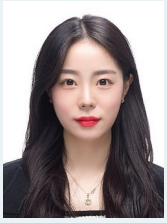
So Hee Yang, Ph.D.

Professor of Agricultural Chemistry

Department of Agricultural Chemistry, Chonnam National University, Republic of Korea

RESEARCH & COLLABORATION PROFILE

KEY WORDS: Tomato, CRISPR/Cas9 Genome Editing, Protoplast, Transgene-free Editing, Fruit weetness



Research Snapshot. Dr. Yang develops practical genome-editing tools for tomato and other Solanum crops. Her work covers sgRNA selection for CRISPR/Cas9, protoplast isolation, transfection and regeneration for transgene-free editing, and editing of target genes to improve fruit traits such as sweetness. She has also studied alginate- and fucoidan-degrading bacteria as plant growth-promoting microbes.

RESEARCH EXPERTISE

- **CRISPR/Cas9 genome editing in tomato:** sgRNA design and efficiency evaluation for herbicide-related genes (PDS, ALS, EPSPS), and generation of gene knock-out lines in the Micro-Tom background for functional studies and trait improvement.
- **Protoplast-based, transgene-free editing:** optimization of the full workflow of protoplast isolation, PEG-mediated transfection and plant regeneration (protoplast culture, callus and shoot induction). The work compares PEG concentration against protoplast viability and benchmarks editing efficiency against Agrobacterium-mediated delivery.
- **Metabolic engineering for fruit quality:** use of genome editing to examine how primary metabolism affects sugar accumulation. SlALS1 knock-out reduced branched-chain amino acids while raising glucose and fructose about 1.3-fold and increasing Brix, linking amino acid metabolism to carbon allocation in fruit.
- **Precision breeding in Solanum crops:** development of protocols applicable to tomato, potato and eggplant that avoid exogenous DNA insertion and chimerism, addressing GMO-related concerns.

RECENT RESEARCH HIGHLIGHTS

- **Fruit sweetness editing (Front. Plant Sci. 2026):** CRISPR/Cas9-mediated editing of SlALS1 to enhance fruit sweetness in tomato (manuscript accepted in September 2026).
- **Efficient protoplast protocol (Appl. Biol. Chem. 2026, 69:29):** tomato protoplast isolation and transfection via seedling etiolation.
- **Solanum protoplast platform (Appl. Biol. Chem. 2024, 67(1)):** optimized protocols for protoplast isolation, transfection and regeneration in the Solanum genus for CRISPR/Cas-mediated transgene-free genome editing.

POTENTIAL COLLABORATION RESEARCH

Best-fit collaborator areas: plant genome editing & biotechnology | crop breeding & tissue culture | chemical biology & analytical chemistry

- **1. Joint development of genome-editing platforms:** co-development of protoplast-based, DNA-free (RNP) editing workflows for tomato and other Solanum crops, with systematic optimization of protoplast isolation, delivery and regeneration, evaluation of editing efficiency and off-target effects, and extension to new crop species.
- **2. Fruit quality and metabolic engineering:** collaborative studies of genes in primary metabolism, such as SlALS1 and related branched-chain amino acid pathways, that influence sugar accumulation. This includes metabolite profiling of edited lines (sugars, amino acids, organic acids), elucidation of the mechanisms linking amino acid metabolism to carbon allocation, and evaluation of agronomic traits such as plant growth and fruit yield.
- **3. Precision breeding and tissue culture**: joint work on regenerating transgene-free edited plants and on stacking multiple edits, in cooperation with breeders and crop companies interested in applying genome editing to practical cultivars.

SELECTED RECENT PUBLICATIONS

- **Front. Plant Sci. 2026, 17:1927332** — CRISPR/Cas9-mediated editing of SlALS1 enhances fruit sweetness in tomato.
- **Appl. Biol. Chem. 2026, 69:29** — A highly efficient protocol for tomato protoplast isolation and transfection via seedling etiolation.
- **Appl. Biol. Chem. 2024, 67(1)** — Optimized protocols for protoplast isolation, transfection, and regeneration in the Solanum genus.

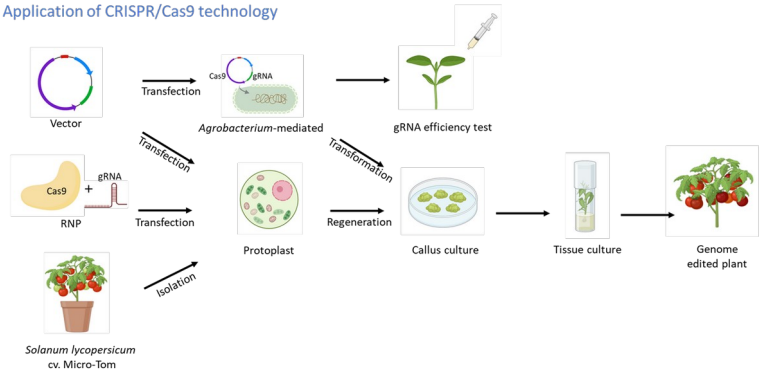
CONTACT

sohee57172@chonnam.ac.kr | +82-62-530-

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REPRESENTATIVE RESEARCH FIGURES / SCHEMES

Application of CRISPR/Cas9 technology



Construction map for targeted mutagenesis of the ALS gene

