIWEM MCIWM
Reviewer's home unit, institution	Water and Environmental Engineering Group, Faculty of Engineering and Physical Sciences, University of Southampton, United Kingdom

The habilitation thesis presented by Dr Simon Rittmann focuses on archaeal biology, with special emphasis on anaerobic and extremophilic micro-organisms and on the knowledge required for their potential biotechnological application.

The thesis is based on a selection of 12 research publications in high-quality peer-reviewed journals (all but one in Q1 or Q2). The publications are listed in the thesis and percentage values are assigned for the author's contribution to experimental work, supervision, manuscript preparation and research direction. Full texts for each publication are given in the appendices. On six of these publications, Dr Rittmann is the last author and responsible for 80-100% of the supervision and direction of the research.

From the publication list and the supporting materials provided, it is clear Dr Rittmann has an impressive track record of research funding and leadership, an extensive national and international collaboration network, and a strong commitment to the guidance and development of other researchers.

The thesis lays the groundwork for Dr Rittmann's stated ambitions for his future research of elucidating relationships between environmental factors, patterns of growth and productivity, genetic signatures and distinctive physiological features. It does so by providing a densely-packed review of relevant current knowledge on microbial extremophiles, anaerobes and archaea, with methanogens as a particular focus. It considers the development of biotechnology as a field, and the place of archaea within this. It comments on the availability of methods for genetic manipulation of archaeal organisms, seeing them as essential to the development of archaeal production platforms. Specific examples of this application include archaeal polyhydroxyalkanoate (PHA) production, lipid production and utilisation; and gaseous biofuel production including carbonic anhydrases for CO2 conversion.

Two chapters then present studies of amino acid excretion rates and comparative lipidonomics in thermophilic and hyperthermophilic methanogens, and of amino acid excretion by *Methanothermobacter marburgensis* in fed-batch cultivation mode. The work identifies knowledge gaps and proposes future actions to fill them.

Overall I consider that this thesis represents an outstanding body of original work, linking fundamental aspects of microbial growth, substrate uptake and production kinetics with an understanding of the requisites for translation to full-scale biotechnological development and application.

Reviewer's questions for the habilitation thesis defence (number of questions up to the reviewer)

(i) Apart from the challenges of cultivation, what are the main reasons accounting for the fact that archaea in general and extremophiles in particular are so under-studied?

(ii) Given the extent to which these groups are under-explored, what is a sensible balance in terms of the input of research effort and scientific resources between genetic manipulation of known species on the one hand, and bioprospecting for new organisms / characterisation and cultivation of those not yet fully described?

(iii) In view of the metabolic capabilities of methanogenic archaea, and in some cases their relatively low growth rates, which pathways are likely to be most promising for future development to commercial scale and why?

(iv) As noted in the thesis, PLA production has attracted interest for many years but is still not a commercial reality. What

(v) Based on the extensive metabolic capabilities of extremophile microorganisms (and taking note of the fascinating work on microbial-meteorite redox interactions), which environments in our solar system appear most promising for extraterrestrial life?

(vi) The halophilic archaeon Haloquadratum walsbyii is notable for its unusual shape. What combination of physiological, metabolic, environmental and other factors might account for this?

Conclusion

The habilitation thesis entitled “Physiology and biotechnology of archaea” by Simon Karl-Maria Rasso Rittmann **fulfils** requirements expected of a habilitation thesis in the field of Microbiology.

Date: 31 August 2025 Signature: