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## Interactions between *Ulva* spp. and its cultivable epiphytic bacteria

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## Interactions between *Ulva* spp. and its cultivable epiphytic bacteria

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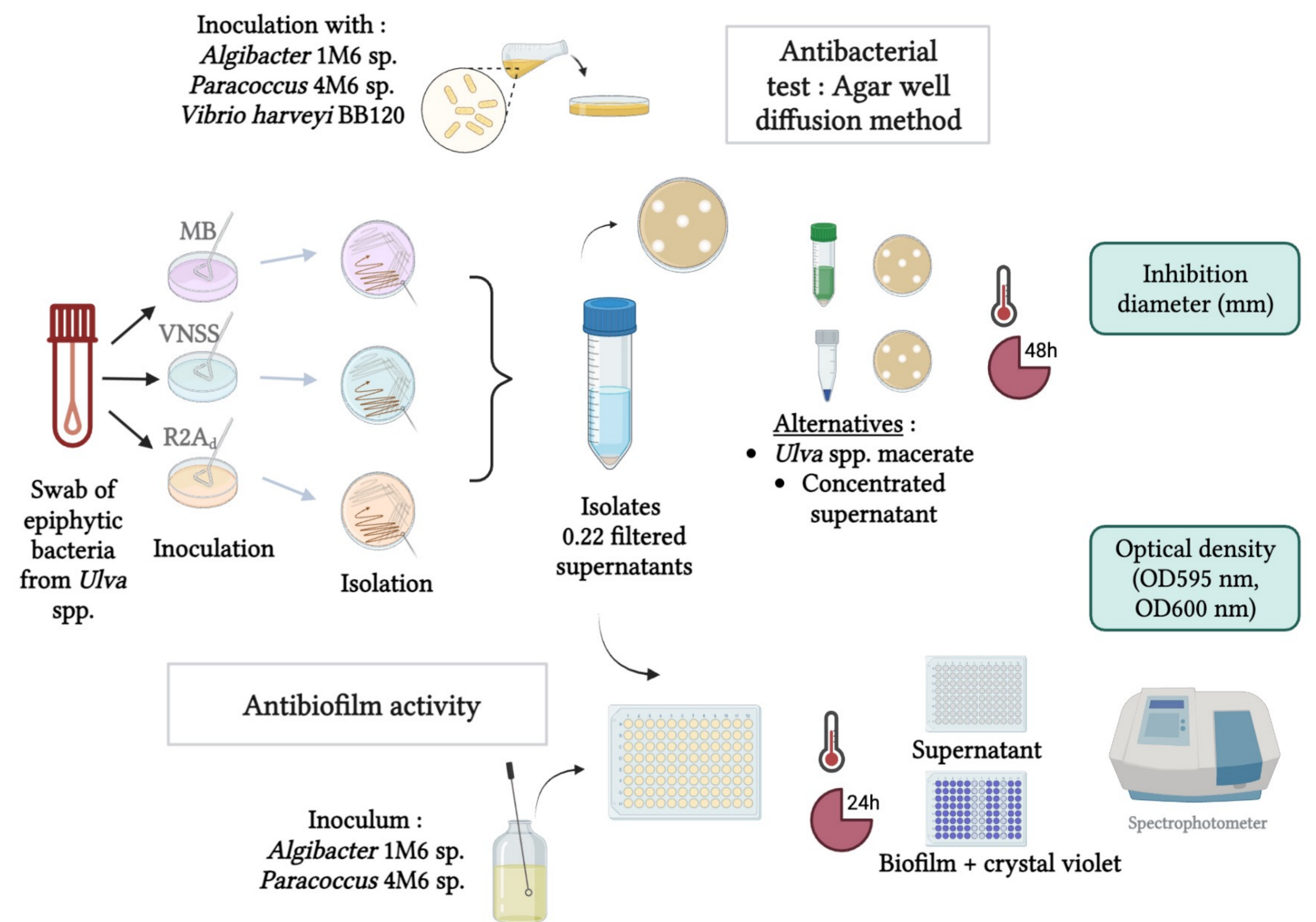
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Macroalgae harbor a rich and diverse epiphytic microbiota that plays a crucial role in their growth, development, and defense mechanisms<sup>[1]</sup>. The *Ulva* genus, known for causing algal blooms and environmental problems, may also have significant biotechnological potential<sup>[2][3]</sup>. This study proposes to investigate the biotechnological potential of the epiphytic cultivable microbiota of *Ulva* spp. collected in south Brittany, with different culture media to assess a broader diversity of cultivable microbiota.



*Ulva* spp. were collected in southern Finistère in December 2021. Macroalgae were molecularly identified and were affiliated to three distinct species (*U. australis*, *U. rigida*, *U. lacunculata*).

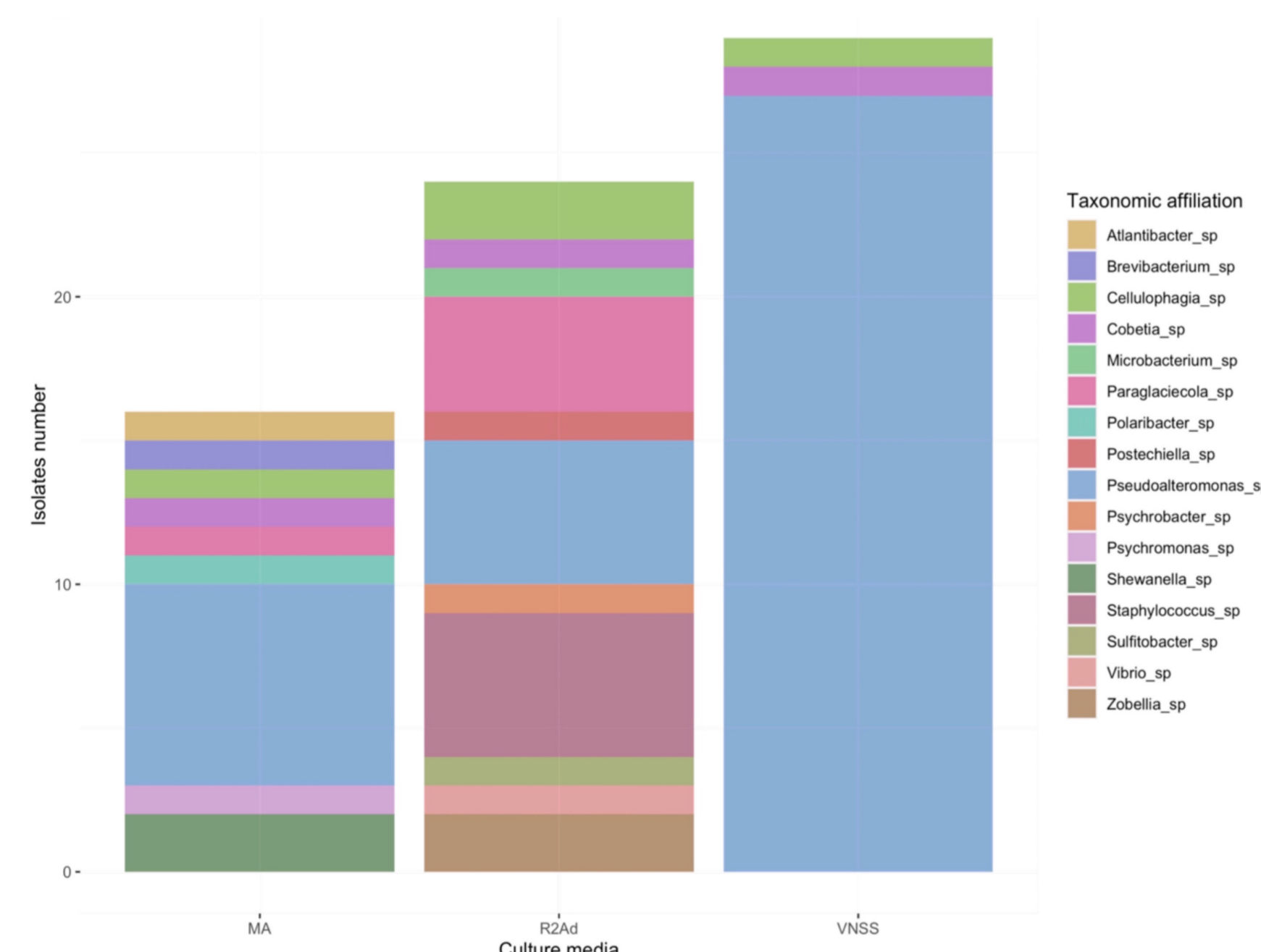


## Cultivable diversity

69 isolates were identified and screened for their biological activities. A large majority (91%) were Gram negative mostly affiliated to *Grammaproteobacteria* (77%), *Flavobacteriia* and *Alpha proteobacteria* in a lesser extent. Gram positive included *Actinomycetes* and *Bacilli* class.

Differences were notified according to the culture media. Bacterial concentration was higher with the MA medium but the bacterial diversity was higher with the R2Ad medium (11 genera).

VNSS proved to be particularly suitable for the culture of *Pseudoalteromonas* as it constituted the large majority of cultivated genera.

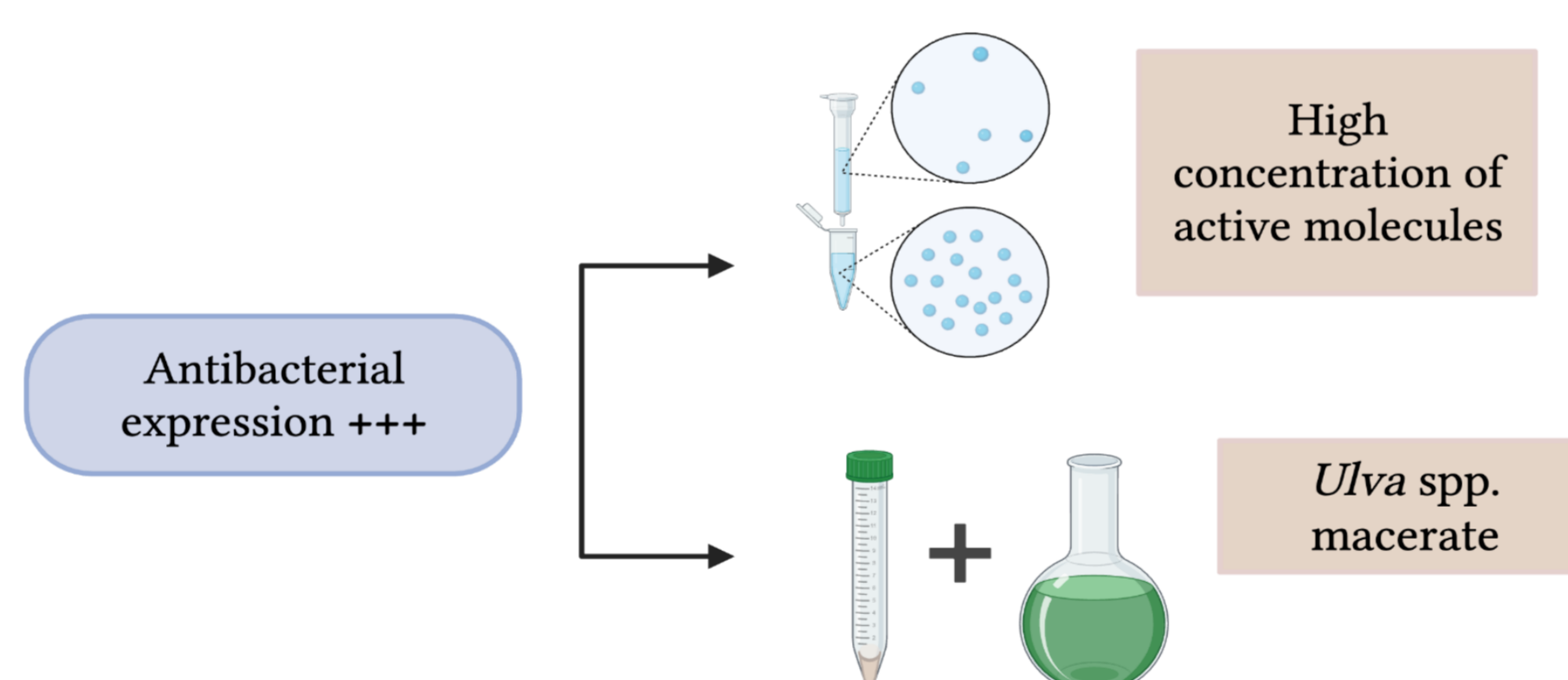


Bacterial communities associated with *Ulva* spp. grown on three different media: MA (Marine agar), VNSS (Väätänen Nine Salt Solution agar), R2Ad (Reasoner and Geldreich, 1/20 diluted).

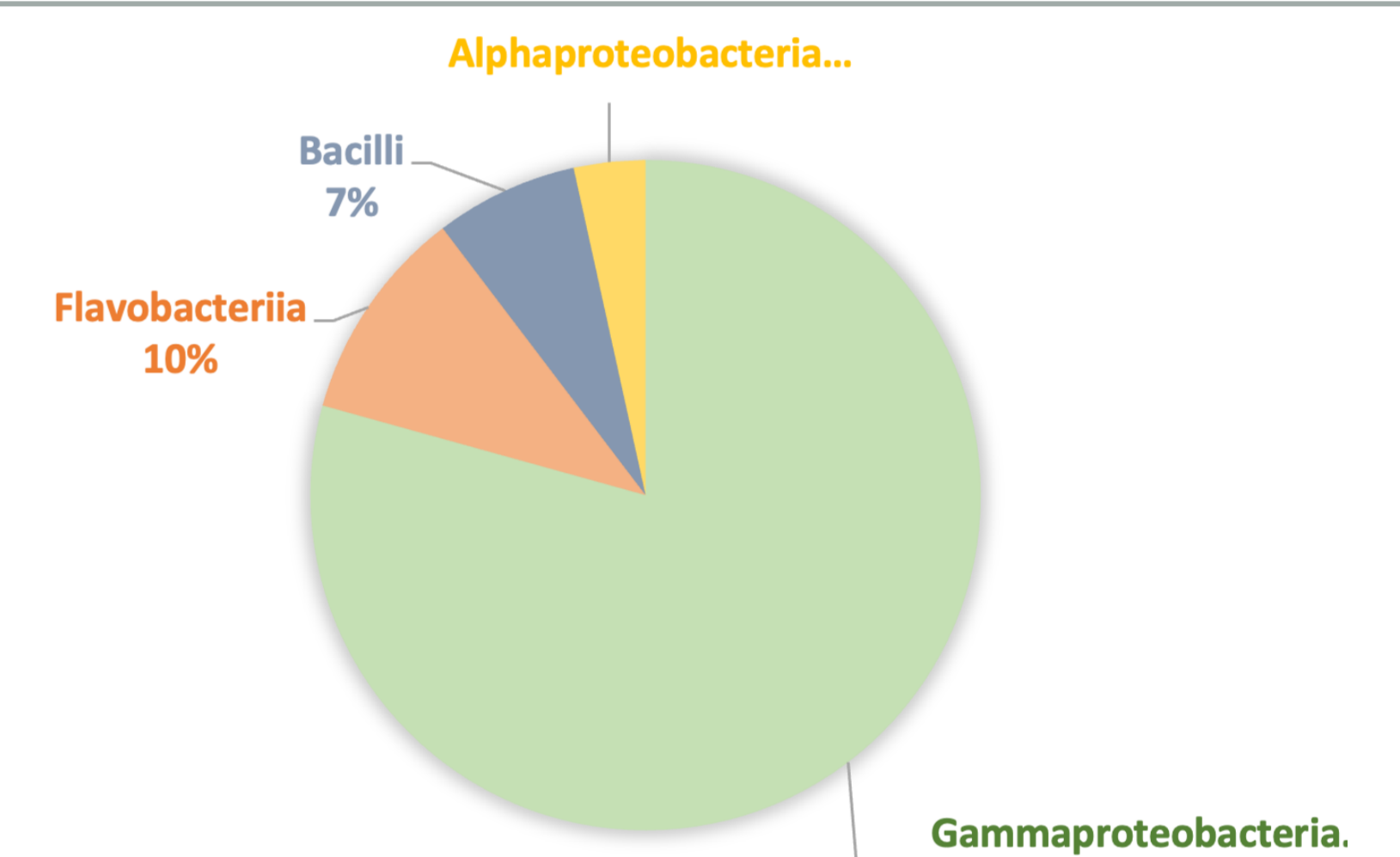
## Evaluation of biological activities

31 isolates possessed antibacterial activities against the three target-bacteria tested. Among those, one third was found to have agarolytic properties and half was pigmented.

Antibacterial activities also depended on culture medium: 54 % of isolates from R2Ad medium exhibited antibacterial activities and only 21% for VNSS.



Other parameters were also involved in the antibacterial activities of the *Ulva* spp. isolates. For instance, the yellow-pigmented *Pseudoalteromonas* VNSS-42 only expressed antibacterial activity when in contact with *Ulva* spp. macerate.

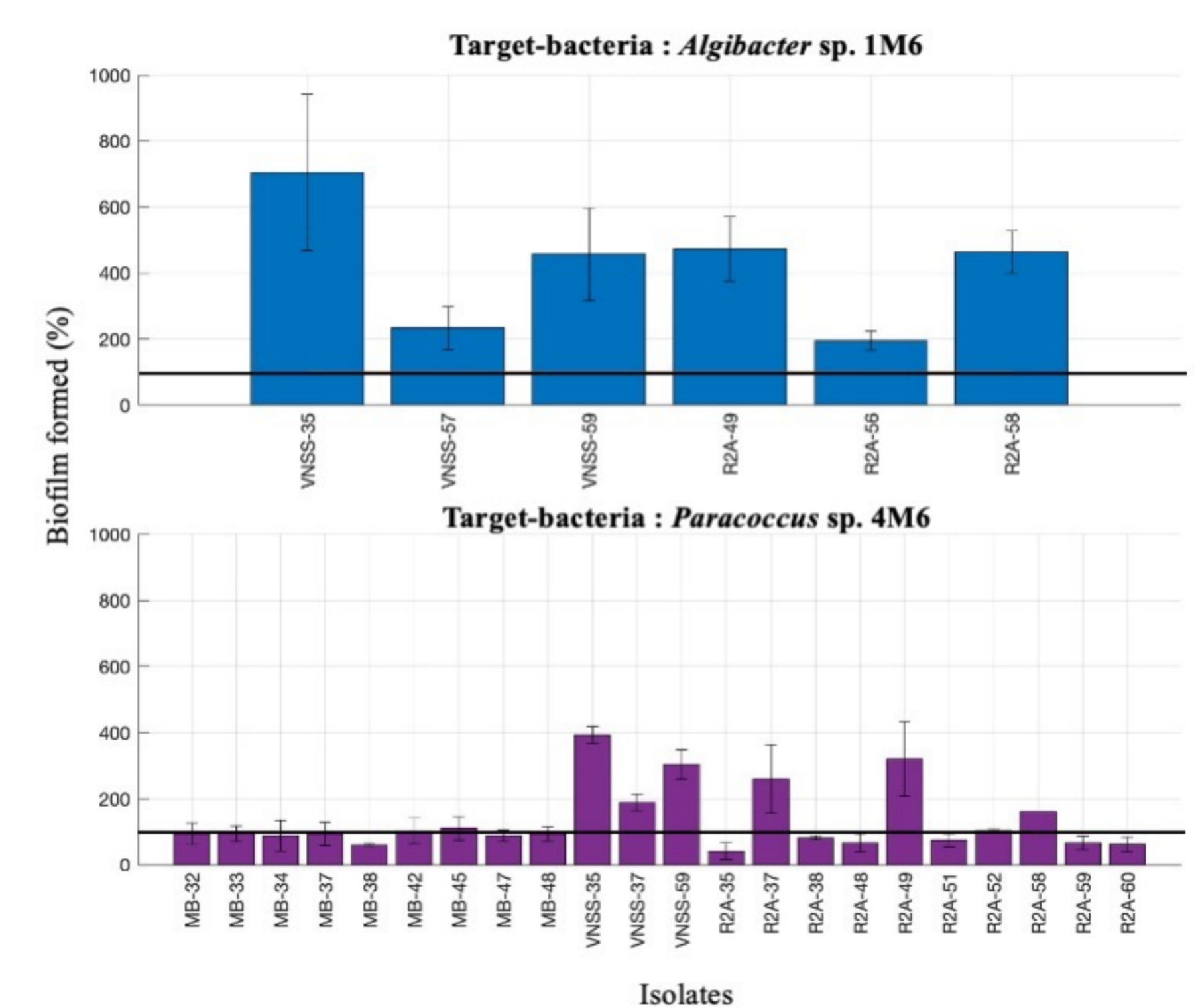


28 isolates possessed biofilm modulation properties on the biofilm formed by *Algibacter* 1M6 sp. and *Paracoccus* 4M6 sp..

Withing those isolates, 48% possessed antibiofilm properties and belonged to *Gammaproteobacteria*, *Flavobacteriia* and *Bacilli*.

Isolates with probiofilm effects mostly belonged to *Gammaproteobacteria* (80%).

Some of *Ulva* spp. isolates could be of biotechnological interest: a *Pseudoalteromonas* sp. VNSS-35 which possessed a very strong probiofilm effect and a *Paraglaciicola* sp. MB-38 showing antibiofilm effect up to 50% of inhibition without antibacterial activity.



Effect of supernatants on biofilm formation (%). Only significant differences as compared to the positive controls are represented (anova, p < 0.05)

## Discussion & perspectives

- High cultivable diversity enhanced by the use of several culture media
- Large proportion of *Ulva* spp. isolates with antibacterial (45%) and/or biofilm modulation properties (40%)
- Antibacterial effect was influenced by molecules concentration within supernatants and contact with algal components
- Macroalgal surfaces constitute bioactive molecules reservoir whose antibacterial and antifouling potential may be explored through bacteria culture-based approaches

[1] Alsufyani, T., Califano, G., Deicke, M., Grueneberg, J., Weiss, A., Engelen, A. H., ... & Wichard, T. (2020). Macroalgal–bacterial interactions: identification and role of thalassin in morphogenesis of the seaweed *Ulva* (Chlorophyta). *Journal of experimental botany*, 71(11), 3340–3349.

[2] Louis, J., Ballu, S., Rossi, N., Perrot, T., Daniel, C., Cellier, L., ... & Richier, S. (2023). Multi-Year Renewal of Green Tides: 18 Years of Algal Mat Monitoring (2003–2020) on French Coastline (Brittany Region). Available at SSRN 4412789.

[3] Lian, J., Wijffels, R. H., Smidt, H., & Sijkema, D. (2018). The effect of the algal microbiome on industrial production of microalgae. *Microbial biotechnology*, 11(5), 806–818.