

Chair Applied Microbiology

2.3.8 Laboratory : Microbial Biotechnology

Member:	Professor	Sakai, Yasuyoshi, Dr. Agric. Sci.
	Associate Professor	Yurimoto, Hiroya, Dr. (Agric. Sci.)
	Assistant Professor	Masahide Oku, Dr. (Agric. Sci.)
	Doctor's program	7
	Master's Program	10
	Undergraduate	4
	Other	1
	Post-Doctoral fellow	1
	Program-Specific Researcher	1

A. Research Activities (2010.4-2011.3)

A-1. Main Subjects

a) Molecular and cellular biology for efficient production of heterologous proteins

We have developed the field of “C1 fermentation”, in which methanol is used as the raw material for microbial cultivation and chemical synthesis. We have noticed methylotrophs that grow on C1 compounds as a useful biocatalyst and a protein production system. In our studies, a new heterologous gene expression system using the methylotrophic yeast has been established. This is widely noticed as a system for production of various eucaryotic proteins.

b) Development of novel metabolic functions of microbes

For the application of the heterologous gene expression system and the metabolic function of the methylotrophic yeast, many genes that participate in methanol metabolism were cloned and we tried to clarify the metabolic pathway at the molecular level. We have found the genes encoding formaldehyde fixation pathway, which has been well characterized in methylotrophic bacteria, in nonmethylotrophic bacteria and archaea. We study on the physiological role and its application of these enzymes. We focus on methane, methanol, and short-chain alkanes as the future natural resources, and clarify the cellular and metabolic function of microorganisms, which utilize these resources, from the aspect of biochemistry, molecular biology and intracellular structure.

c) Development of technology to monitor intracellular redox potential

It has been recognized that reactive oxygen species (ROS) attack various biomolecules resulting in aging and many diseases. For the prevention of diseases and control of aging, evaluation and control of oxidative stress in vivo may become essential. However, it has been difficult to monitor oxidative stress in a living cell and in real time. We have developed a new molecular probe that can detect intracellular oxidative stress non-invasively using methylotrophic yeasts and mammalian cells as model cells.

A-2.Publications and presentations

a) Publications

Original Papers(including book-reviews)

- Sasano, Y., H. Yurimoto, M. Kuriyama and Y. Sakai: Trm2p-dependent derepression is essential for methanol-specific gene activation in the methylotrophic yeast *Candida boidinii*. *FEMS Yeast Res* 10; 535-544, 2010

- Nakagawa, T., S. Fujimura, T. Ito, Y. Matsufujii, S. Ozawa, T. Miyaji, J. Nakagawa, N. Tomizuka, H. Yurimoto, Y. Sakai and T. Hayakawa: Molecular characterization of two genes with high similarity to the dihydroxyacetone synthase gene in the methylotrophic yeast *Pichia methanolica*. *Biosci Biotechnol Biochem* 74; 1491-1493, 2010

- Nakagawa, T., K. Yoshida, A. Takeuchi, T. Ito, S. Fujimura, Y. Matsufujii, N. Tomizuka, H. Yurimoto, Y. Sakai, and T. Hayakawa: Peroxisomal catalase gene in the methylotrophic yeast *Pichia methanolica*. *Biosci Biotechnol Biochem* 74; 1733-1735, 2010

- Yano, T., M. Oku, N. Akeyama, A. Itoyama, H. Yurimoto, S. Kuge, Y. Fujiki and Y. Sakai: A novel fluorescent sensor protein for visualization of redox states in the cytoplasm and in peroxisomes. *Mol Cell Biol* 30; 3758-376, 2010

- Song, Z., I. Orita, F. Yin, H. Yurimoto, N. Kato, Y. Sakai, K. Izui, K. Li and L. Chen: Overexpression of an HPS/PHI fusion enzyme from *Mycobacterium gastri* in chloroplasts of geranium enhances its ability to assimilate and phytoremediate formaldehyde. *Biotechnol Lett* 32; 1541-1548, 2010

- Iguchi, H., H. Yurimoto and Y. Sakai. Soluble and particulate methane monooxygenase gene clusters in the type I methanotroph *Methylovulum miyakonense* HT12. *FEMS Microbiol Lett* 312; 71-76, 2010

- Orita, I., A. Kita, H. Yurimoto, N. Kato, Y. Sakai and K. Miki: Crystal structure of 3-hexulose-6-phosphate synthase, a member of the orotidine 5'-monophosphate decarboxylase suprafamily. *Proteins* 78; 3488-3492, 2010

- Tamura, N., M. Oku and Y. Sakai: Atg8 regulates vacuolar membrane dynamics in a lipidation-independent manner in *Pichia pastoris*. *J Cell Sci* 123; 4107-4116, 2010

- Fukuta, Y., S. Nanda, Y. Kato, H. Yurimoto, Y. Sakai, H. Komeda and Y. Asano: Characterization of a new (R)-hydroxynitrile lyase from the Japanese apricot *Prunus mume* and cDNA cloning and secretory expression of one of the isozymes in *Pichia pastoris*. *Biosci Biotechnol Biochem* 75; 214-220, 2011

Reviews

- Oku, M. and Y. Sakai: Peroxisomes as dynamic organelles: autophagic degradation. FEBS J 277; 3289-3294, 2010

- Yurimoto, H. and Y. Sakai: Interactions between C1-microorganisms and plants and the carbon cycle. Regulation of Plant Growth & Development 45(2); 125-131, 2010 (in Japanese)

- Yurimoto, H. and Y. Sakai: Photosynthesis and microbial formaldehyde fixation. Bioscience & Industry 69(1); 46-48, 2011 (in Japanese)

- Oku, M. and Y. Sakai: Visualization of intracellular redox state by redoxfluor. Jikken Igaku 29(6); 945-950, 2011 (in Japanese)

b) Conference and seminar papers presented

- Annual Meeting of the Japan Society for Bioscience, Biotechnology, and Agrochemistry 2011: 19 presentations

- Yeast Genetics and Molecular Biology News Japan No. 43: 2 presentations

- The 62st Annual Meeting of the Vitamin Society of Japan: 1 presentation

- The 1st Autophagy Meeting: 4 presentations

- The 26th Annual Meeting of Japanese Society of Microbial Ecology: 1 presentation

- The 19th Yeast Joint Symposium: 1 presentation

- 131st Annual Meeting of the Pharmaceutical Society of Japan: 1 presentation

A-3.Off-campus activities 1

Membership in academic societies

- Sakai, Yasuyoshi : Japan Society for Bioscience, Biotechnology, and Agrochemistry (Director, Editor, Councilor of Kansai Branch) , Yeast Genetics Society of Japan (Administrator), Japan Bioindustry Association; Academic Society for Biotransformations with New Resources (Vice Chairman, Standing Director), Yeast Research Society of Japan (Administrator), Japan Society for Cell Biology (Councilor), The Japanese Biochemical Society (Councilor)

- Yurimoto, Hiroya : Yeast Research Society of Japan (Administrator)

A-3.Off-campus activities 2

Research grants

1. Grants-in-aid for Scientific Research(KAKENHI)

- Scientific Research on Priority Areas : Sakai, Y. : Mechanism of selective intracellular degradation by autophagy

- Scientific Research (B) : Sakai, Y. : Molecular circulation and carbon fixation by C1-microorganism bioconsortia

- Scientific Research (B) : Yurimoto, H. : Development of environmental technology based on molecular basis of microbial one-carbon metabolism

2. Other Research Grants

- Japan Science and Technology Agency, CREST : Sakai, Y. : Metabolism-based regulation of organelle homeostasis and cell function

- The Uehara Memorial Foundation : Sakai, Y. : Intracellular proteolysis and redox: molecular mechanism of their relation

A-4. International cooperation and overseas activities 1

International meetings(country,roles)

- Sakai, Y. : Gordon Conference on Autophagy in Stress, Development and Disease (Italy, invited speaker), Gordon Conference on Molecular Basis of Microbial One-Carbon Metabolism (USA, poster presentation), Swiss Yeast Meeting (Switzerland, invited speaker), The 1st Sino-Japan Autophagy Symposium (China, invited speaker), The 2nd Workshop Argentina-Japan (Tokyo, invited speaker)

- Yurimoto, H. : The 5th Japan—Finland Biotechnology Symposium (Finland, invited speaker), Gordon Conference on Molecular Basis of Microbial One-Carbon Metabolism (USA, poster presentation)

- Oku, M.: Yeast Genetics and Molecular Biology Meeting (Canada, poster and oral presentation), The 1st Sino-Japan Autophagy Symposium (China, invited speaker)

International joint research, overseas research surveys

- Sakai, Y. and Yurimoto, H.: JSPS Asian Core Program on Capacity Building and Development of Microbial Potential and Fermentation Technology towards New Era (Thailand, Vietnam, Laos)

A-4.International cooperation and overseas activities 2

Visiting Research Scholars

- Professor 1 (Thailand)

- Professor 1 (Canada)

B.Educational Activities(2010.4-2011.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level: Introduction to Applied Life Sciences II (Sakai), Applied Microbiology I (Sakai), Applied Microbiology II (Yurimoto), Applied Microbiology III (Yurimoto), Applied Microbiology IV (Sakai), Biochemistry I (Yurimoto), Laboratory Course in Applied Microbiology (Yurimoto and Oku), Seminar in Applied Life Sciences, Part I and II (Sakai, Yurimoto and Oku),
- Graduate level: Microbial Biotechnology Seminar (Sakai, Yurimoto and Oku), Experimental Course of Microbial Biotechnology (Sakai, Yurimoto and Oku)

B-2.Off-campus teaching etc.

Part-time lecturer

- Sakai, Y.: Graduate School of Agricultural and Life Sciences, The University of Tokyo

B-3.Overseas teaching 1

International students

- International students : Doctral 2 (China 1, Vietnam 1) Research Students 1 (Nepal)

C.Other Remarks

- Sakai, Y. : Advisory Committee of Technological Research for the Verification of Feasibility on CO₂ Fixation and Effective Utilization in Research Institute of Innovative Technology for the Earth (Member), Advisory Committee of International Center for Environmental Technology Transfer (Member)