Microorganisms are small organisms, which we can not see with the naked eye. However, they have specific and surprising powers. Furthermore, there are numerous protein molecules in the microbial cells. We focus on finding, clarification, and application of superior microbial systems. These research subjects are carried out by molecular biology (functional analysis of genes and enzymes/proteins), cell biology (electron and fluorescence microscopy), structural biology (X-ray crystallography), and synthetic biology (metabolite and gene-expression analysis) including omics biology (genomics, transcriptomics, proteomics, metabolomics). Our aim is to shed light on these powers for future microbiology.

**Omics biology**

We have determined the genomic sequence of probiotics (*Enterococcus* sp.) degrading host animal extracellular matrix from normal flora. Through genomics, proteomics, and metagenomics, we are analyzing the bacterial mechanism for colonization in humans. Furthermore, we are investigating the microbial mechanism of interaction with plants by molecular and cellular biological approaches.

**Structural biology**

We are pursuing studies in structural biology, namely, studying the structure-function relationship of various protein molecules by X-ray crystallography. We focus on physiologically significant kinases, and polysaccharide-related enzymes/transporters which are important to utilize the various unutilized polysaccharides. Our target is to improve the function of protein molecules.

**Future biology: super-microbes producing biofuels and biopolymers**

Based on the studies mentioned above, we have been attempting to establish the promising technology for our future life. We have succeeded in creating the “super-microbes”, which have large capacity to produce ethanol from marine biomass or biopolymers from waste materials.
Keywords

Bacteria, yeast, super-microbe, cellular biology, molecular biology, structural biology, synthetic biology, genomics, transcriptomics, proteomics, metagenomics, metabolomics, microbiome, X-ray crystallography, polysaccharide, transporter, lyase, kinase, biofuel, bioplastic, interaction with animals and plants, future biology

Recent Publications

A solute-binding protein in the closed conformation induces ATP hydrolysis in a bacterial ABC transporter involved in the import of alginate
J. Biol. Chem., 292:15681-15690

Binding mode of metal ions to the bacterial iron import protein EfeO

Crucial role of 4-deoxy-L-erythro-5-hexoseulose uronate reductase for alginate utilization revealed by adaptive evolution in engineered Saccharomyces cerevisiae
Sci. Rep., Article number: 4206

A bacterial ABC transporter enables import of mammalian host glycosaminoglycans
Sci. Rep., Article number: 1069

Extremely high intracellular concentration of glucose-6-phosphate and NAD(H) in Deinococcus radiodurans
Yamashiro T, Murata K, Kawai S (2017)
Extremophiles, 21:399-407

Lateral-typed flagellin responsible for formation of a polar flagellum but not of lateral flagella in Sphingomonas sp. strain A1
Microbiology, 162:2042-2052

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Microbiology, 161:1552-1560

Production of pyruvate from mannitol by mannitol-assimilating pyruvate decarboxylase-negative Saccharomyces cerevisiae.
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Structural insights into alginate binding by bacterial cell-surface protein
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Significance of Ser-188 in human mitochondrial NAD kinase as determined by phosphomimetic and phosphoresistant amino-acid substitutions

Acquisition of the ability to assimilate mannitol by Saccharomyces cerevisiae through dysfunction of the general corepressor Tup1–Cyc8
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Metabolic fate of unsaturated glucuronic/iduronic acids from glycosaminoglycans: Molecular identification and structure determination of streptococcal isomerase and dehydrogenase
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