Toshiaki MITSUI, Ph.D.

Professor
Program: Life and Food Sciences
Area: Applied Life and Food Science
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Professional Expertise

His professional expertise encompasses molecular biological, cell biological and biochemical aspects on the regulation of starch biosynthesis and degradation in rice. He and his colleagues found that employing the proteomic and bio-imaging techniques, the starch metabolism-related enzyme glycoproteins are targeted from the Golgi apparatus through the secretory pathway to the plastids in higher plant cells. On the basis of the results of basic research, his group urges to develop rice cultivars with high temperature tolerance during the grain filling.

Research Fields of Interest

Golgi-to-Plastid traffic in higher plant cells

・Protein targeting into plastids is an essential cellular event for expressing plant function and maintaining plant life. Recently, we found that glycoproteins, AmyI-1 and NPP1 are localized in plastids of rice living cells and play significant roles in the starch metabolism in plastids. We found a mysterious pathway for targeting glycoproteins from the endomembrane system into the plastids, which involves direct communication between the Golgi apparatus and the plastid.

Molecular mechanisms of white immature grain occurring under high-temperature during ripening in rice – Development of rice cultivars with High temperature tolerance during the grain filling

N-glycome of plastidial nucleotide pyrophosphatase/ phosphodiesterase (NPP) in rice - ADP-glucose hydrolyzing nucleotide NPPs are involved in the regulation of sucrose and starch accumulation

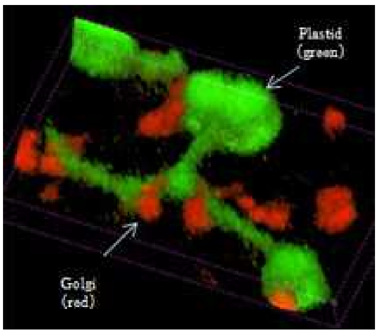

Fig.1: Direct Communication between Golgi and plastid visualized by LCMS

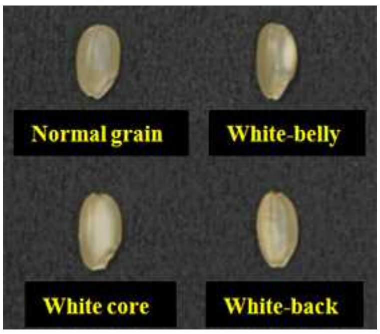

Fig.2: White immature grains caused by high temperature stress

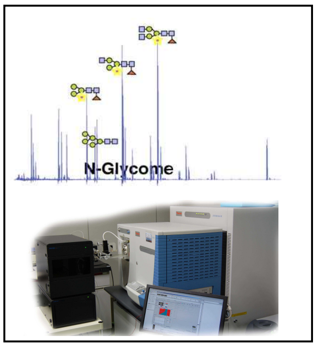

Fig.3: MS/MS analysis by LTQ-Orbitrap XL

Education

1986: Ph. D. in Plant Biochemistry, Graduate School of Agriculture, Nagoya University, Japan
1983: M.S. in Plant Biochemistry, Graduate School of Agriculture, Nagoya University, Japan
1981: B.S. in Chemistry, Faculty of Science and Technology, Ritsumeikan University, Japan

Professional Societies and Activities

1. The Japanese Society of Plant Physiologist
2. The Japanese Society of Applied Glycoscience
3. American society of Plant Biochemistry

Awards

The Japan Bioscience, Biotechnology and Agrochemistry Society Award for the Encouragement for Young Scientist

Major Publication

Books Chapters

[1] The Biochemistry of Plants. A Comprehensive Treatise. Vol. 14, Carbohydrates. (Ed., J. Press), Academic Press, Inc., pp465-492, 1988.

[2] Current Topics in Plant Physiology: An American Society of Plant Physiologists Series Volume 14. Sucrose Metabolism, Biochemistry, Physiology and Molecular Biology. (Eds., H.G. Pontis, G.L.Salerno, E.J. Echeverria), American Society of Plant Physiologists, pp254-265, 1995.

Papers

[1] Golgi/plastid-type manganese superoxide dismutase involved in heat-stress tolerance during grain filling of rice. *Plant Biotechnol. J.*, in press

[2] Peroxisome - chloroplast physical interaction elucidated by in situ laser analysis. *Nat. Plants* 1, Article number: 15035, 2015

[3] Crystal structure of α-amylase from *Oryza sativa*: Molecular insights into enzyme activity and thermostability. *Biosci. Biotechnol. Biochem*, 78(6): 989-997, 2014 (Award for Excellence to Authors Publishing in Bioscience, Biotechonology, and Biochemistry in 2014)

[4] Nucleotide Pyrophosphatase/phosphodiesterase 1 exerts a negative effect on starch accumulation and growth in rice seedlings under high temperature and CO_2 concentration conditions. *Plant Cell Physiol.* 55(2): 320-332, 2014

[5] Suppression of α-amylase genes improves quality of rice grain ripened under high temperature. *Plant Biotechnol. J.* 10(9): 1110-1117, 2012

[6] Differential localization and functions of rice nucleotide pyrophosphatase/phosphodiesterase isozyme 1 and 3. *Plant Biotech.* 28(1):69-76, 2011

[7] Crystallographic analysis reveals a unique conformation of the ADP-bound novel rice kinesin K16. *Biochem. Biophys. Res. Comun.* 401(2):251-256, 2010

[8] The rice α-amylase glycoprotein is targeted from the Golgi apparatus through the secretory pathway to the plastids. *Plant Cell.* 21(9): 2844-2858, 2009

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[12] α-Amylase affects starch accumulation in rice grain. *J. Appl. Glycosci.* 53: 187-192, 2006

[13] Preparation and characterization of a novel plant specific kinesin. *J. Biochem.* 139: 645-654, 2006

[14] Involvement of α-amylase I-1 in starch degradation in rice chloroplasts. *Plant Cell Physiol.* 46(6): 858-869, 2005

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[16] Proteomics of the rice cell: systematic identification of the protein populations in subcellular compartments. *Mol. Genet. Gen.* 271: 566-576, 2004

[17] Introduction of *Wx* transgene into rice *wx* mutants leads to both high- and low-amylose rice. *Plant Cell Physiol.* 44: 473-480, 2003

[18] Separation of distinct compartments of rice Golgi complex by sucrose density gradient centrifugation. *Plant Sci.* 161: 665-675, 2001

[19] Sugar-controlled Ca^{2+} uptake and α-amylase secretion in cultured cells of rice (*Oryza sativa* L.). *Plant Cell Physiol.* 40: 884-893, 1999

[20] Role of the N-terminal region of the regulatory light chain in the dephosphorylation of myosin by myosin light chain phosphatase. *J. Biol. Chem.* 274: 30122-30126, 1999

[21] Effects of (+)-8',8',8'-trifluoroabscisic acid on α-amylase expression and sugar accumulation in rice cells. *Planta* 205: 319-326, 1998

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[24] Structure and function of the Golgi complex in rice cells. 2. Purification and characterization of Golgi membrane-bound nucleoside diphosphatase. *Plant Physiol.* 106: 119-125, 1994

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[29] Preferential secretion of R-type α-amylase molecules in rice seed scutellum at high temperature. *Plant Physiol.* 82(3): 880-884, 1986

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