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	6
	Master's Program	14
	Undergraduate	3
	Post-Doctoral fellow	1
	Program-Specific Researcher	1

A. Research Activities (2009.4-2010.3)

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 methylotrhophic yeasts and mammalian cells as model cells.

A-2.Publications and presentations

a) Publications

Original Papers

- Yano, T., E. Takigami, H. Yurimoto and Y. Sakai: The Yap-1 regulated glutathione redox system curtails the accumulation of formaldehyde and reactive oxygen species in methanol metabolism of Pichia pastoris. Eukaryot Cell 8: 540-549, 2009
- Asakura, M., S. Ninomiya, M. Sugimoto, M. Oku, S. Yamashita, T. Okuno, Y. Sakai and Y. Takano: Atg26-mediated pexophagy is required for host invasion by the plant pathogenic fungus Colletotrichum orbiculare. Plant Cell 21: 1291-1304, 2009
- Yano, T., H. Yurimoto and Y. Sakai: Activation of the oxidative stress regulator PpYap1 through conserved cysteine residues during methanol metabolism in the yeast Pichia pastoris. Biosci Biotechnol Biochem 73: 1404-1411, 2009
- Yamashita, S., H. Yurimoto, D. Murakami, M. Yoshikawa, M. Oku and Y. Sakai: Lag-phase autophagy in the methylotrophic yeast Pichia pastoris. Genes Cells 14: 861-870, 2009
- Watanabe, Y., N.N. Noda, K. Honbou, K. Suzuki, Y. Sakai, Y. Ohsumi and F. Inagaki: Crystallization of Saccharomyces cerevisiae alpha-mannosidase, a cargo protein of the Cvt pathway. Acta Crystallogr Sect F Struct Biol Cryst Commun 65: 571-573, 2009
- Takano, Y., M. Asakura and Y. Sakai: Atg26-mediated pexophagy and fungal phytopathogenicity. Autophagy 5: 1041-1042, 2009
- Yata, T. M. Nishikawa, C. Nishizaki, M. Oku, H. Yurimoto, Y. Sakai and Y. Takakura: Control of hypoxia-induced tumor cell adhesion by cytophilic human catalase. Free Radic Biol Med 47: 1772-1778, 2009
- Chen, L. M., H. Yurimoto, K. Z. Li, I. Orita, M. Akita, N. Kato, Y. Sakai and K. Izui. Assimilation of formaldehyde in transgenic plants due to the introduction of the bacterial ribulose monophosphate pathway genes. Biosci Biotechnol Biochem 74: 627-635, 2010

Reviews

- Yurimoto, H.: Molecular basis of methanol-inducible gene expression and its application in the methylotrophic yeast Candida boidinii. Biosci Biotechnol Biochem 73: 793-800, 2009
- Yurimoto, H. and Y. Sakai: Methanol-inducible gene expression and heterologous protein production in the methylotrophic yeast Candida boidinii. Biotechnol Appl Biochem 53: 85-92, 2009
- Yurimoto, H., N. Kato and Y. Sakai. Genomic organization and biochemistry of the ribulose monophosphate pathway and its application in biotechnology. Appl Microbiol Biotechnol 84: 407-416, 2009
- Sakai, Y. and Y. Tankano:Regulation of organellar numbers and autophagy during host invation plant pathogen. BRAIN TECHNO NEWS 135: 25-30, 2009 (in Japanese)
- Yoshimoto, K., Y. Takano and Y. Sakai: Autophagy in plants and phytopathogens. FEBS Lett 584: 1350-1358, 2010
- Sakai, Y.: Autophagy and plant pathogenity as the strategy to survive in nature -To be, or not to be: that is the question…-Kagakutoseibutsu 48(3): 153-155, 2010 (in Japanese)

b) Conference and seminar papers presented

- Annual meeting of the Japan Society for Bioscience, Biotechnology, and Agrochemistry 2010: 13 presentations
- Yeast Genetics and Molecular Biology News Japan No. 42: 3 presentations
- The 61st Annual Meeting of the Japan Society for Cell Biology: 1 presentation
- The 61st Annual Meeting of the Vitamin Society of Japan: 1 presentation
- The 16th Annual Meeting of Japan Society for Culture Collections: 1 presentation
- The 25th Annual Meeting of Japanese Society of Microbial Ecology: 1 presentation
- Joint meeting of Kansai, Chushikoku, and Kyushu Branches of Japan Society for Bioscience, Biotechnology, and Agrochemistry 2009: 2 presentations
- The 458th meeting of Japan Society for Bioscience, Biotechnology, and Agrochemistry Kansai Branch: 1 presentation

A-3.Off-campus activities

Membership in academic societies

- Sakai, Yasuyoshi, D.Agric.Sci : 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 (Standing Director), Yeast Research Society of Japan (Administrator)

- Yurimoto, Hiroya, Dr. (Agric. Sci.) : Japan Society for Bioscience, Biotechnology, and Agrochemistry (Representative), Yeast Research Society of Japan (Administrator)

Research grants

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

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

2.Other Research Grants

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

A-4.International cooperation and overseas activities

International meetings(country,roles)

- Sakai, Y. : The 36th Congress of the International Union of Physiological Sciences (Kyoto, invited speaker), The 5th International Symposium on Autophagy (Otsu, organizer head and invited speaker), EMBO conference series: Autophagy Cell Biology, Physiology & Pathology (Switzerland, invited speaker), International Meeting on Peroxisome Research (USA, invited speaker)
- Yurimoto, H. : 24th International Conference on Yeast Genetics and Molecular Biology (UK, poster presentation)
- Oku, M. : The 5th International Symposium on Autophagy (Otsu, poster presentation)

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)

B.Educational Activities(2009.4-2010.3)

B-1.On-campus teaching

a) Courses given

- Undergraduate level : Introduction to Applied Life Sciences II (Sakai), Applied

Microbiology I (Sakai and Yurimoto), 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 : Basis of Microbial Biotechnology (Sakai and Yurimoto), 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 Bioresource and Bioenvironmental Sciences, Kyushu University (Advanced Applied Microbiology I), Faculty of Engineering, Tottori University (Microbiology I)

B-3.Overseas teaching

International students

- International students : Master 1 (Vietnam) Doctral 1 (China)

Lectures and seminars

- Sakai, Y.

Special seminar(Invited speaker) : Institute for Microbiology, Swiss Federal Institute of Technology Zurich (ETH)(Switzerland)

- Yurimoto, H.

Special seminar(Invited speaker) : Kasetsart University(Thailand)

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)