Tropentag, September 14-16, 2010, Zurich

"World Food System —
A Contribution from Europe"

Biofortification of Cassava and Rice

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Abstract

The starchy roots of cassava (*Manihot esculenta* Crantz) and the grain of rice (*Oryza sativa*) are a vital source of carbohydrate for more than half of the human population in the world, especially in tropical and sub-tropical regions. However, consumption of cassava or rice does not provide all the required elements for human health due to low protein content, poor levels of several EAAs (essential amino acids), micronutrients and vitamins. It provokes major nutritional deficiencies in populations having a diet mostly relying on cassava or rice consumption.

In order to raise the protein and EAAs content in cassava, both push (metabolic pathways alteration) and pull (sink strength alteration) strategies are being assessed. Strategies 1) Manipulation of a nitrogen assimilation related transcription factor; and 2) Modulation of the aspartate family metabolic pathway; refer to the "push" concept while the strategies 3) Over-expression of heterologous storage proteins; and 4) Investigation of cassava storage proteins; represent an evaluation of the "pull" approach. Transgenic cassava lines for each approach have been produced to determine the most suitable strategy to elevate protein and EAAs contents in cassava roots.

Another important limitation in cassava roots is the low level of vitamins; in particular the vitamin B complex that is partially lost after processing. The metabolic pathways for the de novo biosynthesis of vitamins B1 and B6 have been recently characterised in Arabidopsis with the identification of key enzymes for vitamin B1 (THIC) and vitamin B6 (PDX1 and PDX2) synthesis. In order to improve the vitamin B content in cassava roots, transgenic cassava over-expressing the aforementioned enzymes have been produced. Elevation of vitamin B1 and B6 contents will be attempted for the whole cassava plant and for the cassava roots. In order to evaluate the possibility to raise vitamin B levels in seed crop, transgenic rice over-expressing vitamin B1 and B6 related enzymes in the complete plant and in the rice endosperm have also been generated.

The above-presented strategies are currently evaluated through protein, EAAs and vitamins B quantification in the transgenic lines. The most promising strategies could be combined to produce biofortified cassava and rice cultivars.

Keywords: Cassava, rice, vitamin B1, vitamin B6, biofortification, protein

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