Webinar on Scaling Up Rice Fortification in Government Safety Net Programmes and Open Market

Technology and Process for Fortification

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Deputy Director - MNCHN
PATH a key TECHNICAL PARTNER
To GoI and Multiple State Governments

Pilot Scheme
Fortification of Rice and its Distribution under Public Distribution System

OPERATIONAL GUIDELINES

Technology manual for the production of fortified rice kernels and blended fortified rice

GLOBAL AND INDIAN EVIDENCE ON FORTIFIED RICE

LAUNCH OF FOOD FORTIFICATION STANDARDS
Designed with support of PATH
https://ffrc.fssai.gov.in/partners
Rice is an ideal vehicle in India to meet missing nutrient needs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Suitability for rice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>• <strong>Staple food for 70 percent of Indian population</strong></td>
</tr>
<tr>
<td></td>
<td>• Second largest producer of rice in the world (10.7 crore MT)</td>
</tr>
<tr>
<td></td>
<td>• Meets 31 percent of population’s energy intake.</td>
</tr>
<tr>
<td>Coverage</td>
<td>• <strong>Highest uptake in the Government’s safety net programs – 3.5 Crore MT for FY 2019-20</strong></td>
</tr>
<tr>
<td>Acceptability</td>
<td>• Well accepted – taste and aroma of final product cannot be distinguished from unfortified rice</td>
</tr>
<tr>
<td>Stability</td>
<td>• Can be stored as normal rice with minimal losses of nutrients</td>
</tr>
<tr>
<td>Micronutrients</td>
<td>• Iron, Folic Acid, Vitamin B12</td>
</tr>
<tr>
<td>Technology</td>
<td>• Technology is simple, cost-effective and well established – Extrusion Technology in India</td>
</tr>
<tr>
<td>Shelf life</td>
<td>• 24 months</td>
</tr>
<tr>
<td>Cost</td>
<td>• minimal – (1:40 incremental cost for rice fortification: price of rice to the Government)</td>
</tr>
</tbody>
</table>
Rice fortification – a strategy since 1930s

- Parboiling
- Coating
- Dusting
- Philippines mandate
- Cold extrusion
- Hot/warm extrusion
- Costa Rica mandate

1930s 1940s 1950s 1952 1990s 2000s 2001

Global status of rice fortification programs

- Social safety net program (4)
- Mandatory legislation (6)
- Voluntary fortification (market-based) (4)
- Workplace benefit program (2)
- Pilot project (3)
Rice fortification is a proven strategy to address malnutrition

19 research and field studies across globe¹
5 Studies from India has been published and 2 studies are to be published

**Key research areas**
- Effectiveness
- Efficacy
- Acceptance

**Age-groups**
- Women of reproductive age – including pregnant and lactating mothers
- Infants
- Children
- Adolescents

**Peer-reviewed research highlights**
- Increase in blood haemoglobin level
- Increase in serum ferritin levels
- Significant increase in plasma Vitamin A levels
- Increase in serum zinc levels
- Increase in plasma B12
- Increase in thiamine levels
- Increase in cognition and physical capacity
- Decrease in anaemia prevalence
- Decrease in prevalence of iron deficiency

Additional studies in more than 25 countries worldwide support the acceptability and safety of extruded fortified rice

¹ Source: World Health Organization
Evidence created by PATH along with Partners

Study done by DBT, NIN, and PATH in 2011 showed improvement in iron stores and reduction in iron deficiency among school children in Andhra Pradesh.
Major components for scaling up rice fortification

- Blending Solutions
- Production
- Rice Fortification
- Technical Support
- Advocacy
- Project Implementation

Supply

Demand
The process to fortify rice consists of two main steps:

1. **STEP 1: Create fortified kernels**
   - Extruded kernels:
     - Rice flour
   - Vitamin & Minerals
   - Fortified kernels

2. **STEP 2: Blend fortified kernels with milled rice**
   - Fortified kernels
   - Milled rice
   - Fortified rice

Fortified Rice Kernels - FRK
Extrusion line for FRK production

Cost of the FRK line set up is estimated to be 65 – 80 lakh for 150kg FRK / hr capacity
## Supply Capacity of FRK Manufacturers in India

<table>
<thead>
<tr>
<th>Current Supplier</th>
<th>FRK/ Annum (MT)</th>
<th>Fortified Rice/ Annum (MT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Suppliers-13</td>
<td>16,314</td>
<td>16,31,400</td>
</tr>
<tr>
<td>Prospective-7</td>
<td>21,942</td>
<td>21,94,200</td>
</tr>
<tr>
<td>Pipeline-10</td>
<td>12,945</td>
<td>12,94,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>51,201</strong></td>
<td><strong>51,20,100</strong></td>
</tr>
</tbody>
</table>

Centre sector scheme requirement is 9,500 MT and for PDS ~ 350,000 MT

* Manufacturers having extruders for large scale manufacturing of snack products can take up rice fortification by upgrading the die for the extruder for 5 lakh.
Various blending solutions

Drum blender

Zig Zag Blender

Batch Blender
Components of blending machine for rice fortification

- **Vibratory Feeder**
- **Blender**
  - Customized solution based on requirement, various blending solutions are available
  - 5-7 Lakhs
- **Bucket elevator, based on requirement**
- **Storage hoppers for FRK and Rice**

Blending solutions are designed based on requirement and availability of existing infrastructure at rice mill.

A blending solution is depicted here.

Blending system price has been considerably brought down from 40 to 16 lakh (5MT) and 12 L (3MT). If the miller has the addl. grader at his facility, then it will cost 6 to 7 lakh for the entire blending solution.
Blending Efficiency Test

- Fortified Rice Kernel Density should be as close to the normal rice that is being fortified.
- Homogeneity of FRK in fortified rice can be evaluated by understanding the number of kernels per gram of FRK in 100 grams of fortified rice.
- The density of FRK depends on each batch/lot produced by FRK manufacturer.
- It may be advised to measure the number of FRK grains per one gram of FRK which will be equivalent to the number of FRK in 100 grams of blended fortified rice.
- For example, if 1g of FRK has 50 FRK kernels then the 100g of fortified rice should contain 50 FRK kernels or the 50g of fortified rice should contain 25 FRK kernels.
Standard operating procedure to test the consistency of iron-fortified blended rice

Step 1 Collect 50 grams of blended fortified rice from the batch using the small beaker.

Step 2 Pour a 50 gram sample into the tray.

Step 3 Prepare 1% chemical solution in the large beaker by adding 1ml of Povidone-Iodine solution to 100ml of water until it turns an orange colour.

Step 4 Pour the chemical solution into the tray.

Step 5 Mix sample with the solution by tilting the tray for 10 to 15 seconds until it turns dark-violet in colour.

Step 6 Drain the solution keeping the rice in the tray.

Step 7 Count the discolored fortified grains and record the number.

Step 8 Throw away the sample after testing is complete.

Step 9 Wash your hands.
Quality Assurance (QA)/Quality Control (QC) Plan for Rice Fortification for FRK producer and Fortified Rice Producer

### QA/QC plan for Fortified Rice Kernel Producer

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Products</th>
<th>Test Details</th>
<th>Testing Frequency</th>
<th>Agency responsible</th>
<th>Place of Testing</th>
<th>Place of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Broken rice</td>
<td>Quality Control Parameters</td>
<td>Every Consignment</td>
<td>FRK Producer</td>
<td>National Accreditation Board for Testing and Calibration Laboratories (NABL)/FSSAI Accredited Laboratory</td>
<td>FRK Producer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>microbiological, Pesticide residues and metal contaminants within prescribed limit</td>
<td>As per FSSAI regulations</td>
<td>FRK Producer</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>FRK Producer</td>
</tr>
<tr>
<td>2</td>
<td>Vitamin Premix</td>
<td>Vegetarian source declaration</td>
<td>Every Batch</td>
<td>Premix Supplier</td>
<td>Premix Supplier</td>
<td>Premix Supplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CoA for Micro-nutrient content</td>
<td>Every Batch</td>
<td>Premix Supplier</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>Premix Supplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food Grade Certificate</td>
<td>Every Batch</td>
<td>Premix Supplier</td>
<td>Premix Supplier</td>
<td>Premix Supplier</td>
</tr>
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</table>
# Quality Assurance (QA)/Quality Control (QC) Plan for Rice Fortification for FRK producer and Fortified Rice Producer

## QA/QC plan for Fortified Rice Kernel Producer

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<th>Place of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Water</td>
<td>Water test report</td>
<td>Once in 6 Months</td>
<td>FRK Producer</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>FRK Producer</td>
</tr>
<tr>
<td>4</td>
<td>Finished goods</td>
<td>Microbial load, Micronutrient content</td>
<td>Every Consignment</td>
<td>FRK Producer</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>FRK Producer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy metal contaminants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## QA/QC plan for Fortified rice producer/miller

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Products</th>
<th>Test Details</th>
<th>Testing Frequency</th>
<th>Agency responsible</th>
<th>Place of Testing</th>
<th>Place of sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blended Rice</td>
<td>Blending ratio</td>
<td>Continuous system: four times a day i.e. i) Start of the day, ii) End of first half, iii) Start of second half and iv) end of the day. Batch System: Each new batch that is initiated.</td>
<td>Fortified Rice producer</td>
<td>Fortified Rice blending unit</td>
<td>Fortified rice producer</td>
</tr>
</tbody>
</table>


Rice Fortification Scale-up Model – Blending @ Source / Rice Mill

Paddy Procurement

- DCMSs
- PACs
- Farmer Societies

FARMERS Procures Paddy

Brings paddy to PPCs

Paddy Procurement Centers (PPCs)

Milling

- FRK Producer

FRK supplied to rice mill

Rice Miller

Blending operations after milling – Fortified rice supplied by rice mill

Rice Distribution

- Warehouse – State Civil Supplies Corporation
- Warehouse – State Civil Supplies Corporation

Distribution of fortified rice

Fair Price Shops

Social welfare schemes

Beneficiaries

Rice purchase from FPS

- BPL
- APL
- AAY
- MDM
- ICDS

Depending on quantity and operational feasibility, fortified rice can be supplied either from FPS or block level warehouses

*DCM - District co-operative marketing societies and PAC - Primary Agricultural Cooperative societies.
Process of Rice fortification in PDS
## Incremental Cost of Fortification @ Source (Rice Mills)- Scale Up

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Yearly rice offtake volume under the scheme in MT</th>
<th>Yearly economic cost of rice procurement - Crore (Raw Rice Common Grade) - INR Crore</th>
<th>Yearly economic cost of fortified rice procurement - Crore (Raw Rice Common Grade)** - INR Crore</th>
<th>Incremental cost of rice fortification - INR Crore</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPDS+NFSA</td>
<td>3,09,73,720</td>
<td>1,02,291</td>
<td>1,04,886</td>
<td>2,595</td>
</tr>
<tr>
<td>MDM</td>
<td>16,88,380</td>
<td>5,576</td>
<td>5,717</td>
<td>141</td>
</tr>
<tr>
<td>ICDS</td>
<td>4,79,860</td>
<td>1,585</td>
<td>1,625</td>
<td>40</td>
</tr>
<tr>
<td>SABLA</td>
<td>2,960</td>
<td>10</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Welfare Inst.</td>
<td>3,44,680</td>
<td>1,138</td>
<td>1,167</td>
<td>29</td>
</tr>
<tr>
<td>Annapurna</td>
<td>7,160</td>
<td>24</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Defence</td>
<td>1,06,450</td>
<td>352</td>
<td>360</td>
<td>9</td>
</tr>
<tr>
<td>Others</td>
<td>1,08,220</td>
<td>357</td>
<td>366</td>
<td>9</td>
</tr>
<tr>
<td>Retail Sale</td>
<td>14,22,540</td>
<td>4,698</td>
<td>4,817</td>
<td>119</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,51,33,970</strong></td>
<td><strong>1,16,030</strong></td>
<td><strong>1,18,973</strong></td>
<td><strong>2,943</strong></td>
</tr>
</tbody>
</table>


Cost of rice fortification at warehouse locations would be 1.7 times higher hence not recommended (4,994 crores).
Inclusion of Rice Fortification in the NFSA

- Total food subsidy under NFSA for 2019-20 is 1,08,688.35 crores.

- Additional cost of Rs.2595 crore annually constitutes around 2% of total NFSA food subsidy.

- Thus, fortified rice through PDS is a cost-effective strategy to address malnutrition at the population level.
Cost : Benefit ratio – Rice Fortification

- Each year, India loses more than 9000 crores (12 billion) in gross domestic product due to nutrient deficiencies.

- At the Copenhagen Consensus Center, 2012, a team of Nobel Laureate economists found that micronutrient interventions designed to increase nutrient intake were the most effective investment that could be made, with massive benefits for a tiny price tag.

- Fortification yields Rs. 84 for every Re spent on reducing iron deficiency anemia prevalence.

- Correcting iron deficiency yields benefits in increased cognitive ability for children as well as greater endurance and work capacity of adults, with an estimated 8:1 benefit: cost ratio.

- Folic acid interventions would have prevented about 116,070 cases of folic acid preventable spina bifida and anencephaly (FAP SBA) and 101,565 under-five deaths associated with FAP SBA.

- Fortification of rice with iron, Vitamin B12 and folic acid through the schemes like PDS extending to ICDS, SABLA, MDM, welfare home etc. requires an additional outlay of Rs. 2,943 Crore which when done provides a benefit of 23,544 crores expense in health and wellness.
Potential of rice fortification through safety net and open market

✓ Staple food consumed by more than half of population.

✓ Cost of fortifying – minimal – (1:40 to 1:100 = premix : sale price of rice)

✓ Enabling environment created by the government of India

✓ Technology is simple, cost-effective and well established – Extrusion Technology in India

✓ Growing demand by consumers
Rice fortification is ready for a quantum leap in scope and impact

“The doctor of the future will no longer treat the human frame with drugs, but rather will cure and prevent disease with nutrition.”
- Thomas Edison (1847 – 1931), American Inventor, Scientist & Businessman