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

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Context

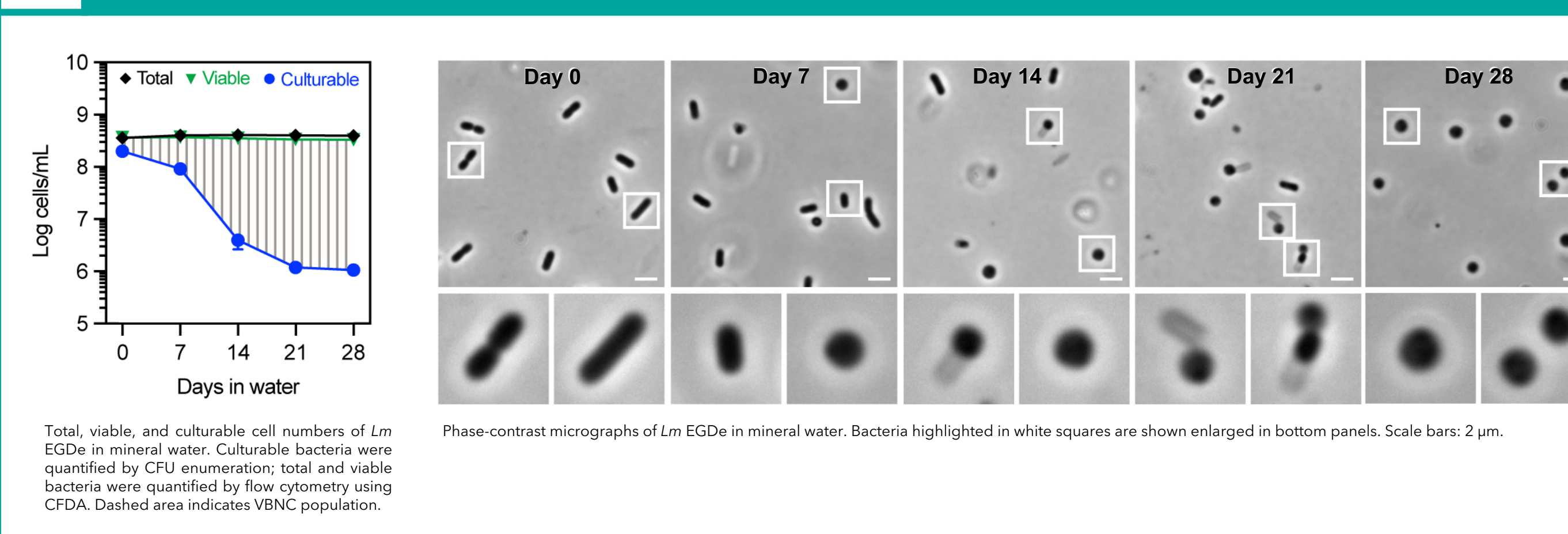
- Under environmental stress, bacteria may enter a state of dormancy called **viable but non-culturable (VBNC)** because, as a result of a generalized metabolic slowdown, cells lose their ability to grow in standard culture media.
- In the case of bacterial pathogens, the VBNC state poses an increased 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

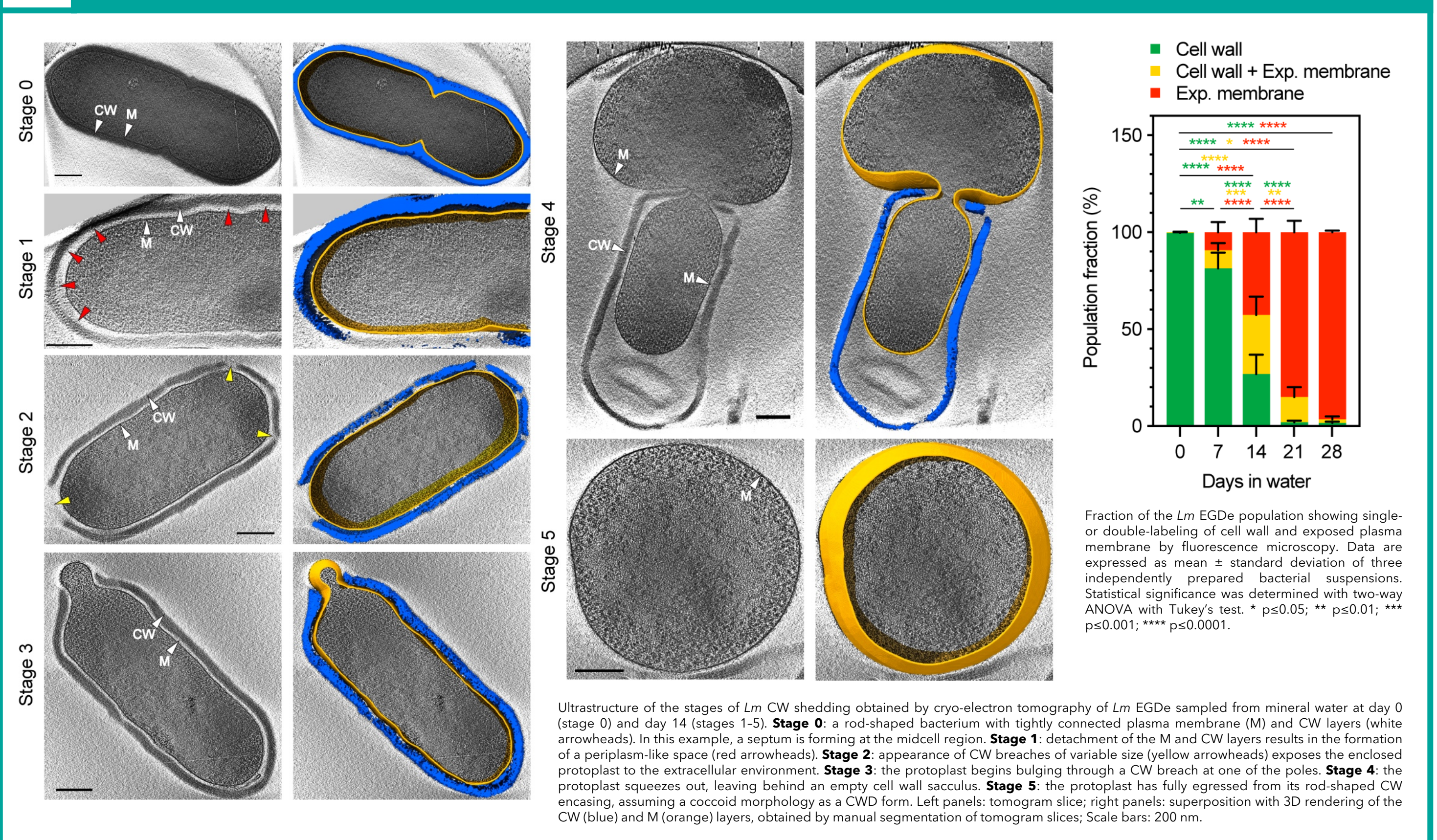
In-depth characterization of the physiological processes and molecular mechanisms and factors implicated in the formation, maintenance, and reversal of the VBNC state in the human foodborne pathogen *Listeria monocytogenes*

Results

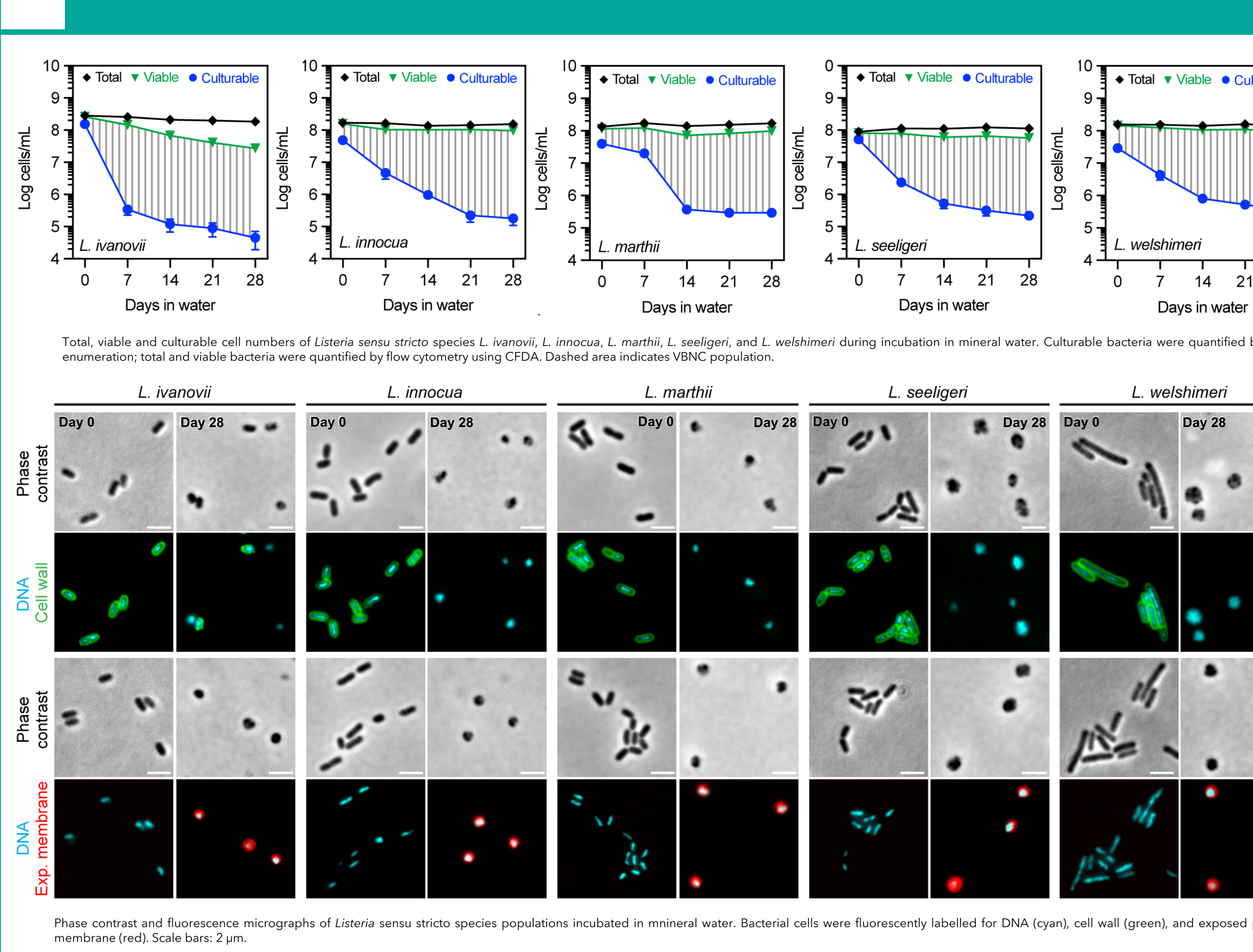
1 *L. monocytogenes* undergoes a rod-to-coccus shape shift during transition to a VBNC state in mineral water



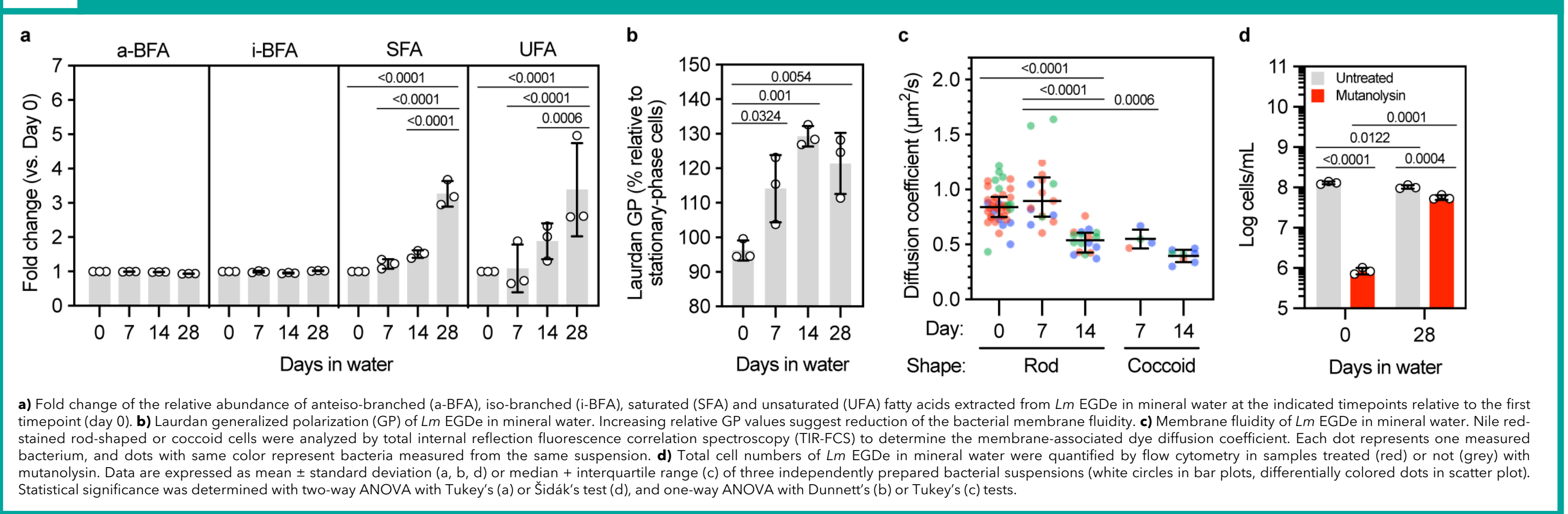
2 This morphological transformation is caused by a complete loss of the bacterial cell wall via a molting-like shedding process



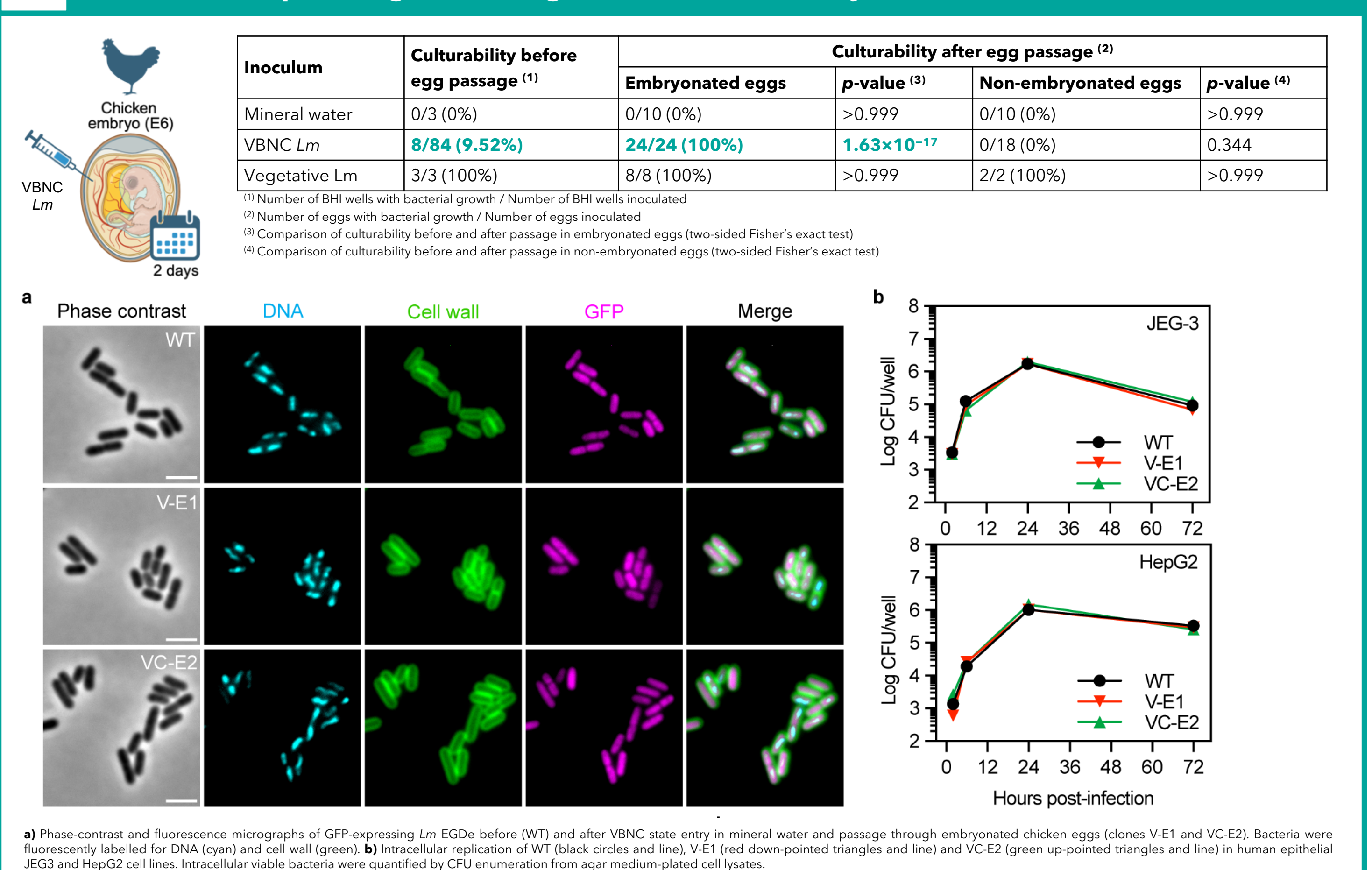
3 A cell wall-deficient VBNC state is widespread in *Listeria* species



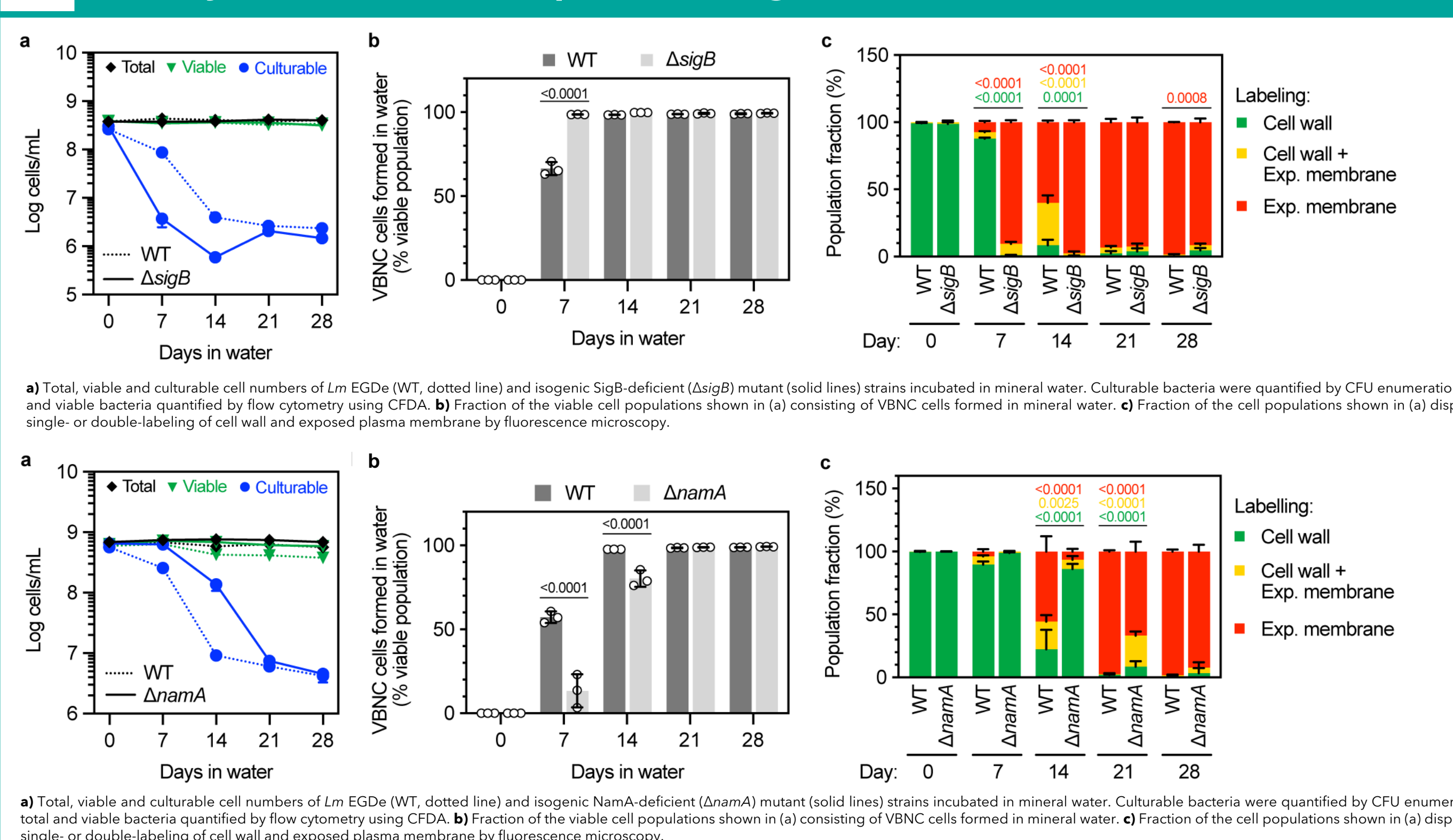
4 *L. monocytogenes* adjusts its plasma membrane properties to adapt to a cell wall-deficient lifestyle in mineral water



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



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



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.