Evolution and Engineering in Escherichia coli

Synthetic biology (synbio) is a chance for our societies to advance from oil-dependent to bio-based production, with the help of microbes. The two pillars of synbio are fundamental biological knowledge and applied engineering. In the present thesis, these two aspects of synbio are explored, and their connections described. First, the different definitions and features of synbio are covered, after which two individual research projects are reported. Evolution is the basis for all life on Earth, and we are constantly learning more about its mechanisms. This thesis describes important elements of evolutionary theory, and in particular the controversy surrounding the theory of adaptive mutagenesis. Furthermore, experimental results showing how adaptive mutation is strongly associated with transcription are reported. When constructing cell factories, display of proteins on the cell surface by using the cell machinery is an attractive technology. This thesis includes the report of a new bacterial surface display platform that makes use of green fluorescent protein and nanobodies for easy detection and evaluation of surface presentation. While representing the two pillars of synthetic biology, the two research projects presented also illustrate how every synbio venture contains features of fundamental as well as applied science. With fundamental studies inspiring new engineering efforts, and application development enabling further study of basic biology, it is clear how synbio is created in the overlap between the two.

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