

#InspiredByLife to

Prevent childhood blindness from vitamin A deficiency

Over millennia, living organisms and biological systems in nature and the human body have developed a resourceful toolbox of biochemical capabilities, cellular and biomolecular processes and genetic resources. Inspired by a deeper understanding of these tools, life sciences researchers have studied nature to create new biotech solutions, in sectors including healthcare, agriculture and industry that help people and the planet.

Today, modern biotechnology provides breakthrough therapeutic treatments and biofortified nutrition that save lives and improve wellbeing. It enables new technologies that support a circular bio-economy, the European Green Deal and more sustainable agriculture that reduces the impact of human activity on our climate and ecosystems. It has inspired the development of new cutting-edge industrial manufacturing processes that are safer, cleaner and more efficient.



Golden Rice offers biofortified nutrition that can prevent blindness and premature death

Lack of vitamin A as part of a healthy diet can lead to blindness, ill health and even death; this is the reality for many people around the world. Children are particularly vulnerable in developing countries where access to a rich and varied diet is limited. Each year more than 2.5 million children¹ under the age of five die as a result of an unbalanced diet and hundreds of thousands go blind because of vitamin A deficiency.

In the 1990s, European bio-scientists created a genetically modified (GM) crop – Golden Rice – which is rich in vitamin A and could provide one way of tackling this public health crisis in developing countries. Despite very stringent regulation and scientific assessments of GM crops, some opposition to Golden Rice still exists amongst activists, primarily arising from misconceptions. Because of this, as well as lengthy field trials, Golden Rice has not yet come to the market, but may soon in countries like Bangladesh and the Philippines.

Learning from living organisms and biological systems in nature



Golden Rice is different from other rice because it contains extra genes. They ensure the production of beta-carotene (provitamin A), which is converted into vitamin A and which colours the grains yellow-orange (hence the name golden rice).

The biological world provided the inspiration for this adaptation. The inventors of Golden Rice created it by adding two genes from the daffodil (*Narcissus pseudonarcissus*) and one from the soil bacteria *Erwinia uredovora* to the DNA of rice, thus enabling the production of provitamin A in rice grains. The beta-



Golden Rice could provide just as much vitamin A as provitamin A capsules and more than spinach.”

carotene produced in Golden Rice grains is identical to the beta-carotene found in fruit and vegetables.

Golden Rice can be grown just like ordinary rice, and varieties containing the GR2E Golden Rice trait have the same yield and agronomic performance as their conventional counterparts.

Improving human life, health and wellbeing

The World Health Organisation estimates that each year between 250,000 and 500,000 children¹ go blind because of vitamin A deficiency. The best way to tackle nutritional deficiencies is a rich, varied diet. But for those living in poverty, access to fresh fruit, vegetables and animal products is not possible. For example, in Bangladesh rice makes up 80% of the daily calorie intake for the rural population.



A bowl of 100-150 grams of boiled Golden Rice (equivalent to 50 grams of dry rice) provides 60% of the recommended daily intake of vitamin A for children. Golden Rice could provide just as much vitamin A as provitamin A capsules and more than spinach.

Golden Rice can therefore be an important part of the solution to tackle vitamin A deficiency, alongside other public health measures like nutrition education, vitamin A capsule supplementation; and food fortification.



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- In Bangladesh rice makes up 80% of the daily calorie intake for the rural population.
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The bio-scientists and researchers inspired by life to create this solution for people

The inventors of Golden Rice were [Ingo Potrykus](#), former Professor of the Institute for Plant Sciences of the Swiss Federal Institute of Technology (ETH, Zurich) and [Professor Peter Beyer](#), of the Centre for Applied Biosciences, University of Freiburg, Germany. They took genes which already existed in nature to produce beta-carotene in rice, enabling a staple food to become rich in an essential vitamin.

The International Rice Research Institute, together with national counterparts in the Philippines and Bangladesh, have further developed the techniques envisioned by Golden Rice's inventors to ensure that the deployment of Golden Rice in the countries that need it most enjoys full national ownership. Matthew Morell, Director-General of IRRI, said “We're excited to partner with our local partners to develop this nutrition-sensitive agricultural solution to address hidden hunger. This is the core of IRRI's purpose: to tailor global solutions to local needs.”

This case study including sources and references is available at <https://www.europabio.org/inspiredbylife/case-studies>

¹ [VIB Golden Rice factsheet](#)

Sources:

- **Golden Rice Project.** [Transgenic crops, the best-analysed plants in history.](#)
- **International Rice Research Institute (2018).** [Golden Rice FAQs.](#)
- **VIB (2016).** [Facts Series – Golden Rice.](#)