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Improving the Protein Content in Staple Crops via Biofortification

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Abstract

In many poor developing countries, in which consumers rely only or mostly on low-protein staple crops for food, daily intake of essential amino acids (EAAs) is usually not sufficient because other high-protein sources such as meat, fish, or soybean are not readily available. In order to alleviate malnutrition in these countries, EAA intake could be improved by protein biofortification of these staple crops. Cassava for instance is one of the most important food crops in tropical countries. More than 600 Million people rely on it, primarily as a subsistence crop. Together with rice, these two crops serve as main source of carbohydrates for more than half of the world population. The greatest nutritional value of cassava lies in the starchy storage root, which contains high levels of carbohydrates but only a small amount of protein. Similarly, polished rice is an important source of carbohydrate, but it is low in protein because most proteins are found in the seed coat and aleurone layer, both of which are typically discarded during polishing of the rice seed.

Suitable protein candidates for biofortification of cassava and rice include the natural storage protein SporaminA from sweet potato as well as an artificial storage protein (ASP1) designed for optimal human needs in terms of EAAs. ASP1 has been transferred and expressed in cassava and rice successfully, but protein accumulation was variable and usually low. Cellular targeting is considered as a possible solution to overcome limited protein accumulation. We have successfully targeted a green fluorescent protein (GFP) to different cellular organelles in transient assays in cassava protoplasts and GFP:ASP1 fusion assays will reveal detailed information about suitable protein storage locations.

In the long term, we hope that these studies will lead to increased protein levels in two of the world's most important food resources, and so we could provide people lacking EAAs with value-added cultivars of cassava and rice.

Keywords: Biofortification, cassava, essential amino acids, rice

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