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Student: Weinberger Viktoria

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Characterization of cell surface structures of two major methanogenic archaea of the human gut

Viktoria Weinberger; Torben Kühnast; Tejus Shinde; Alexander Mahnert; Christine Moissl-Eichinger

Archaea, particularly Methanobrevibacter species, comprise more than 1% of the gastrointestinal microbiome but remain largely unexplored. These archaea are capable of producing methane (hence they are called methanogens) and interact widely with their environment as they can support bacterial fermentation and trigger immunogenic responses. To gain a better understanding of these archaeal residents and their interactive potential, we are performing detailed molecular and genome-based cell wall characterizations of Methanobrevibacter smithii "ALI", M. smithii "strain 2", and Candidatus M. intestini. Specifically, we are analyzing the capacity of the archaea to form extracellular vesicles and surface adhesins, for communication and attachment purposes, respectively. For that, we use a combination of genomics, proteomics and structural analyses (electron microscopy). In the genome-centric approach, the genomes of the above mentioned three Methanobrevibacter strains were analyzed with respect to the presence of adhesins. All strains contained a different number and composition of adhesin-related genes (four genes in M.smithii "ali", 22 genes in M. smithii "strain 2", and 24 genes in Candidatus M. intestini). Alignments were performed to identify the common adhesin gene clusters of the archaeal strains and to test whether they are inherently existing. Further, adhesin protein structures on the surface of the analyzed archaeal strains could indeed be visualized and identified in in a proteomics approach. Further, we were successful to isolate methanoarchaeal extracellular vesicles, a trait that had not been described for human-derived archaeal isolates so far. For a better characterization of the archaeal vesicles, multiomics analysis (Sequencing, Proteo-, Lipid-, and Metabolomics) are currently being performed. Our work is part of a detailed characterization of the human archaeome and provides the basis for further research on the immune system.