



**HAL**  
open science

## Diving into bacterial dormancy: emergence of osmotically stable wall-less forms in an aquatic environment

Filipe Carvalho, Alexis Carreaux, Anna Sartori-Rupp, Stéphane Tachon, Anastasia D Gazi, Pascal Courtin, Pierre Nicolas, Florence Dubois-Brissonnet, Aurélien Barbotin, Emma Desgranges, et al.

### ► To cite this version:

Filipe Carvalho, Alexis Carreaux, Anna Sartori-Rupp, Stéphane Tachon, Anastasia D Gazi, et al.. Diving into bacterial dormancy: emergence of osmotically stable wall-less forms in an aquatic environment. 21st International Symposium on Problems of Listeria and Listeriosis (ISOPOL), Sep 2024, Norwich, United Kingdom. hal-04697876

**HAL Id: hal-04697876**

**<https://hal.science/hal-04697876v1>**

Submitted on 14 Sep 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License

# Diving into bacterial dormancy: emergence of osmotically stable wall-less forms in an aquatic environment

Filipe Carvalho<sup>1</sup>, Alexis Carreaux<sup>1</sup>, Anna Sartori-Rupp<sup>2</sup>, Stéphane Tachon<sup>2</sup>, Anastasia D. Gazi<sup>3</sup>, Pascal Courtin<sup>1</sup>, Pierre Nicolas<sup>4</sup>, Florence Dubois-Brissonnet<sup>1</sup>, Aurélien Barbotin<sup>1</sup>, Emma Desgranges<sup>1</sup>, Matthieu Bertrand<sup>1</sup>, Karine Gloux<sup>1</sup>, Catherine Schouler<sup>5</sup>, Rut Carballido-López<sup>1</sup>, Marie-Pierre Chapot-Chartier<sup>1</sup>, Eliane Milohanic<sup>1</sup>, Hélène Bierne<sup>1</sup>, Alessandro Pagliuso<sup>1</sup>

<sup>1</sup>INRAE, Université Paris-Saclay, AgroParisTech, Institut MICALIS, 78350 Jouy-en-Josas, France; <sup>2</sup>NanoImaging Core Facility, Institut Pasteur, 75015 Paris, France;

<sup>3</sup>Ultrastructural Bioimaging Facility, Institut Pasteur, 75015 Paris, France; <sup>4</sup>INRAE, Université Paris-Saclay, MalAGE, 78350 Jouy-en-Josas, France; <sup>5</sup>INRAE, Université de Tours, ISP, 37380 Nouzilly, France

## Context

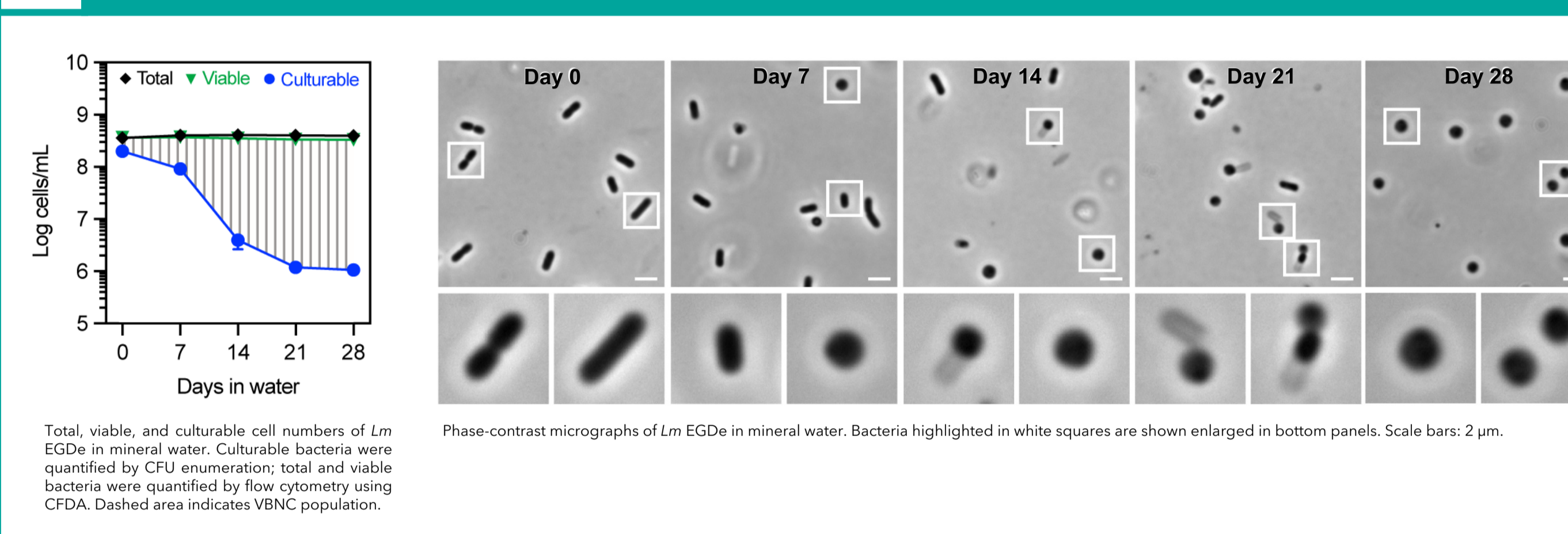
- Under environmental stress, bacteria may enter a state of dormancy called **viable but non-culturable (VBNC)** because, as a result of a generalized metabolic slowdown, cells lose their ability to grow in standard culture media.
- In the case of bacterial pathogens, the VBNC state poses an increased public health risk, as bacteria are **undetectable by conventional growth-based tests** and, given the right conditions, **can revert back to a vegetative and virulent state**.
- Although the VBNC state is widespread among bacteria (>100 species reported so far), the mechanisms governing this phenotypic switch remain poorly understood.

## Aim

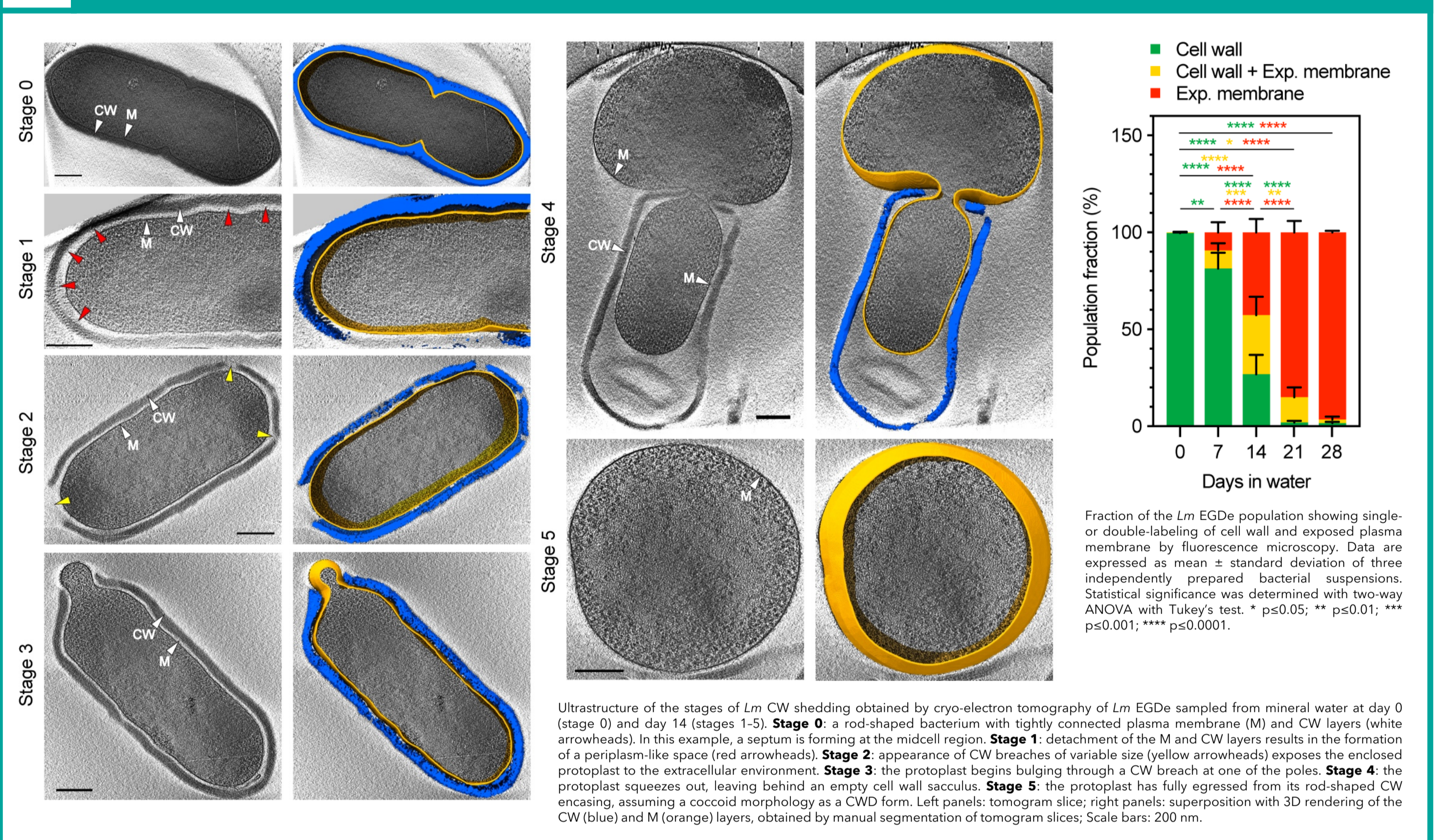
In-depth characterization of the physiological processes and molecular mechanisms and factors implicated in the formation, maintenance, and reversal of the VBNC state in the human foodborne pathogen *Listeria monocytogenes*

## Results

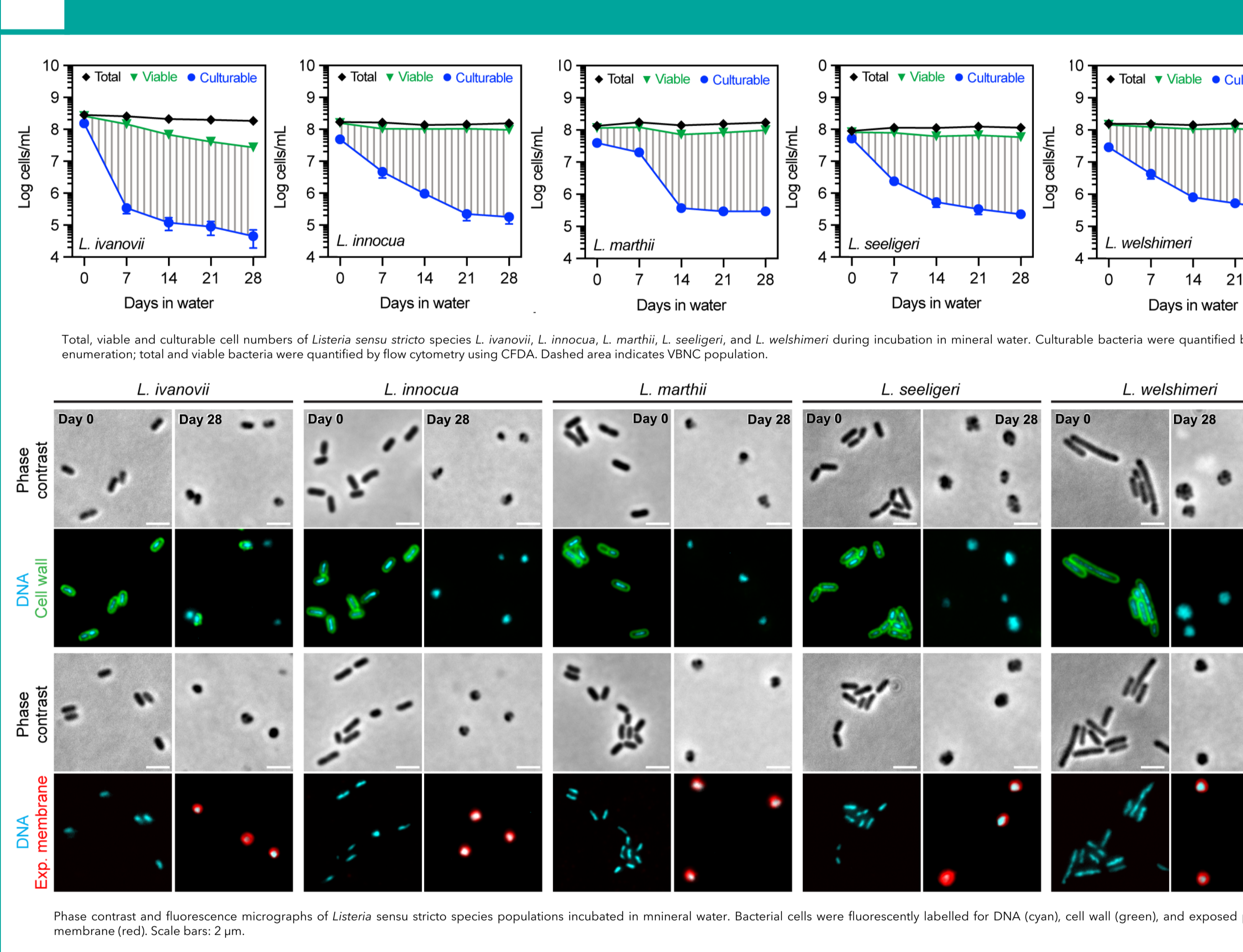
### 1 *L. monocytogenes* undergoes a rod-to-coccus shape shift during transition to a VBNC state in mineral water



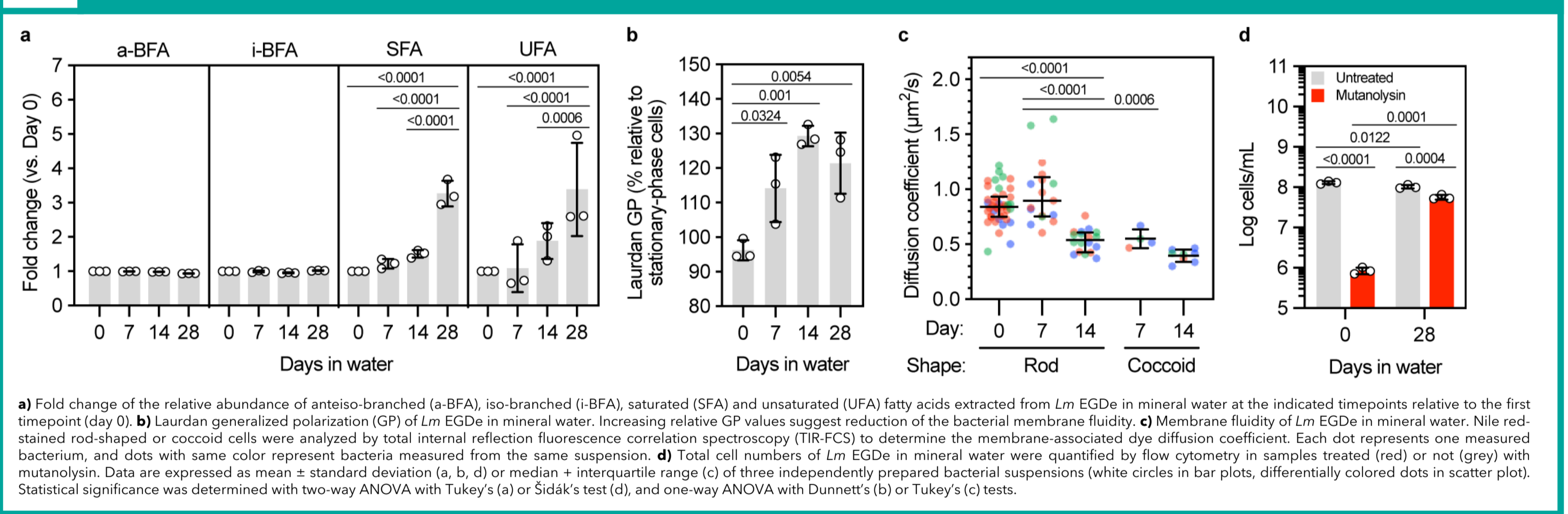
### 2 This morphological transformation is caused by a complete loss of the bacterial cell wall via a molting-like shedding process



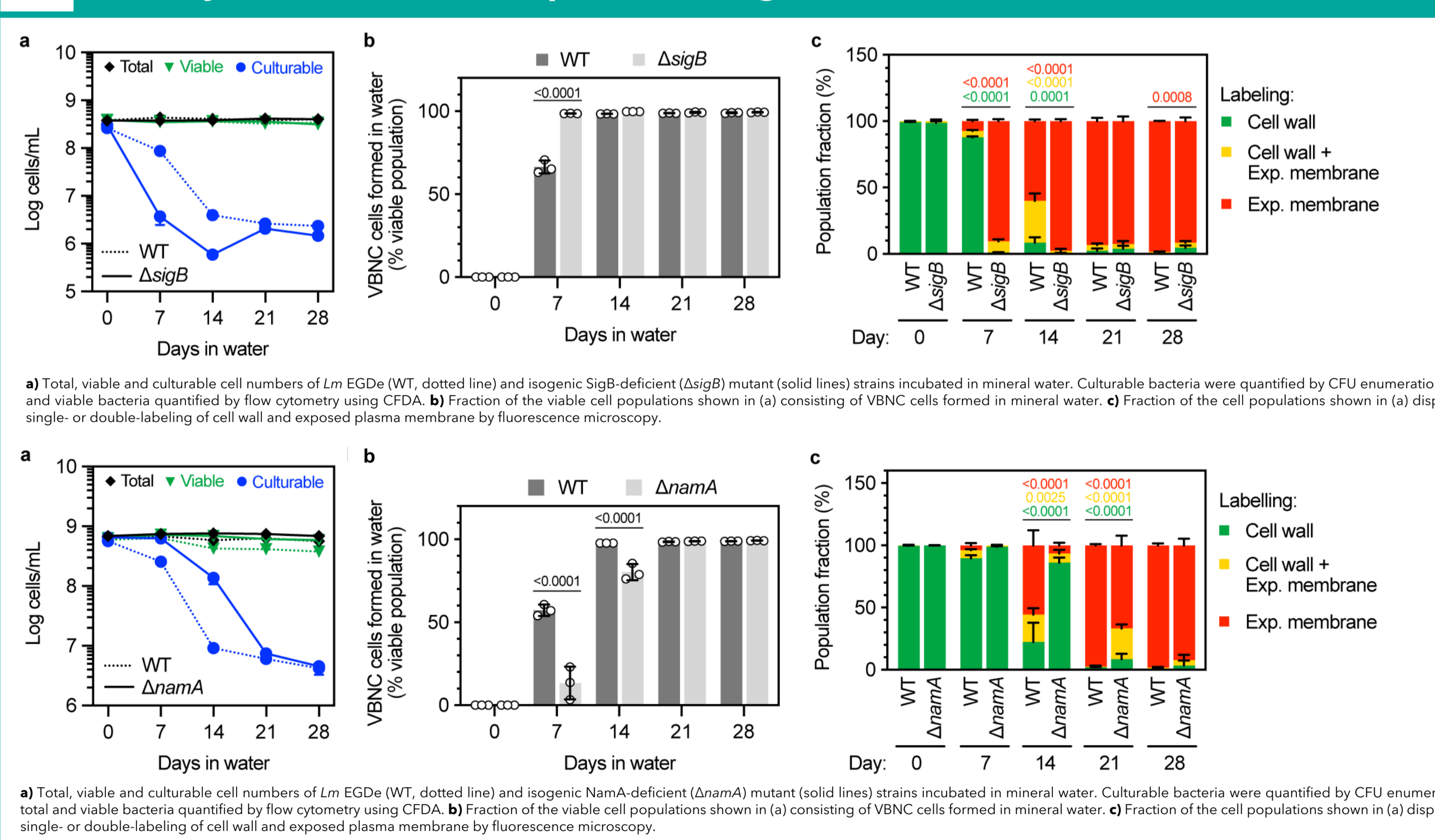
### 3 A cell wall-deficient VBNC state is widespread in *Listeria* species



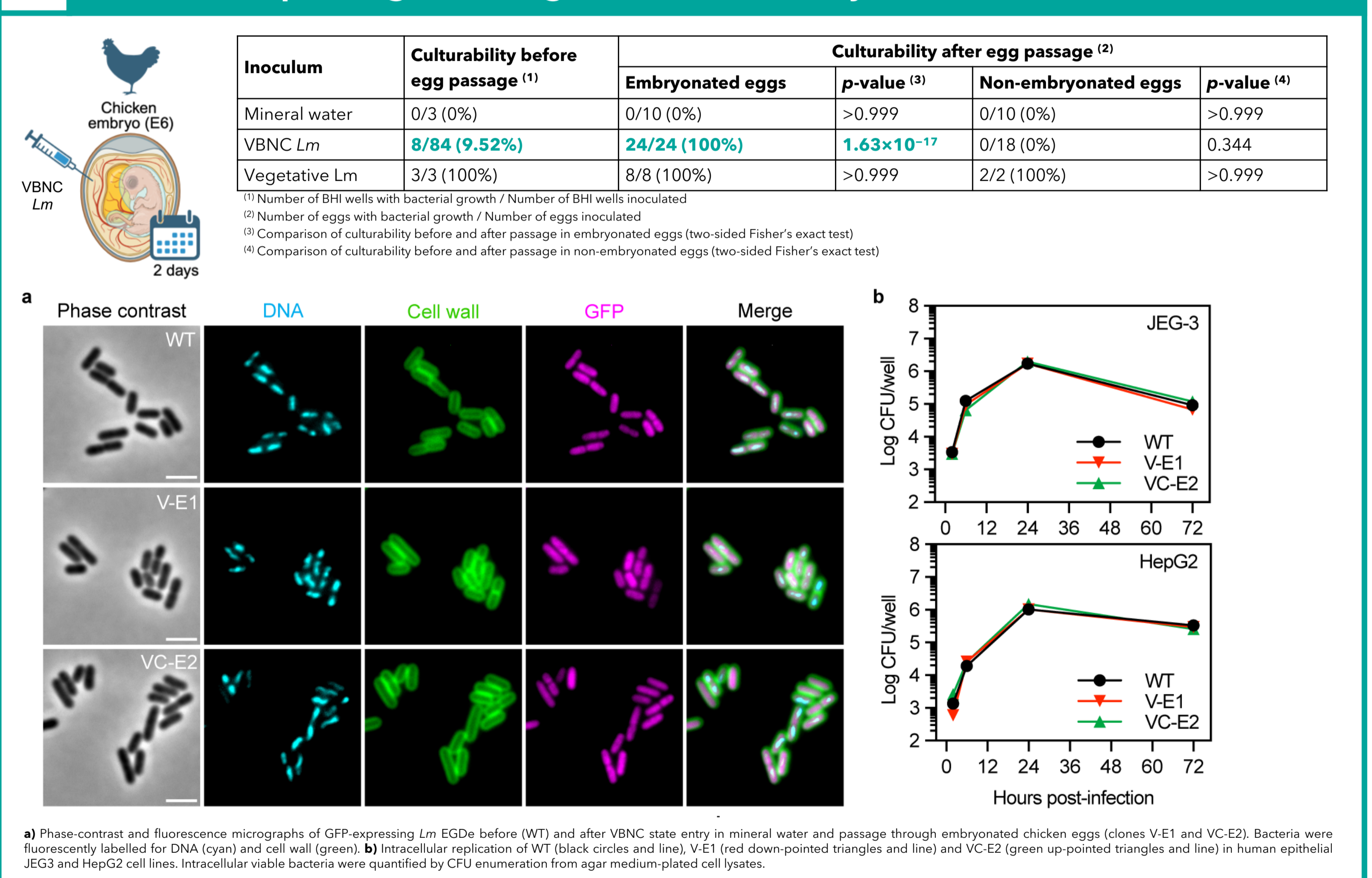
### 4 *L. monocytogenes* adjusts its plasma membrane properties to adapt to a cell wall-deficient lifestyle in mineral water



### 5 Global and targeted genetic approaches reveal SigB and the autolysin NamA as important regulators of VBNC state transition



### 6 VBNC *L. monocytogenes* reverts back to a culturable and virulent form after passage through chicken embryos



## Conclusions

- This study provides **new evidence on molecular mechanisms and factors governing the VBNC state transition of a major Gram-positive foodborne pathogen**:
  - Cell wall loss is required** for *Listeria monocytogenes* (and other *Listeria* species) to enter a VBNC state upon starvation in mineral water.
  - Stress response** (through transcriptional regulator **SigB**) and **cell wall turnover** (through the autolysin **NamA**) processes are key drivers of VBNC state formation.
- Our findings show that **cell wall-deficient bacteria can arise naturally in non-osmoprotective aquatic environments**, which may constitute a potential strategy for bacterial survival in hypoosmotic and oligotrophic conditions.