

Multi-nutrient rice against malnutrition

August 8 2017, by Peter Rüegg



The new rice line in the greenhouse can supply rice consumers with three essential micronutrients in the future. Credit: ETH Zurich / courtesy of Navreet Bhullar

ETH researchers have developed a new rice variety that not only has increased levels of the micronutrients iron and zinc in the grains, but also produces beta-carotene as a precursor of vitamin A. This could help to reduce micronutrient malnutrition, or "hidden hunger," which is widespread in developing countries.

Nearly every second person eats primarily rice to meet the daily calorie needs. A meal of rice stops the hunger, but contains only very few or none of the essential micronutrients. As a consequence, large segments of the human population are malnourished, especially in Asia and

Africa. They do not obtain enough iron, zinc and also vitamin A to stay healthy. Insufficient iron intake results in anemia, retards brain development and increases mortality among women and infants. If children are deficient for vitamin A, they can turn blind and their immune system is weakened, often causing infectious diseases such as measles, diarrhea or malaria.

Golden rice against vitamin A deficiency

To combat malnutrition, ETH researchers led by Ingo Potrykus developed a new rice variety already many years ago that in 2000 became known as "Golden Rice." This was one of the first genetically modified rice varieties in which the researchers could produce beta-carotene, the precursor of vitamin A, in the endosperm of the rice grain. Golden Rice was later improved and is now used in breeding programs in several countries, primarily in Southeast-Asia. To address other [micronutrient](#) deficiencies, researchers in the Laboratory of Plant Biotechnology of Professor Gruissem at ETH Zurich and in other countries also developed rice varieties with increased iron levels in the rice and wheat grains, for example.

All of the new transgenic rice varieties have one thing in common, however: they can only provide one particular micronutrient. Until to date, combining several micronutrients into one rice plant was a dream that had not been realized.

First multi-nutrient rice

Now a group led by Navreet Bhullar, senior scientist in the Laboratory of Plant Biotechnology at ETH Zurich, report a success in creating a multi-nutrient rice. The results were recently published in the journal *Scientific Reports*.

The researcher and her PhD student Simrat Pal Singh succeeded in genetically modifying rice plants such that in addition to sufficient levels of iron and zinc, they also produce significant levels of beta-carotene in the endosperm of the grain compared to normal varieties. "Our results demonstrate that it is possible to combine several essential micronutrients—iron, zinc and beta-carotene—in a single [rice plant](#) for healthy nutrition," explains Bhullar.

Scientifically, the success was the engineering of a gene cassette containing four genes for the micronutrient improvement that could be inserted into the rice genome as a single genetic locus. This has the advantage that iron, zinc and beta-carotene levels can be simultaneously increased by genetic crosses in rice varieties of various countries. Otherwise it would be necessary to cross rice lines with the individual micronutrients to reach the improved micronutrient content in rice grains.

Bhullar and her PhD students worked several years to establish this proof-of concept. Although the grains of the multi-nutrient rice lines have more beta-carotene than the original japonica rice variety, depending on the lines the beta-carotene content can be ten-fold lower than in Golden Rice 2, the improved variant of Golden Rice. "But if one would substitute 70 percent of the currently consumed white rice with the multi-nutrient variety, this could markedly improve vitamin A supplementation already in addition to sufficient [iron](#) and zinc in the diet," emphasizes the researcher.

Multi-nutrient rice variety tested in the greenhouse

The new multi-nutrient rice lines are still in their testing phase. Until now the plants have been grown in the greenhouse and analyzed for their micronutrient content. "We will improve the lines further," says Bhullar. It is planned to test the plants in confined field trials to determine if the

micronutrient traits and also agronomic properties are equally robust in the field as they are in the greenhouse.

Bhullar hopes that the new rice lines will be tested in the field next year. But she does not know yet when they are ready for production in farmer's fields. "It will probably be five years before the multi-nutrient [rice](#) can be used to reduce hidden hunger," she says.

More information: Simrat Pal Singh et al. Single genetic locus improvement of iron, zinc and β -carotene content in rice grains, *Scientific Reports* (2017). [DOI: 10.1038/s41598-017-07198-5](https://doi.org/10.1038/s41598-017-07198-5)

Provided by ETH Zurich

Citation: Multi-nutrient rice against malnutrition (2017, August 8) retrieved 9 April 2024 from <https://phys.org/news/2017-08-multi-nutrient-rice-malnutrition.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--