FAQs on Rice Fortification
Frequently Asked Questions on Fortification of Rice

Q: What is rice fortification?
A. Rice fortification is the process of increasing essential micronutrients in rice, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health.

Q: Why fortify rice?
A. India is a leading rice producing country, with 22 percent of the total global rice production and 65% of India's population consumes rice on a daily basis- the per capita rice consumption in India is 6.8 kilogram per month. Rice is therefore a large source of calories and core component of agriculture and nutrition in most of India though low in micronutrients. Milling of rice removes the fat and micronutrient rich bran layers to produce the commonly consumed starch white rice while polishing further removes 75-90% of vit. B1, vit. B6, vit. E and Niacin. Fortifying rice provides an opportunity to add back the lost micronutrients but to also add others such as iron, zinc, folic acid, vit. B12 and vit. A.

Regulatory considerations for rice fortification:

Q: What are the standards that have been put in place by FSSAI for fortified rice?
A. Rice, when fortified, shall contain added iron, folic acid and Vitamin B-12 at the level given in the table below:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Nutrient</th>
<th>Level of Fortification per Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Iron</strong>- (a) Ferric pyrophosphate (b) Sodium Iron (III) Ethylene diamine tetra Acetate, Trihydrate (Sodium federate-Na Fe EDTA);</td>
<td>20 mg</td>
</tr>
<tr>
<td>2.</td>
<td>Folic acid- Folic acid;</td>
<td>1300 µg</td>
</tr>
<tr>
<td>3.</td>
<td>Vitamin B12- cyanocobalamine, hydroxycobalamin;</td>
<td>10 µg</td>
</tr>
</tbody>
</table>
In addition, rice may also be fortified with following micronutrients, singly or in combination, at the level given in the table below:

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Zinc-Zinc Oxide</td>
<td>30 mg</td>
</tr>
<tr>
<td>2.</td>
<td>Vitamin A- Retinyl Palmitate;</td>
<td>1500 μg RE</td>
</tr>
<tr>
<td>3.</td>
<td>Thiamine (Vitamin B1)- Thiamine hydrochloride, Thiamine mononitrate;</td>
<td>3.5 mg</td>
</tr>
<tr>
<td>4.</td>
<td>Riboflavin (Vitamin B2)- Riboflavin, Riboflavin 5'-phosphate sodium;</td>
<td>4 mg</td>
</tr>
<tr>
<td>5.</td>
<td>Niacin-Nicotinamide, Nicotinic acid;</td>
<td>42 mg</td>
</tr>
<tr>
<td>6.</td>
<td>Pyridoxine(Vitamin B6)-Pyridoxine hydrochloride;</td>
<td>5 mg</td>
</tr>
</tbody>
</table>

**Rice fortification technologies:**

**Q:** What are the various technologies available for fortification of rice?  
**A:** There are three main technologies available to produce fortified rice. They are: coating, extrusion and dusting.

In the coating method, the nutrient (vitamin or mineral mix) is combined with ingredients such as waxes and gums. It is then sprayed on the surface of rice grains in several layers. This is then blended with polished rice at about a ratio of 1:100.

In dusting, micronutrients in the form of fine particles are blended with bulk rice. This method makes use of the electrostatic forces between the rice's surface and the micronutrients. Details on extrusion are provided below.

**Q:** What is the rice fortification technology available in India?  
**A:** In India, rice is fortified using extrusion technology. In this technology, milled rice is pulverized and mixed with a premix containing vitamins and minerals. Fortified rice kernels (FRK) are produced from this mixture using an extruder machine. FRK is added to traditional rice in ratio ranging from 1:50 to 1:200 resulting in fortified rice nearly identical to traditional rice in aroma, taste, and texture. It is then distributed for regular consumption.

**Q:** Why is extrusion the technology of choice for fortification of rice?  
**A:** The extrusion technology for production of fortified rice kernels (FRKs) is the technology of choice given the stability of micronutrients in the rice kernels across processing, storage, washing and cooking also in view of the cost considerations.
Q: What are the different types of extrusion technology available for fortification of rice?
A. Depending upon the temperature at which extrusion is done, the extrusion may be referred to as hot or cold. Hot extrusion (70-110°C) produces the highest quality kernels and is most expensive. Cold extrusion (70°C) is less expensive but might be rejected by consumers demanding uniformity in each grain’s shape, color, translucency, size and texture. A hybrid method called warm extrusion is also used by various manufacturers.

Process and equipment needed for production of extruded fortified rice kernels:

Q. How are fortified rice kernels produced by extrusion process?
A. Milled rice is pulverized and mixed with a premix containing vitamins and minerals. FRKs are produced from this mixture using an extruder machine. The kernels resemble rice grains. These kernels are then blended with milled rice in the proportion of 1:50 to 1:200 (FRK: Traditional Rice).

Q. What is the equipment required for the production of fortified rice kernels through extrusion technology?
A. Extrusion processing requires an extrusion assembly with a dryer to produce the fortified rice kernels. The function of various parts of extrusion set-up is as follows:
   Blender/Mixer: To uniformly blend the rice flour and the premix
   Preconditioning Unit: It hydrates the raw material and helps in homogeneity of the raw materials
   Extruder Barrel: The heating of the dough & cooking happens at the extruder barrel. Ideally, a twin screw extruder would suit best for the purpose
   Knife Assembly & Die Plate: It cuts the dough to facilitate movement to the die plate and the die plate is responsible for forming the kernels.
   Vibratory Conveyor: For Separating the Kernels from each other.
   Dryers: It is responsible for drying the end product to a desired moisture content.

Q. How is fortified rice produced?

Production of Fortified Rice is a two staged process.
In stage 1, the rice shaped grains will be produced using rice flour, Vitamins & minerals and water passing the dough through an extrusion machine.

In stage 2, the rice shaped grains will be mixed with the traditional milled rice in 1:50 to 1:200 ratios depending on the costing and physical properties of the grain.

The blended rice is called fortified rice which includes the prescribed amounts of nutrients.

**Q: How are the fortified rice kernels blended with the normal rice?**
A. Two types of blending are applicable for the production of fortified rice – continuous blending & batch blending.

**Continuous Blending:** Applicable for large scale blending of the fortified rice. The batch blending involves the simultaneous addition of fortified rice kernels and the regular rice. A typical continuous blending assembly involves bins/hoppers for fortified rice kernels and normal rice, bucket elevators for transport, blending, air locks/flow balancers to regulate the flow or Fortified Rice Kernels/Regular Rice.

**Batch Blending:** A batch blending assembly usually involves a bin for the fortified rice kernels, through which the kernels are dispensed into the blending unit where the normal rice and kernels are blended.

**Q: What are blender options available for uniform blending of FRK with regular rice?**
A. Equipment with variable flow mechanisms and modern mixing systems guarantee uniform mixing of the FFRKs with rice and are used for blending. The different blenders available are – Ribbon/Paddle blenders, Rotary Batch Blenders, Vee Cone Blenders and fluidized bed blenders.

**Q: What are the factors to be considered while selecting a blending system?**
A. (i) Quantity of rice to be fortified
(ii) Feasibility of installation
(iii) The blending unit should ensure that the FRKs are not broken in the process

**Cost considerations:**

**Q: What would be the approximate cost of an extruder line?**
A. A typical low cost 150 kgs per hour twin screw extruder with all ancillary equipment costs 35 – 40 lakhs INR upwards. A good quality extrusion line may cost up to 13.5 crore INR. Utility costs like purified water plant, steam generator, air compressor and packaging lines are not included here.
Q: What is the per kg incremental cost on account of fortification?
A. The cost of fortification is determined by a multitude of context specific variables such as the structure and capacity of the rice industry, the complexity of the supply chain, the policy and regulatory environment and the scale of the relevant programme. The retail price increase for fortified rice ranges from an additional 1% to 10%. As rice fortification expands, production and distribution achieve economies of scale, costs are expected to reduce. Fortifying rice is cost-effective; the additional cost to the consumer inclusive of all associated costs is expected to vary between 0.4-1.3 INR per kg depending on the above factors as well as the nutrients added.

Research and experience:

Q: Can any variety of rice be fortified?
A. All varieties of rice can be fortified; however this will require tailoring of fortified kernels accordingly.

Q: Does fortified rice improve people's health and nutritional status?
A. There are more than 17 scientific publications in over 25 countries including India demonstrating that consumption of extruded fortified rice is safe and effective in women and children and can significantly address hemoglobin status, iron-deficiency anemia, iron deficiency (i.e., ferritin levels), and improve status of other critical micronutrients including vitamin A, zinc, folic acid, vitamin B12. It is also known to improve cognition and physical performance. Many more studies also support the acceptability of extruded fortified rice.
Q. Is fortified rice acceptable to consumers?

![Acceptability Scores for Fortified and Non-fortified Rice](image)

Fortified rice tastes, looks and smells like non-fortified rice

Q. Are the nutrients in fortified rice retained after cooking?

30 min soaking before boiling in excess water and discarding water

- Boiling in excess water and discarding water
- Boiling and letting rice absorb water
- Washing before boiling and letting rice absorb water
- Frying before boiling and letting rice absorb water

![Percent Retention of Nutrients Exposed to Different Preparation and Cooking Methods](image)

In fortified rice made through extrusion technologies, there is good retention of most nutrients over a wide variety of washing and cooking methods

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Q. Are there any other countries where fortified rice is consumed?
A. There are five countries in the world where rice is mandated to be fortified by law—these are Costa Rica, Nicaragua, Panama, Papua New Guinea and the Philippines. Costa Rica is the country in the world with the most successful rice fortification programme. In addition to these countries, rice is also fortified voluntarily in Brazil, Dominican Republic, Colombia, South Africa and the United States of America.

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Potential market for fortified rice:

Q. What could be the delivery options for fortified rice?
A. Fortified rice could be delivered through the social safety nets of the Government namely the Targeted Public Distribution System, the Mid-day meal scheme as well as the Integrated Child Development Services (ICDS) scheme as well as through open market channels.

For more information, please contact

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