It is becoming increasingly important to establish a sustainable society that depends on renewable resources. Because woody biomass is the most abundant renewable resource, studies of wood formation are central to improving forest biomass production and utilization. In this context, we are involved in analyzing metabolic functions of forest plants from a wide variety of aspects. We are also conducting molecular breeding studies of trees and plants suitable for biomass refinery systems.

Cell-wall and heartwood formation

Wood formation refers to the formation of cell walls and heartwood. Since the biosynthesis of phenylpropanoid compounds, such as lignin, lignan, and nortiliogalactin, is central to both metabolic processes, detailed and holistic analyses of phenylpropanoid biosynthesis are being conducted.

Molecular breeding of trees and plants suitable for biofuel production and use in biomass refineries

Based on our comprehensive understanding of wood formation mechanisms, studies are being conducted on the molecular breeding of trees, development of energy plants for bioethanol production, and biomass refinery systems.

Biosynthesis and metabolic engineering of antitumor lignans

Biosynthesis of the antitumor agent podophyllotoxin, the biosynthetic route of which is closely related to that of heartwood lignans, is also being studied for its potential biotechnological applications.
Keywords

tree, wood formation, secondary wall formation, phenylpropanoid, lignin, lignan, norlignan, hemicelluloses, rice, Acacia, poplar, energy plants, biomass refinery, enzymatic saccharification, biofuel, transcription factor, molecular breeding

Recent Publications

Occurrence of guaiacyl/p-hydroxyphenyl lignin in Arabidopsis thaliana T87 cells
Plant Biotechnol., 28, 1-8

Analysis of expressed sequence tags in developing secondary xylem and shoot of Acacia mangium
J. Wood Sci., 57, 40-46

A rice fungal MAMP-responsive MAPK cascade regulates metabolic flow to antimicrobial metabolite synthesis
Plant J., 63, 599-612

Microscale alkaline nitrobenzene oxidation method for high-throughput determination of lignin aromatic components.
Plant Biotechnol., 27, 305-310

High-throughput determination of thioglycolic acid lignin from rice
Plant Biotechnol., 26, 337-340

Characterization of Arabidopsis thaliana Pinoresinol Reductase, a new type of enzyme involved in lignan biosynthesis
J. Biol. Chem., 283, 15550-15557

Cloning of a cDNA encoding a NAD-dependent formate dehydrogenase involved in oxalic acid metabolism from the white-rot fungus Ceriporiopsis subvermispora and its gene expression analysis
FEMS Microbiol. Lett., 279, 64-70

The subunit composition of hinokirsinol synthase controls geometrical selectivity in norlignan formation
PNAS 104, 21008-21013

Metabolic analysis of the cinnamate/monolignol pathway in Carthamus tinctorius seeds by a stable-isotope-dilution method
Org. Biomol. Chem., 5, 802-815
Involvement of FpTRP26, a thioredoxin-related protein, in oxalic acid-resistance of the brown-rot fungus Fomitopsis palustris
FEBS Lett., 581, 1788-1792

Formation of two methylenedioxy bridges by a Sesamum CYP81Q protein yielding a furofuran lignan, (+)-sesamin
Ono, E., Nakai, M., Fukui, Y., Tominori, N., Fukuchi-Mizunati, M., Saito, M., Satake, H.,
PNAS 103, 10116-10121

Cinnamoyl-CoA reductase, a key enzyme in lignin biosynthesis, is a novel effector of small GTPase Rac in defense signaling in rice
Kawasaki, T., Koita, H., Nakatsubo, T., Hasegawa, K., Wakabayashi, K., Takahashi, H.,
Umemura, K., Umezawa, T. and Shimamoto, K.
PNAS 103, 230-235

Subcellular localization of glyoxylate cycle key enzymes involved in oxalate biosynthesis of wood-destroying basidiomycete Fomitopsis palustris grown on glucose
Microbiology, 152, 1609-1620

Kappa-View: A web-based analysis tool for integration of transcript and metabolite data on plant metabolic pathway maps
Tokimatsu, T., Sakurai, N., Suzuki, H., Ohta, H., Nishitani, K., Koyama, T., Umezawa, T.,
Plant Physiol., 138, 1289-1300

Clarification of cinnamoyl co-enzyme A reductase catalysis in monolignol biosynthesis of aspen
Plant Cell Physiol., 46, 1073-1082

Purification and characterization of NAD-dependent formate dehydrogenase from the white-rot fungus Ceriporiopsis subvermispora and a possible role of the enzyme in oxalate metabolism
Enz. Microbial Technol., 37, 68-75

A heartwood norlignan, (E)-hinokiresinol, is formed from 4-coumaryl 4-coumarate by a Cryptomeria japonica enzyme preparation
Chem. Commun., 2838-2839

The ability of ectomycorrhizal fungi to utilize fatty acids and lipid as a carbon source for mycelial growth
Can. J. Bot., 81, 1285-1292

Biosynthesis of yatein in Anthriscus sylvestris