

# HEALTHIER RICE VARIETIES

## High-iron and high-zinc rice

Iron deficiency is the most pervasive form of malnutrition and a leading cause of anemia. The International Rice Research Institute (IRRI) is developing high-iron rice as a novel, food-based approach to complement current interventions that aim to alleviate iron deficiencies. Researchers have found that the procedure for increasing the iron content of rice grains also has the added benefit of enhancing zinc levels in rice.



### Iron deficiency anemia

The World Health Organization (WHO) states that 2 billion people—or about 30% of the world's population—are anemic, many due to iron deficiency.<sup>1</sup> A July 2013 article published in *The Lancet* confirmed that anemia is a risk factor for maternal death. The condition is exacerbated by hemorrhage, the leading cause (23%) of maternal deaths.<sup>2</sup>

In developing countries, instances of iron deficiency anemia (IDA) are higher. Certain population groups, particularly women, children, and the elderly, are also more prone to developing IDA. In the Philippines, the National Nutrition Survey of 2013 revealed that IDA affected 11.1% of the national population. IDA is highest among infants (39.4%), followed by pregnant women (25.2%) and the elderly males (23.1%).<sup>3</sup> For women and children, the main cause of IDA is an increased iron requirement coupled with very low dietary iron intake.

IDA not only affects the health of the individual but can also influence the overall productivity of the population. Estimates from WHO suggest that treatment of IDA can boost national productivity levels by up to 20%.

**Iron is an essential micronutrient for humans.** It is used primarily by the hemoglobin in red blood cells to store and to transport oxygen throughout the body. Iron is also essential for the proper functioning of several other proteins involved in various bodily processes.

### Strategies for reducing IDA

The Philippine Plan of Action has adopted a combination of interventions and services to reduce micronutrient deficiency, particularly IDA, in the Filipino population<sup>4</sup>. These are:

- **Dietary diversification.** The simplest way to ensure sufficient iron intake is to consume a diverse diet that includes good sources of iron, such as green leafy vegetables, legumes, meat, fish, and poultry. Eating iron-rich food with vitamin C-rich food is also known to boost iron absorption.
- **Promotion of optimum infant- and young child-feeding practices,** with an emphasis on exclusive breastfeeding for the first six months.
- **Supplementation.** An iron pill of 65 mg iron or 325 mg ferrous sulfate, which satisfies half of a person's daily iron requirement, costs less than US\$0.10 per dose.
- **Food fortification.** For groups such as some rural communities with limited access to commercial supplements and conventional sources of iron, consuming iron-fortified food is another alternative for ensuring adequate daily iron intake. Examples of iron-fortified food items available include flour, cereal, noodles, and rice in the Philippines and milk products in Japan.

For at-risk groups with limited access to iron-rich foods, additional complementary intervention can be implemented, such as:

- **Crop biofortification.** By increasing inherent iron levels in widely consumed crops such as rice, biofortification offers a sustainable approach to increasing people's access to iron across nearly all population sectors, especially at-risk groups with limited access to other dietary interventions.

## Why rice for iron biofortification?

Rice is an important staple food and provides as much as 80% of the daily calorie intake of populations in developing countries. The majority of these populations consume rice as polished white grains, which contain low amounts of iron.

Biofortification offers the opportunity to increase the iron content of rice and thus elevate baseline iron levels in a large part of the population, especially those who are at risk of developing iron deficiency.

Biofortified crops can be developed through traditional breeding. However, when a crop like rice contains inherently low levels of a particular nutrient like iron, and no sufficient genetic variation is observed in modern or traditional varieties, genetic engineering can be employed to further enhance its nutrition content.

## IRRI's approach to developing high-iron rice

Most of the iron in the rice grain is accumulated in the external part of the grain. Consequently, the iron content of rice drops significantly after polishing. Thus, population groups who eat rice as a staple and consume minimal amounts of iron-rich food are likely to develop iron deficiency.

IRRI is using biotechnology approaches that safely and responsibly deliver additional benefits to farmers and consumers that cannot be achieved through conventional breeding.

IRRI has screened 12,000 types of rice for iron content and more than 11,000 samples have been screened at CIAT. However, the highest iron levels observed were low and highly season-dependent. Moreover, the trait was found in a tropical japonica background, while it is indica rice that is widely consumed in countries with high prevalence of iron deficiency anemia. **The challenge, therefore, of iron biofortification, which cannot be addressed by conventional breeding, is passed on to genetic engineering.**

For more on high-iron rice and high-zinc rice, scan the QR code above with your mobile device or visit:



[irri.org/our-impact/making-rice-healthier/high-iron-rice](http://irri.org/our-impact/making-rice-healthier/high-iron-rice)



[irri.org/our-impact/making-rice-healthier/high-zinc-rice](http://irri.org/our-impact/making-rice-healthier/high-zinc-rice)

One of these approaches is the genetic modification of rice to increase the iron concentration in the endosperm (the part of the rice grain retained after polishing). This approach also has the added benefit of simultaneously boosting zinc levels in the endosperm.

IRRI strives to ensure that the development of any genetically modified (GM) rice will be done in full compliance with national and international biosafety regulations. Advanced bioavailability studies will also be conducted prior to the public release of any GM rice variety to verify its effectiveness in reducing a particular micronutrient deficiency.

The potential impact of GM high-iron rice on child and maternal nutrition is very promising and can complement current dietary interventions to alleviate iron deficiency.

## References:

- <sup>1</sup>World Health Organization. 2013. Micronutrient deficiencies: iron deficiency anaemia. <http://www.who.int/nutrition/topics/ida/en/>
- <sup>2</sup>Black, R. et al. 2013. Maternal and child undernutrition and overweight in low-and middle-income countries: prevalences and consequences. The Lancet nutrition series.
- <sup>3</sup>Food and Nutrition Research Institute. 2013. 8<sup>th</sup> National Nutrition Survey. Philippines.
- <sup>4</sup>National Nutrition Council. 2012. Philippine Plan of Action 2011-16.

## International Rice Research Institute (IRRI)

IRRI is the world's premier research organization dedicated to reducing poverty and hunger through rice science; improving the health and welfare of rice farmers and consumers; and protecting the rice-growing environment for future generations. Headquartered in the Philippines and with offices in 17 countries, IRRI is a global, independent, nonprofit research and training institute supported by public and private donors.

IRRI breeds and introduces advanced rice varieties that yield more grain and better withstand pests and disease as well as flooding, drought, and other harmful effects of climate change. The Institute develops new and improved methods and technologies that enable farmers to manage their farms profitably and sustainably. IRRI recommends rice varieties and agricultural practices suitable to particular farm conditions and consumer preferences. Finally, IRRI assists national agricultural research and extension systems (NARES) in formulating and implementing national rice sector strategies and programs.

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