UNIVERSITÉ DE GENÈVE

PRESS RELEASE

Geneva | 11 April 2024

Biofortified rice to combat deficiencies

A team from UNIGE, together with ETH Zurich and NCHU in Taiwan, has developed a rice line that has enhanced vitamin B1 content.

Vitamin B_1 is an essential micronutrient for human beings. Its deficiency is the cause of numerous diseases of the nervous and cardiovascular systems. Researchers at the University of Geneva (UNIGE), in collaboration with teams at ETH Zurich and Taiwan's National Chung Hsing University (NCHU), have achieved a significant advance in the fight against vitamin B_1 deficiency, frequently associated with a rice-based diet. By specifically targeting the nourishing tissues of the rice grain, the scientists have succeeded in considerably increasing its vitamin B_1 content, without compromising agronomic yield. These results, to be read in the *Plant Biotechnology Journal*, could help solve a major public health problem in regions where rice is the staple food.

Most vitamins cannot be produced by the human body and must be supplied by the diet. When the diet is varied, vitamin requirements are generally covered. But in populations where cereals such as rice are the main or even the only food source, deficiencies are common. This is particularly true of vitamin B_1 (thiamine), a deficiency of which causes numerous nervous and cardiovascular diseases, such as beriberi.

Vitamin B_1 in rice is lost during processing

Rice is the staple crop for half the world's population, particularly in the tropical countries of Asia, South America and Africa. Rice grains are low in vitamin B_1, and processing steps such as polishing (i.e. removing the bran by grating the peripheral layers) reduce it even further, taking 90% with them. This practice thus further aggravates chronic deficiencies.

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The biofortified rice varieties were developed in the laboratory and then grown in experimental fields in Taiwan.

Pictures

The laboratory of Teresa Fitzpatrick, full professor in the Department of Plant Sciences at the UNIGE Faculty of Science, specializes in vitamin biosynthesis and degradation pathways in plants. Her group, in collaboration with a team from ETH Zurich and Taiwan's NCHU, focused on improving vitamin B_1 content in the endosperm of rice, i.e. the nourishing tissue that makes up the bulk of the seed, and therefore of what is eaten.

"Previous attempts at biofortification by other teams had succeeded in increasing the vitamin B_1 content of the leaves and bran - the outer layer of rice grains - but not that of the ready-to-eat rice grain. In our study, we specifically targeted the increase in vitamin B_1 content in the endosperm," explains Teresa Fitzpatrick, first author of the study.

The scientists generated rice lines that express a gene that sequesters vitamin B_1 in a controlled manner in the endosperm tissues. After growing in glasshouses, harvesting and polishing the rice grains, they found that the vitamin B_1 content was increased in rice grains from these lines.

Promising experimental crops

The lines were then seeded in an experimental field in Taiwan and grown for several years. From an agronomic point of view, the characteristics analyzed were the same for both modified and unmodified rice plants. Plant height, number of stems per plant, grain weight and fertility were all comparable. On the other hand, the level of vitamin B1 in rice grains, after the polishing stage, is multiplied by 3 to 4 in the modified lines. This modification therefore enables vitamin B1 accumulation without impacting yield.

"Most studies of this type are carried out with glasshouse grown crops. The fact that we have been able to grow our lines under real field conditions, that the expression of the modified gene is stable over time without any of the agronomic characteristics being affected, is very promising," enthuses Wilhelm Gruissem, Professor emeritus at ETH Zurich and Distinguished Chair Professor and Yushan Fellow at NCHU. A 300-gram bowl of rice from this crop provides around a third of the recommended daily intake of vitamin B1 for an adult. The next step towards the goal of biofortified plants with vitamin B_1 will be to pursue this approach in commercial varieties. However, regulatory steps relating to biofortification by genetic engineering will have to be taken before these plants could be cultivated.

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DOI: 10.1111/pbi.14348

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