Evidence For The Priming Effect In Single Strain And Simplified Communities Of Estuarine Bacteria

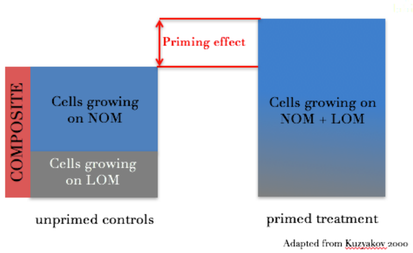
Abigail Edwards, Lauren N. M. Quigley, and Alison Buchan
University of Tennessee Department of Microbiology

Abstract

Through their transformation of naturally occurring organic matter, coastal marine bacteria play an essential role in carbon cycling. A phenomenon termed the priming effect (PE) occurs when microbial communities remineralize recalcitrant organic matter faster in the presence of labile organic matter and may be prevalent in coastal systems. To understand how microbial community members interact to induce PE, it is essential to first understand the mechanisms underlying PE in single strains and simplified bacterial communities. The effect to which different concentrations and sources of labile carbon stimulated the production of bacterial biomass from riverine organic matter by two marine bacteria *Sagittula stellata* E-37 and *Citreicella* sp. SE45, and a six-member, artificial community of marine bacteria that included these two strains was examined. Both strains were primed with 400µM-C acetate and 400µM-C casamino acids; however E-37 was primed with 40µM-C casamino acids, while SE45 was primed with 400µM-C tryptone. The community was primed by 400µM-C tryptone and 400µM-C coumarate. These data indicate that the magnitude and nature of PE is species-specific within the estuarine microbial community. Learning how community members contribute to a PE response will lead to a more holistic and mechanistic understanding of PE and, thereby, carbon cycling.

Priming Effect

Measuring priming



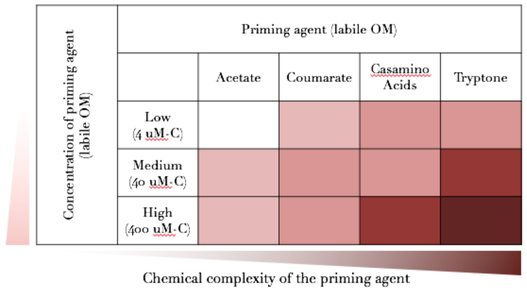
Priming enables bacteria to breakdown and utilize recalcitrant substrates in the presence of labile carbon sources. The increase in available carbon leads to increased biomass and respiration. Measuring these changes allows observation of the priming effect.

Methods

Ring-cleaving pathways	*Citreicella* sp. SE45	*Phaeobacter* sp. Y4I	*Roseovarius nubinhibens* ISM	*Sagittula stellata* E-37	*Sulfitobacter* sp. EE-36	*Sulfitobacter* sp. NAS-14.1
β-ketoadipate	Yes	Yes	Yes	Yes	Yes	Yes
Gentisate	Yes	X	X	Yes	X	X
Benzoate	X	X	X	Yes	X	X
Phenylacetic acid	Yes	Yes	X	Yes	Yes	Yes
Homoprotocatechuate	X	Yes	X	Yes	X	X
Homogentisate	Yes	Yes	X	Yes	X	X

Genome comparisons reveal differences in catabolic potential.

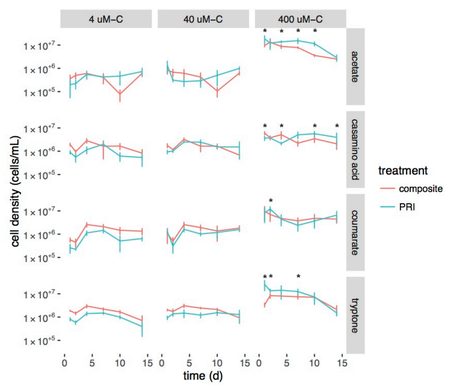
Changes in biomass were measured through viable counts. Four labile carbon sources (LOM) were used. Priming treatments (PRI) contained both LOM and 2 mM recalcitrant Suwannee river natural organic matter (NOM).



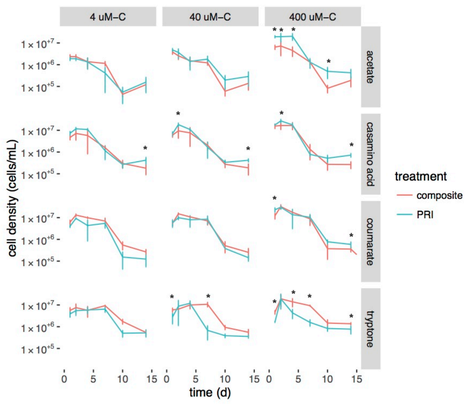
Results

Single Strain Experiments

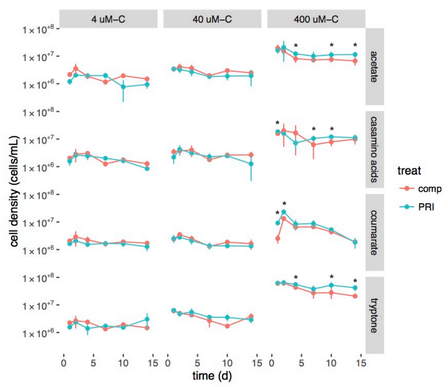
SE45



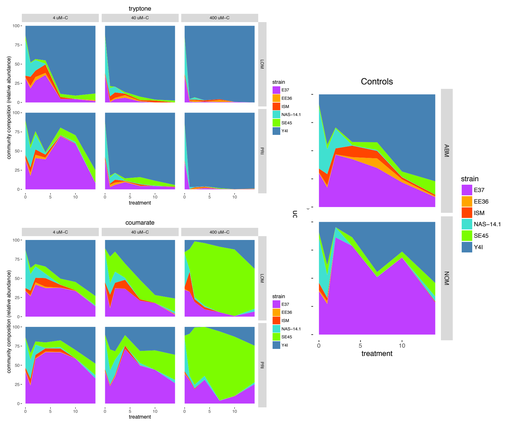
E-37



Intentional Community Experiment



Community Composition

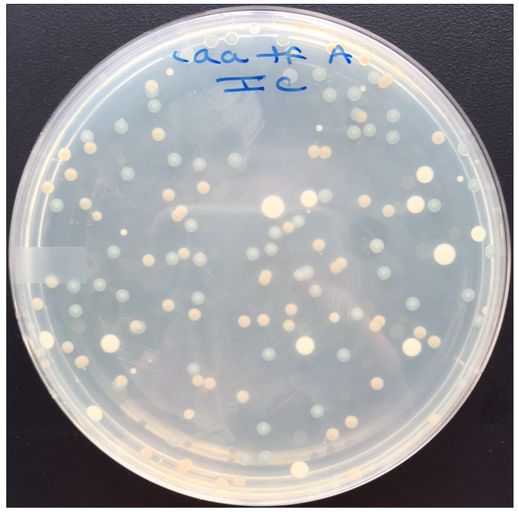


Conclusions

- The priming effects had the greatest magnitude at the highest concentration of LOM
- Priming observed in the presence of acetate had the greatest longevity
- Community diversity decreased in the priming and LOM treatments with increasing concentration of LOM and passage of time
- Community composition was dependent upon carbon source

Future Questions

- Will strains with fewer aromatic catabolizing pathways, such as ISM and EE36, exhibit the priming effect in single strain experiments?
- How is the priming effect presented in terms of respiration in treatments that showed evidence for priming measured by biomass production?
- What are the differences in specific enzyme activity when Roseobacters are placed in NOM versus priming conditions?



This work was supported by NSF grant OCE-1357242.