

Golden Rice Briefing

A symptom of poverty

Vitamin A deficiency is widespread in many parts of the developing world resulting in the blindness and death of millions of children. It is a symptom of the fact that people are so poor they have to survive on virtually nothing but rice, which lacks certain nutrients.

Scientists and engineers get excited when there is the potential for their research to solve a humanitarian issue – and rightly so. However, there are inevitably times when, in this excitement, certain things get overlooked and the research can plough ahead without much thought as to whether it is the right solution to spend time and resources on. Golden Rice is sadly a classic case of misspent time and resources.

Whilst in the eyes of scientists the solution is to create rice which provides one missing nutrient, this is only treating the part of the symptom, not the problem – poverty. In the eyes of humanitarian experts, the solution is to reduce the number of people having to survive on rice in the first place. It is poor distribution and access, both to other foods and the tools and skills to grow them, which are the main reasons children are going blind. Furthermore, they are suffering from broader malnourishment than just vitamin A deficiency.

GM technology out performed by less glamorous solutions

The best solution to vitamin A deficiency is to use supplementation and fortification as emergency 'sticking-plasters', and in the meantime, for funding support and research to go into measures which tackle the broader issues of poverty and malnutrition.

There are already up to half a dozen strategies used to tackle vitamin A deficiency. Sadly they are less exciting to some journalists, politicians and scientists than the idea of beta-carotene producing rice, containing genes from a bacteria and maize plant. But they work and have saved many lives.

We know they work, as, for example in the Philippines vitamin A deficiency in young children has fallen by 25% in just 5 years – a fantastic achievement¹, without any GM rice.

The alternatives

'Sticking plaster' short-term measures

- **Vitamin A supplement provision** particularly successful projects include those combining Vitamin A with immunisations, for example when new mothers have just delivered and during National Immunisation Days (NIDs) to eradicate polio²
- Fortifying rice and flour through processing methods Flour is mandatorily fortified in the Philippines³. There are also improvements in the ability to fortify rice, however the full potential of this still 'remains untapped' and lacks adequate research⁴.

• The availability and publicity of cheap food containing sources of vitamin A, for example fortified milk and ready-made meals containing supplements and carrots (rich in vitamin A) in the Philippines have had major success

Long-term measures with multiple benefits

- The use of awareness campaigns warning parents of the cause of child blindness a key weapon is to advise parents, the key target audience, of the dangers of rice based diets (which lead to more problems than just vitamin deficiency problems that could actually be worsened by encouraging more rice consumption).
- **Projects which target poverty in smallholders** these include providing farmers with a range of seeds, tools and skills necessary for growing more diverse crops to target broader issues of malnutrition. The benefits include: more resilient and increased incomes, often reduced reliance on external inputs, and of course more balanced diets. A fantastic example of this is the work carried out by Send A Cow in Uganda and Kenya, including the development of kitchen gardens⁵.
- Breeding and providing biofortified crops: breeding crops high in nutrients is proving to be easier than creating GM versions. The best example is the creation of sweet potatoes that grow in tropical conditions, cross-bred with vitamin A rich orange sweet potatoes, which grow in the USA. There are successful campaigns providing these potatoes, a staggering five times higher in vitamin A than Golden Rice⁶, to farmers in Uganda and Mozambique⁷⁸.

Stealing the limelight

Golden Rice, sadly, was never going to be an emergency 'sticking-plaster' – as with all genetic modification it takes years to develop. Incredibly, whilst portrayed as the leading solution for at least 15 years, it has not yet actually helped a single person, when (or if) it finally is released for general use, it will not be helping to reduce people's reliance on a rice based diet. It is another example of where scientists have overlooked the social nature of a problem, in which they optimistically see a simple, quick fix and have ploughed on regardless of difficulty, expense and time, and of course, while ignoring the readily available alternatives.

We believe that we could have gone further to curing blindness in developing countries years ago if only the money, research and publicity that have gone into Golden Rice over the last 15 years had gone into proven ways of curing the Vitamin A deficiency that causes blindness.

Other concerns

Controversy in its development

• Efforts to create a 'not for profit' crop, to be made freely available to the people who would need it most, should be applauded. However in the development of Golden Rice there has been controversy, in particular, due to studies testing children without adequate permission.

Will it work?

- One reason it is taking so long to develop was because the first generation had poor levels of beta-carotene and required further gene changes.
- There are still concerns regarding potential declines in beta-carotene during storage, as it can break down in the presence of oxygen and light⁹, so it is unclear how much beta-carotene might be available when the GM rice is actually eaten.

Health risks

- It is unwise for a long-term major solution to focus on fortification of foods as there are general issues with fortification due to differences between individuals, some people in the population will inevitably get too little and others too much. Overdosing on beta-carotene has been linked to an increased cancer risk¹⁰.
- Genetic modification of metabolic pathways in plants can have unintended effects due to the complexity of the genetic pathways and break-down of genetically engineered metabolic products. There are concerns that other metabolic products may emerge in the GM rice plants which have unintended health risks, in particular Retinoic acid, which can damages human foetuses¹¹.

Will it ever be ready?

- All the initial work on Golden Rice was focussed on a strain of rice *Japonica*, a short-grain variety, not suitable for growing in the areas where Vitamin A deficiency is highest. It is only recently that the long-grain variant *Indica* has been targeted, grown in countries such as the Philippines where vitamin A deficiency is a major problem.
- After more than 15 years, Golden Rice is still far from commercialisation. The International Rice Research Institute reports that it hasn't yet been deemed safe for humans, animals or the environment, or has it been shown to reduce vitamin A deficiencies in community conditions they say this will take a further two years or more¹

Conclusion

There is no evidence that opposition to GM rice from scientists and NGOs has delayed the development of Golden Rice. What is clear after 15 years of claims about Golden Rice is that it did not provide the instant, miracle cure to blindness that pro-GM scientists, GM companies and some politicians claimed it would back in 1998. We now know that those claims were untrue. We also know from those developing it that Golden Rice is still years away from being available, and that those developing it still do not know if it is safe, nor if it will work, nor if it will prove acceptable to the people suffering from Vitamin A deficiency. What we do know is that there are already effective cures for Vitamin A deficiency, both short-term and long-term, we know that these work, and we know that the long-term solutions solve not just the problem of Vitamin A deficiency, which does not occur in isolation, but the wider problem of multiple vitamin deficiency.

¹ IRRI website: http://www.irri.org/golden-rice/faqs/what-is-the-status-of-the-golden-rice-project-coordinated-by-irri

http://aje.oxfordjournals.org/content/early/2009/02/10/aje.kwn409.abstract?maxtoshow=&HITS=10&hits=10&RE SULTFORMAT=1&author1=Satia&andorexacttitle=and&andorexacttitleabs=and&andorexactfulltext=and&searchid=1&FIRSTINDEX=0&sortspec=date&resourcetype=HWCIT

¹ http://www.fnri.dost.gov.ph/images/stories/7thNNS/biochemical/biochemical_vad.pdf

² http://www.who.int/vaccines/en/vitamina.shtml

³ 'Philippine Food Fortification Act of 2000' http://faolex.fao.org/cgi-bin/faolex.exe?rec id=032376&database=FAOLEX&search type=link&table=result&lang=eng&format name=@ER ALL

⁴ http://riforg.gainhealth.org/rice-fortification/rice-key-facts-and-figures

http://www.sendacow.org.uk/about-us For impacts, in particular in terms of balanced diets see http://www.sendacow.org.uk/assets/files/Related-downloads/Send-a-Cow-Impact-Report-WEB.pdf

⁶ See quote from Dr. Medina http://www.bbc.co.uk/news/science-environment-23581877 and quantities listed in Burri, B. J. (2011) 'Evaluating Sweet Potato as an Intervention Food to Prevent Vitamin A Deficiency', Comprehensive Reviews in Food Science and Food Safety, 10: (2) 118,130

⁷ http://www.harvestplus.org/content/uganda-and-mozambique

⁸ Burri, B. J. (2011) 'Evaluating Sweet Potato as an Intervention Food to Prevent Vitamin A Deficiency', Comprehensive Reviews in Food Science and Food Safety, **10**: (2) 118,130

⁹ http://www.clrri.org/ver2/uploads/noidung/14-03 1.pdf

 $^{^{10}}$ Satia et al (2009) 'Long-term Use of β-Carotene, Retinol, Lycopene, and Lutein Supplements and Lung Cancer' *Journal of American Epidemiology'*,

¹¹ Quoted from Dr Michael Hansen, Senior Scientist, Consumers Union – whilst carrots contain high levels of beta-carotene with no known effects on foetus development, he argues that any carrots which had resulted in adverse effects would likely to have been selected out over time. In other words, food has a long coevolutionary relationship with humans, which is short-circuited in GM crops.