A global need for nutrients Everything you need to know about fortified rice

by DSM, The Netherlands

Rice kernels can be fortified with several micronutrients, such as iron, folic acid and other B-complex vitamins, vitamin A and zinc. Size, shape and color of fortified kernels can be adapted to local needs. Fortified rice cooks, tastes, and looks the same as ordinary rice. A global need for nutrients

As one of the world’s most widely consumed foods, rice plays a significant role in many diets around the globe. In low income countries, it can make up to 70 percent of an individual’s calorie intake.

Although it is a great source of energy, it is a poor source of micronutrients and has a low overall nutritional value beyond carbohydrates and protein. This is because the milling process that produces white rice removes the fat, as well as the more nutrient-rich bran layers.

Parboiled rice, brown rice and bio-fortified rice (for example high-zinc rice) are more nutritious compared to white rice in one or a few essential micronutrients. This is due to different paddy processing or utilising more nutritious rice varieties.

In this article the focus will be on post-harvest rice fortification – the addition of several essential vitamins, minerals and potentially other nutrients to make any rice variety more nutritious post-harvest and after paddy processing.

Vitamin and mineral deficiencies are also an issue outside of low-income countries, affecting most regions worldwide at varying levels. While malnutrition is often associated with those not consuming enough calories, the lack of essential vitamins and minerals in ample or high calorie diets is a prominent issue, known as 'hidden hunger’.

Filling the nutrient gap

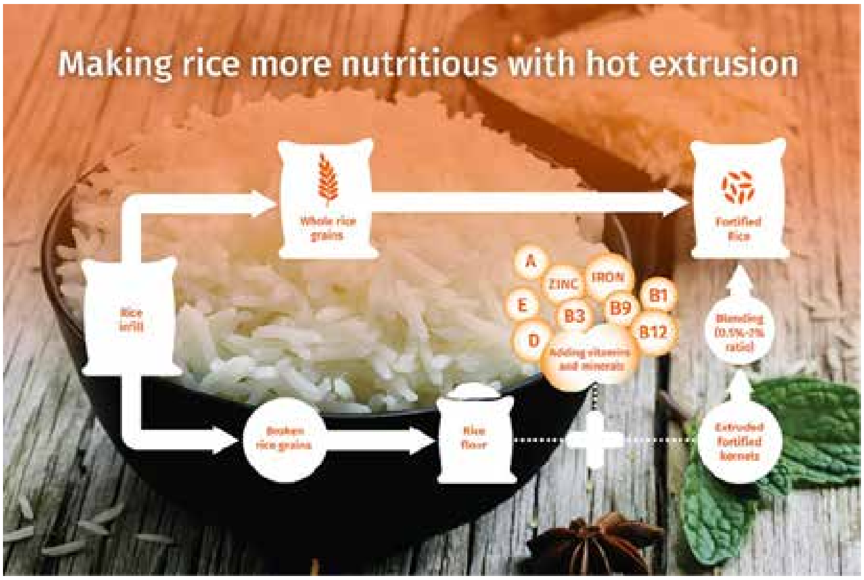
The popularity of rice presents an opportunity to fill the nutrient gap in rice-eating populations worldwide by increasing the nutritional value of rice. A wide variety of vitamins, minerals and other nutrients such as amino acids and fibres can be added post-harvest to effectively address malnutrition and contribute to Sustainable Development Goal 2 (SDG2).

A growing number of countries have mandated rice fortification and are fortifying rice distributed through social safety nets (for example school feeding), or have set voluntary rice fortification standards to address hidden hunger.

Rice fortification terminology (post-harvest)

Term	Definition
Fortificant:	selected vitamins and minerals used to fortify rice
Fortificant mix or micronutrient premix	powder blend of various vitamins and minerals
Fortified rice kernels	rice kernel-shaped kernels that are fortified with vitamins and minerals and are mixed with the regular rice
Fortified rice	regular rice blended with the fortified kernels, typically at 0.5-2%

To have a positive health impact, fortified rice needs to have good:
Stability during transport and storage
Retention during cooking & preparation
Consumer acceptability
Absorption by the body of the used micronutrients



Rice can be made more nutritious by adding vitamins, minerals and other nutrients to replenish micronutrients lost in the milling process and reinforce its nutritional value. Fortified rice can be adjusted based on the nutritional needs and can made to resemble the different rice varieties.

Methods of making rice more nutritious post-harvest

Dusting is a process where rice kernels are dusted with a micronutrient powder, relying on an electrostatic force to bind the dry powder to the surface of the grain. Fortified rice produced by dusting cannot be washed or cooked in excess of water.

Coating is a method that involves the use of a fortificant mix and ingredients such as wax or gum to 'fix' the micronutrient layer being sprayed onto rice. The produced fortified kernels are blended with regular rice, typically at 0.5-2 percent ratio.

Hot or warm extrusion is considered the most robust method of rice fortification, supported by extensive evidence base to have a positive impact on micronutrient deficiencies. Broken rice grains are ground into rice flour, then mixed with water and the required nutrients to produce a dough.

The fortified dough is then passed through an extruder to produce the fortified kernels, which are then blended with regular rice typically at 0.5-2 percent ratio. The temperature at which the extrusion takes place determines if we speak of hot or warm extrusion and has an influence on the rice starch gelatinisation and thus firmness of the produced fortified kernels.

Selecting an appropriate technology and fortificant forms to fortify rice post-harvest is crucial to successfully improve micronutrient health. In countries where rice is frequently washed, soaked or cooked in excess water, dusting will not be effective, and a coating technology needs to be rinse resistant to be effective.

Hot extrusion is supported by a robust evidence base and shows excellent consumer acceptability. The fortified rice looks, cooks and tastes the same as non-fortified rice.

Benefits of fortification & beyond

The overarching purpose of fortified rice is to meet nutritional goals for the end consumer. In order for nutritional programs to reach their full benefit, fortification programs need to meet certain requirements in order to be effective.

Ease of use

As a widely used staple food, it is simple to replace standard rice with fortified rice to boost the nutritional profile of a simple diet. With certain methods of fortification, consumer usage is key in effectiveness.

However, advances in fortification technologies, such as the use of hot extrusion, also ensure the added high-quality micronutrients remain stable without requiring a behaviour change or further education for the end consumer.

Low cost

The specific costs of fortified rice depend on several factors, such as the scale of the operation and the blending ratio of fortified to non-fortified kernels - most commonly 0.5-2 percent.

However, rice fortification costs are small compared to the wide-reaching benefits. The cost impact is around 0.5-3 percent, yet such strategies can help tackle malnutrition at both a population and personal level.

Consistency for consumers

It looks, cooks, and tastes the same as non-fortified rice. This is great for individuals in low income countries, where awareness and education on both nutrition and usage of fortified rice may be lacking.

Market differentiation for brands

Fortified rice can also be customised for specific needs. It presents a solution for health-conscious consumers looking for new ways to reach specific health benefits.

Reducing micronutrient deficiencies for governments and schools

For governments, mandatory rice fortification can support a country to significantly reduce micronutrient deficiencies (MNDs), though this does rely heavily on successful and wide-reaching implementation and is very challenging when the rice milling landscape is highly fragmented.

There's also the opportunity to build fortified rice into school feeding programs and government social safety nets, offering the same benefits on a smaller scale, but targeting vulnerable populations at high risk of deficiencies.

Case study: fortification in practice

Fortification itself is not a new concept. It has served as a popular method of improving public health for more than 90 years. While over 30 percent of industrially milled wheat flour and almost half of industrially milled maize flour is fortified worldwide, efforts to fortify rice are relatively new.

About one percent of industrially milled rice is fortified. Due to the growing pool of scientific evidence supporting the positive nutritional effects of rice fortification, it is expected to see substantial growth.

Rice fortification presents an opportunity to reach hundreds of millions of people in parts of the world where rice is the most commonly consumed grain.

Rice fortification is currently mandatory in eight countries: Costa Rica, Nicaragua, Panama, Papua New Guinea, Philippines, Solomon Islands, some states of the United States and voluntary in another eight countries: Bahrain, Bangladesh, Belize, India, Myanmar, Peru, and Venezuela.

Since 2001, all rice in Costa Rica is required to be fortified with vitamins B_1 (thiamin), B_3 (niacin), B_{12} (cobalamin), E, folic acid, selenium and zinc. This, alongside fortification of other food vehicles such as salt, wheat flour, and milk, is considered to have significantly helped improve the nation's micronutrient status.

As a result of the wider fortification program, micronutrient status has improved across Costa Rica, and the country has seen reductions in conditions associated with micronutrient deficiencies, such as anemia and neural tube defects.

The success of Costa Rica's rice fortification program is due to a combination of factors. Its experience in, and understanding of, fortification for other foods is key, as is its centralised rice industry, alongside the government's commitment to the scheme.