

Transgenic rice plants overexpressing maize C4 acid metabolism enzymes exhibit an improved nutritional quality

JUNG Jung-Su¹, KIM, Su-Jae¹, KWUN, Hyok-Oun¹, LEE, Jeom-Ho², HWANG Hung-Goo², Maurice S.B. KU³, CHO, Dong-Ha¹ *

¹Division of Biotechnology, Kangwon National University, Chunchon 200-701, Korea

²National Crop Experiment Station, RDA, Suwon 441-100, Korea

³School of Biological Sciences, Washington State University, Pullman, WA 99164-4236, USA

Objectives

The grain qualities of transgenic rice plants overexpressing three maize C4 acid metabolism enzymes, phosphoenolpyruvate carboxylase (PEPC), pyruvate orthophosphate dikinase (PPDK), and NADP-malic enzyme (ME), were analyzed.

Materials and Methods

Plant Materials: Untransformed wild-type (WT, cv. Kitaake) and four transgenic rice lines were included in this study: homozygous transgenic rice overexpressing the rice NADP-ME(ME), the maize C4-specific PEPC(PC), PPDK(PK) and CK(PEPC & PPDK hybrid).

Seed analysis- Mineral composition ICP machine after treatment with H₂SO₄:HClO₄: H₂O solution. Mg, K, - by atomic absorption spectrophotometer. Starch and amylose contents.

Results and Discussion

1) Protein, fat, starch, amylose, fiber, and ash contents in these transgenic rice lines were similar to those of untransformed wildtype. However, calcium and iron contents were 18-27% and 75-158% higher than those of the wildtype, respectively, whereas the contents for other minerals were not significantly altered. As compared with wildtype, the contents for the eight essential amino acids were slightly (5%) higher in ME, but 10-15% lower in other transgenic lines.

2) All transgenic rice lines showed a higher degree of lightness in chromaticity after cooking and a higher transparency after alkali digestion, both considered preferred traits by rice eaters. All lines have a lower gelatinization temperature, but with a similar gelatinization form.

3) A preliminary functional test of the eating quality showed testers consistently prefer transgenic rice over wildtype. Taken together, these results suggest that overexpression of maize C4 acid metabolism enzymes in rice can lead to increased phytochemicals and a higher nutritional quality.