ECOLOGICAL ADAPTATIONS AND FUNCTIONAL ROLES OF ANTARCTIC ENDOPHYTIC BACTERIA WITHIN THEIR PLANT HOSTS

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Deschampsia antarctica Desv. (Poaceae) and *Colobantus quitensis* (Kunth) Bartl. (Caryophyllaceae) are the only two vascular plants that have colonized the Antarctic continent, which is usually exposed to extreme environmental conditions. Endophytic bacteria residing within plant tissues can exhibit diverse adaptations that contribute to their ecological success and potential benefits for their plant hosts.

We aimed to characterize 12 endophytic bacterial strains associated with Antarctic vascular plants describing their ecological adaptations and functional roles including plant growth-promoting activity, nutritional strategies and environmental tolerance to varying pH and salt levels.

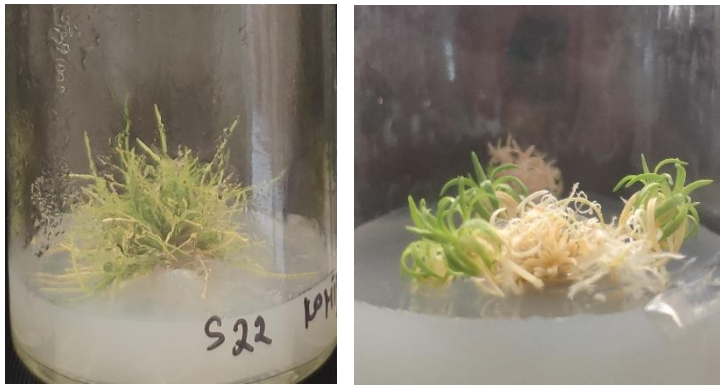
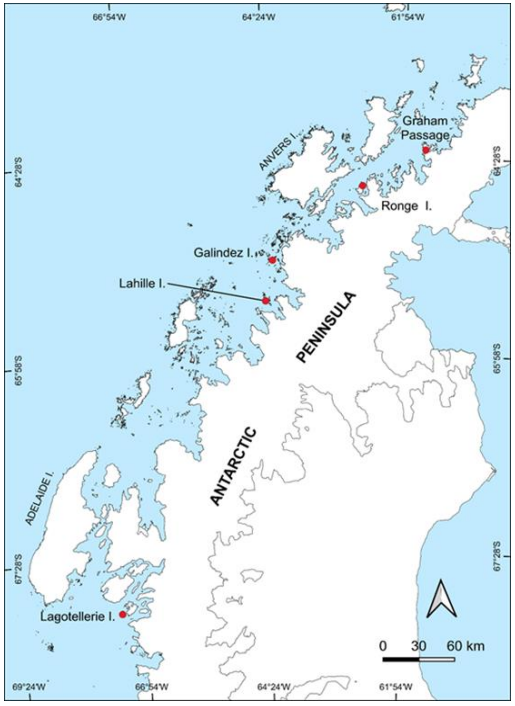
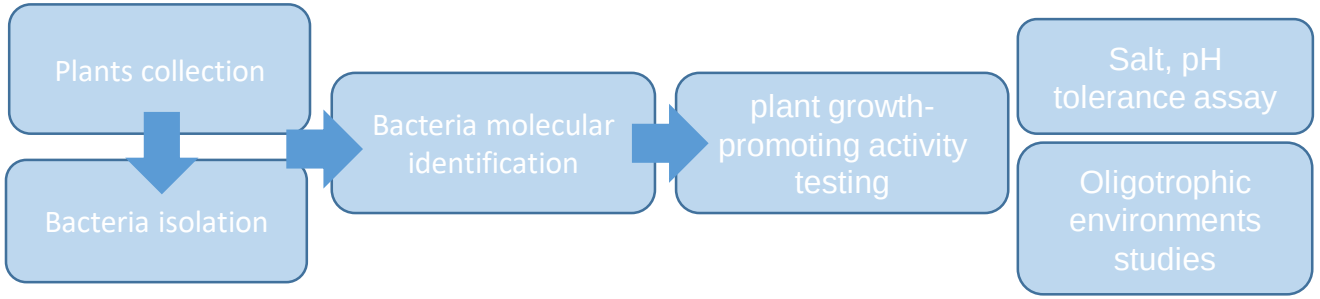


Figure 1. *D.antarctica* (left), *C.quitensis* (right)



Materials and methods. Endophytic bacterial cultures were isolated from the inner part of roots and leaves of *D.antarctica* and *C.quitensis* sampled during the 25th Ukrainian Antarctic Expedition (January-April 2020) and identified by the 16S rRNA molecular approach and followed phylogenetic analysis using GenBank database and Blast software.

As plant growth-promoting activity Nitrogen-fixing activity, biosurfactants, siderophores, HCN, ammonia and indol-3-acetic acid production as well as phosphates solubilization were studied. Environmental tolerance to varying pH (3-11) and salt levels (3%-25%) were tested in NB medium at 20ºC as well as ability to thrive in oligotrophic environments.



Results. With the present study, **new species** have been identified as possible inhabitants of the endosphere of *D. antarctica* and *C. quitensis*, i.e. *Hafnia* sp. and *Agreia* sp. (Fig.2)

Ecological adaptations. All studied strains were highly adaptive to environmental changes like pH and salt concentrations (Fig.3). The majority of studied strains could be characterized as slightly to moderate halotolerant bacteria. However, Pseudomonas and Psychrobacter strains were sensitive to increased salt concentrations. Interestingly, 2 strains – *Pseudoarthrobacter* sp.26_7 and *Kocuria salsitica* 40_1 – were characterized as truly halotolerant and oligotrophic(Fig. 3,4).

Plant-growth promoting traits

Strain number	Species name	Growth on NF media	Phosphates solubilization index (PSI)	BSFs	Motility	IAA (μg/mL)	HCN
9.1	*Siminovitchia terrae*	-	1.35±0.02	-	+	-	-
10.1	*Pseudomonas salomonii*	10^6	2.0±0.01	+	+	-	-
10.4	*Psychrobacter arcticus*	10^4	3.23±0.52	+	-	-	-
15.6	*Arthrobacter psychrochitiniphilus*	5×10^5	1.53±0.26	-	+	35.7±3.0	-
16.7	*Arthrobacter psychrochitiniphilus*	-	-	-	+	-	-
23.2	*Agreia* sp.	-	-	-	+	-	-
24.4	*Pseudomonas yamanorum*	10^6	3.11±0.81	+	+	-	+
25.2	*Hafnia* sp.	10^8	3.03±0.28	+	+	544.0±7.0	+
26.2	*Pseudomonas* sp.	10^8	2.71±0.51	+	+	46.1±2.0	-
26.7	*Pseudarthrobacter* sp.	10^6	2.57±0.79	+	-	-	-
39.12	*Brachybacterium* sp.	10^3	2.75±0.34	+	-	-	-
40.1	*Kocuria salsicia*	5×10^5	1.55±0.27	+	-	21.3±2.0	-

Acknowledgements. This research was funded by National Antarctic Scientific Center of Ukraine (State Special-Purpose Research Program in Antarctica for 2011–2025), research grant 0121U112259 in 2021 as well as PhD program 2022-2026 of Natural Sciences Faculty of Vytautas Magnus University.

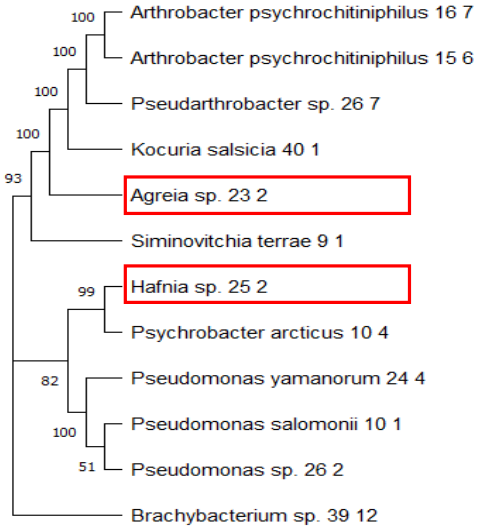


Figure 2. Phylogenic tree of endophytes

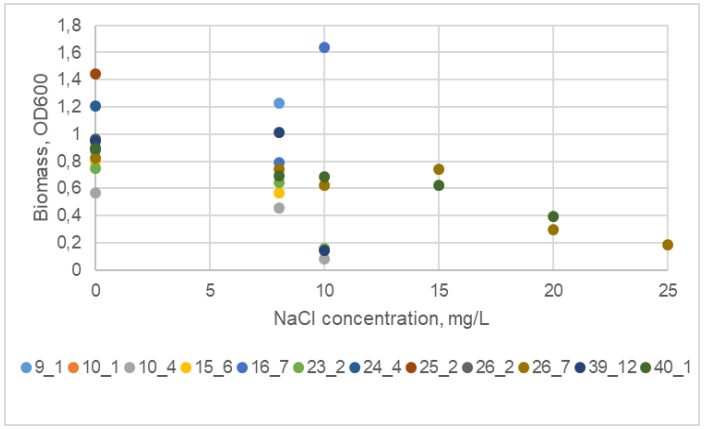


Figure 3. Halophilic(-tolerant) environments studies

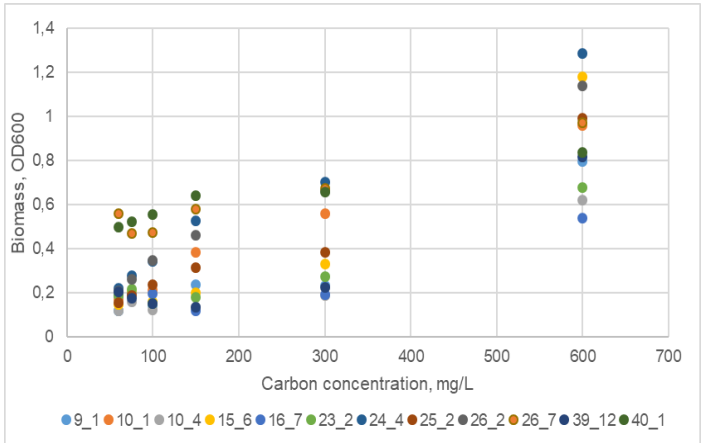


Figure 4. Oligotrophic environments studies

Most bacteria were able to use atmospheric N2 as a source of nitrogen (at least for their own growth) and may be able to provide the host plant with an extra source as well. Additionally, all studied bacteria were able to produce ammonia which could also be used as a nitrogen supplement for plant growth. bacteria were able to produce ammonia which could also be used as a nitrogen supplement for plant growth. Besides, bacteria can enhance plant nutrient uptake by solubilizing immobilized phosphates. Less frequent was the trait to produce IAA, which was observed only in four strains, and HCN production – only in two.

Conclusions. Overall, this study highlights the functional diversity of Antarctic endophytic bacteria and offers hypotheses on how these bacteria assist their plant hosts' growth and resilience in extreme environments.