**Abstract**

Microbial consortia are common in nature and offer a broad variety of new applications in synthetic biology due to their ability to perform more complicated tasks than monocultures. From wastewater treatment to the assistance in food digestion and synthesis of complex biological compounds, engineering microbial consortia facilitates processes of great importance to humans [1]. When using genetically engineered microbes in a mixed culture, one of the members could become dominant. An unbalanced consortium may have unfavorable effects on the whole biotechnological process [2]. Here we constructed a model system for a self-regulating synthetic microbial consortium of two Escherichia coli strains based on a cross-inducible antibiotic resistance.

We engineered genetic devices to enable the growth of two different E. coli strains in a consortium by exploiting components of the quorum sensing systems las and rhl of Pseudomonas aeruginosa.

**Quorum Sensing**

Bacteria can coordinate community-wide behavior by the exchange of small molecules (e.g., homoserine lactones) within or between single populations. Various cell density-dependent events like biofilm formation [3] or the expression of virulence factors [4] are based on this phenomenon called quorum sensing (QS). Having an immediate regulatory effect on transcription level signal molecules of QS systems can be exploited in synthetic biology.

**Applications**

Microbial consortia are able to perform more complex tasks than monocultures [5]. This can be used in the production and composition of biofuels [6] as well as in wastewater treatment [7]. Additionally, it has been shown that lignocellulosic biomass is more efficiently degraded in a consortium than in monocultures [8]. However, no mechanism to efficiently control these complex systems has been established yet. With our system we contribute a universal and widely applicable system for bacterial co-cultivation in order to expand the potential of synthetic biology to more complex tasks.

**Unit 1: Reporter**

Constitutive expression of the chromoproteins eforRed (left) and aelBlue (right) enables distinction of the two strains with the naked eye.

**Unit 2: Inducible Ampicillin Resistance**

Expression of β-lactamase is induced by an active complex of the transcription factor LasR or RhlR and the corresponding inducer. The inducible ampicillin resistance creates a dependency of the two complementing strains in the E. teamwork system.

**Unit 3: Inducer Synthase and Inactive Transcription Activator**

The acyl homoserine lactone synthase (lasR or rhl) produces and secretes inducers into the surrounding medium triggering ampicillin resistance in the other strain. The constitutively expressed inactive transcription factor (lasR or rhl) forms an active complex with its corresponding inducer and enables the β-lactamase expression.

**References**