

## **GE Vitamin 'A' Rice: A Blind Approach to Blindness Prevention**

**By Vandana Shiva**

Genetically engineered Vitamin A rice has been proclaimed as a miracle cure for blindness –“a breakthrough in efforts to improve the health of billions of poor people, most of them in Asia.”

More than \$100 million have been spent over 10 years to produce transgenic rice at the Institute of Plant Sciences at the Swiss Federal Institute of Technology in Zurich. The Zurich research team headed by Ingo Potrykens and Xudong Ye introduced three genes taken from a daffodil and a bacterium into a rice strain to produce a yellow rice with high levels of beta-carotene, which is converted to Vitamin A within the body.

The rice is being promoted as a cure for blindness since Vitamin A deficiency causes vision impairment and can lead to blindness. According to the UN, more than 2 million children are at risk due to Vitamin A deficiency.

The work in Zurich was funded by grants from the Rockefeller Foundation, the agency that had launched the chemical agriculture in Asia through the Green Revolution, which led to erosion of biodiversity and erosion of diverse sources of nutrition for the poor. In addition, the Swiss Government and the European Community has also supported the research.

### **Vitamin A Rice Is a Hoax**

The problem is that vitamin A rice will not remove vitamin A deficiency (VAD). It will seriously aggravate it. It is a technology that fails in its promise.

Currently, it is not even known how much vitamin A the genetically engineered rice will produce. The goal is 33.3% micrograms/100g of rice. Even if this goal is reached after a few years, it will be totally ineffective in removing VAD.

Since the daily average requirement of vitamin A is 750 micrograms of vitamin A and 1 serving contains 30g of rice according to dry weight basis, vitamin A rice would only provide 9.9 micrograms, which is 1.32% of the required allowance. Even taking the 100g figure of daily consumption of rice used in the technology transfer paper would only provide 4.4% of the RDA.

In order to meet the full needs of 750 micrograms of vitamin A from rice, an adult would have to consume 2 kg 272g of rice per day. This implies that one family member would consume the entire family ration of 10 kg. from the PDS in 4 days to meet vitamin A needs through "Golden rice."

This is a recipe for creating hunger and malnutrition, not solving it.

It will however take millions more in dollars and another decade of development work at the International Rice Research Institute to produce Vitamin A rice varieties that can be grown in farmers fields. Is the “golden” rice a miracle that is the only means for preventing blindness for Asia or will it introduce new ecological problems like the Green Revolution did and create new health hazards like other genetically engineered foods?

The genetic engineering of Vitamin A rice deepens the genetic reductionism of the Green Revolution. Instead of millions of farmers breeding and growing thousands of crop varieties to adapt to diverse ecosystems and diverse food systems, the Green Revolution reduced agriculture to a few varieties of a few crops (mainly rice, wheat, and maize) bred in one centralized research centre (IRRI for rice and CIMMYT for wheat and maize).

The Green Revolution led to massive genetic erosion in farmers fields and knowledge, erosion among farming communities, besides leading to large scale environmental pollution due to use of toxic agrichemicals and wasteful use of water.

Genetically engineered rice as part of the second Green Revolution is repeating the mistakes of the Green Revolution while adding new hazards in terms of ecological and health risks.

The “selling” of Vitamin A rice as a miracle cure for blindness is based on blindness to alternatives for removing vitamin A deficiency and blindness to the unknown risks of producing Vitamin A through genetic engineering.

### **Eclipsing Alternatives**

The first deficiency of genetic engineering rice to produce Vitamin A is the eclipsing of alternative sources of vitamin A. Per Pinstripe Anderson, head of the International Rice Research Institute, has said that Vitamin A rice is necessary for the poor in Asia, because "we cannot reach very many of the malnourished in the world with pills." However, there are many alternatives to pills for vitamin A supply. Vitamin A is provided by liver, egg yolk, chicken, meat, milk, and butter. Beta-carotene, the vitamin A precursor is provided by dark green leafy vegetables, spinach, carrot, pumpkin, mango, and drumstick. Women farmers in Bengal use more than 100 plants for green leafy vegetables.

The lower cost, more accessible and safer alternative to genetically engineered rice is to increase biodiversity in agriculture. Further, since those who suffer from vitamin A deficiency suffer from malnutrition generally, increasing the food security and nutritional security of the poor through increasing the diversity of crops and diversity of diets of poor people who suffer the highest rates of deficiency is the reliable means for overcoming nutritional deficiencies.

Sources of vitamin A in the form of green leafy vegetables are being destroyed by the Green Revolution and genetic engineering, which promote the use of herbicides in agriculture. The spread of herbicide resistant crops will further aggravate this biodiversity erosion with major consequences for increase in nutritional deficiency. For example,

bathua, a very popular leafy vegetable in North India, has been pushed to extinction in Green Revolution areas where intensive herbicide use is a part of the chemical package.

### **Environmental Costs of Vitamin A Rice**

Vitamin A from native greens and fruits is produced without irrigation and wastage of scarce water resources. Introducing vitamin A in rice implies a shift from water conserving alternatives for vitamin A to water intensive system of production since so called high yielding rice varieties are highly water demanding. Vitamin A rice will therefore lead to mining of ground water or intensive irrigation from large dams with all the associated environmental problems of water-logging and salinisation.

Further, as in the case of other genetically engineered crops, rice with vitamin A will have impact on the food web. The ecological impact on soil organisms and other organisms dependent on rice in the food chain should be part of the biosafety analysis of genetically engineered rice before it is released for production. Research has already shown that indigenous rice varieties support far more species than Green Revolution varieties. How will genetically engineered rice impact biodiversity and the potential for disease and pest vulnerability?

### **Health Risks of Vitamin A Rice**

Since rice is a staple eaten in large quantities in Asian societies, vitamin A rice could lead to excessive intake of vitamin A especially among those who do not suffer from vitamin A deficiency. Excess vitamin A can lead to hypervitaminosis A or vitamin A toxicity. Such toxicity is known to occur due to over ingestion of vitamin A rich food e.g., polar bear liver or by food faddism by over solicitous parents, or as side effects of inappropriate therapy.

Vitamin A toxicity can lead to abdominal pain, nausea, vomiting, dizziness, papilloedema, bulging fontanelle. Chronic toxicity of vitamin A can occur after ingestion of large quantities of vitamin A for protracted periods. Chronic vitamin A toxicity is characterized by bone and joint pain, hyperostosis, hair loss, dryness and fissures of lips, a nausea intraeranian hypertension, low grade fever, pruritis, weight loss, hepatosplenomegaly.

Natural sources of vitamin A are consumed seasonally and in small quantities as greens, relishes, fruits and hence do not carry the risks of vitamin A toxicity. Rice eating regions have been found to be associated with higher malnutrition than wheat eating regions, especially after the Green Revolution, which destroyed fish and plant biodiversity necessary for a balanced diet. These regions also have higher prevalence of water borne diseases like diarrhea, amoebiasis hepatitis A and E, dysentery, and vector borne diseases like malaria, which unlike in earlier years when it was a less hazardous form of malaria caused by plasmodium vivax is increasingly becoming falciparum malaria. These health problems are known to involve damage to the liver. The additional risks of vitamin A toxicity

under these conditions of vulnerable health situation of the poor in Asia needs to be assessed with care before a large scale push is given to genetically engineered rice.

Further, the globalisation of agriculture is leading to an increase in malnutrition in the Third World, as the most fertile ecosystems are diverted to luxury export crops, and as domestic markets are destroyed due to dumping of subsidised agricultural commodities. In India, per capita consumption of cereals has declined by 12 per cent in rural areas over the past two decades. The shift from policies based on the "right to food" to free trade policies will push millions into hunger and poverty.

Genetically engineered rice is part of a package of globalised agriculture which is creating malnutrition. It cannot solve the problems of nutritional deficiency but it can introduce new risks of food safety. Since the vitamin A in rice is not naturally occurring and is genetically engineered, novel health risks posed by vitamin A rice will need to be investigated before the rice is promoted by IRRI and aid agencies or commercialised.

The risk assessment for living modified organisms intended for direct use as feed is given in Annexe II of the recently finalized Biosafety Protocol under the Convention on Biological Diversity.

The risk assessment of vitamin A rice should therefore involve the following steps:

- An identification of any novel genotypic and phenotypic characteristics associated with the vitamin A rice that may have adverse effects on biological diversity in the likely potential receiving environment, taking also into account risks to human health.
- An evaluation of the likelihood of these adverse effects being realised, taking into account the level and kind of exposure of the likely potential receiving environment.
- An evaluation of the consequences should these adverse effects be realised.

The risk assessment also needs to take into account the vectors used, the insects, the ecological differences between transgenic vitamin A rice, and conventional rice varieties. The diverse contexts in which the rice is to be potentially introduced also needs to be taken into account. This includes information on the location, geographical, climatic and ecological characteristics, including relevant information on biological diversity and centres of origin of the likely potential receiving environment.

It is these potential risks which have put a question mark on genetic engineering in agriculture. The genetically engineered vitamin A rice is now being used as a Trojan horse to push genetically engineered crops and foods.

Mr. Pinstrip Anderson, the IRRI Director, has suggested that the "vitamin A rice could provide a public relations boost for plant biotechnology, which has been criticised by some environmentalists and consumer activists for promoting 'Franken foods.'" It has yet to be established that genetically engineered rice is not a Franken food.

But one thing is clear. Promoting it as a tool against blindness while ignoring safer, cheaper, available alternatives provided by our rich agrobiodiversity is nothing short of a blind approach to blindness control.

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