Technical Hand-out on Fortification of Rice

FORTIFIED
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fssai
FOOD SAFETY AND STANDARDS
AUTHORITY OF INDIA
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Fortified rice has been identified as one of the vehicles to promote food fortification as a means to address micronutrient deficiencies in India which is a serious public health issue affecting all sections of our population, impacting their physical and mental growth. Food Safety and Standards Authority of India (FSSAI) has come out with comprehensive standards to promote food fortification.

In order to scale up rice fortification in India, a technical manual has been developed to build the capacity of the rice millers to upgrade their facilities and ensure quality for mass production. This manual will help guide and train the rice industry on the production of fortified rice kernels (FRKs) and also act as a basis for monitoring by the Food Safety Officers.

I appreciate the support of PATH, who has assisted in the development of this technical manual.

(Pawan Agarwal)
CEO, FSSAI
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**Abbreviations**

- CoV : Coefficient of Variance
- FAO : Food and Agriculture Organization
- FSSAI : Food Safety Standards Authority of India
- FRK : Fortified Rice Kernel
- FR : Fortified Rice
- GMP : Good Manufacturing Practices
- MT : Metric Ton
- NABL : National Accreditation Board for Testing and Calibration Laboratories
- PLC : Programmable Logic Controller
- QA : Quality Assurance
- QC : Quality Control
- QQ : Quintal
- STPP : Sodium Tripolyphosphate/ Sodium triphosphate/ Pentasodium triphosphate (Na5P3O10)
- WHO : World Health Organization
A. Introduction

Micronutrient malnutrition is a major impediment to socioeconomic development and contributes to a vicious circle of underdevelopment, to the detriment of already underprivileged groups. It has long-ranging effects on health, learning ability, and productivity. Micronutrient malnutrition leads to high social and public costs, reduced work capacity in populations due to high rates of illness and disability, and tragic loss of human potential. Overcoming micronutrient malnutrition is a precondition for ensuring rapid and appropriate development. Billions of people in the world today suffer from micronutrient malnutrition—substantially contributing to the global burden of disease, affecting the physical and cognitive development of young children, and dramatically reducing the work productivity of entire populations. Each year, anemia saps the energy and learning capacity of nearly two billion people, many due to iron deficiency. Deficiencies of vitamin A and zinc adversely affect child health and survival, and are attributable for over 270,000 child deaths annually. Lack of folic acid amongst expectant mothers during their first days of pregnancy causes more than 200,000 severe birth defects.

India has one of the highest malnutrition rates in the world. Iron and vitamin A deficiencies are ranked among the 15 leading causes of disease burden. Iron deficiency in women of child-bearing age is the second leading risk factor for increased disease burden as assessed by disability-adjusted life years. Approximately 1.7 million children are born with congenital birth defects and 7,700 children die annually due to inadequate intake of folic acid.

Food fortification in conjunction with other strategies has emerged as a strong pillar to combat micronutrient deficiencies across the globe due to its cost-effectiveness and relatively simple implementation process. The emerging evidence shows that it can improve the nutritional intake of the most vulnerable population.

Food fortification is the process of enriching food with essential vitamins and minerals that regular diets often lack. It is a wide-reaching and sustainable way communities can get greater nutritional value from the foods they eat on a daily basis.
Fortification, especially of staple food, shows merits for sustainable nutrition and high potential for scaling up. Hence, there is a need to strengthen and expand food fortification to other staple foods in India. Mass fortification of staple foods offers the opportunity to deliver key micronutrients to vulnerable populations at a low cost, without changing dietary habits. This strategy is identified by the World Health Organization (WHO) and Food and Agriculture Organization (FAO) to help decrease the incidence of nutrient deficiencies at the global level. It has been continually cited as one of the best development returns on investment. According to the WHO and FAO, selection of an appropriate food vehicle to be fortified is governed by the following characteristics: the food should be commonly consumed on a regular basis by the majority of the population, centrally processed, and allow a micronutrient premix to be added relatively easily in a way that ensures even distribution in the product. Foods that are well-suited for fortification include cereals, oils, dairy products, and condiments including salt, sauces, and sugar.

Among cereals, rice is a staple food in many developing countries. It is therefore considered to have tremendous potential as a fortification vehicle for populations that suffer from micronutrient deficiencies. In India, rice is the staple for 65 percent of the population; it thus has the potential to fill the gap in current fortification programs to tackle micronutrient deficiencies. The addition of essential vitamins and minerals to rice helps to reduce hidden hunger and improve the health of people whose staple diet consists mainly of rice. However, staple food fortification, especially rice fortification, is currently underutilized in India though it has been clinically tested and its operational feasibility has been demonstrated in the safety net programs.

Fortified rice means polished raw rice or polished parboiled rice blended with extruded rice shaped kernels, fortified with essential vitamins and minerals, in ratios ranging from 1:50 to 1:200. There are many scientific publications on the effectiveness and efficacy of extruded fortified rice demonstrating that extruded fortified rice is safe and effective in women and children and can significantly improve hemoglobin status, iron-deficiency anemia, iron deficiency (i.e., ferritin levels), total body retinol, serum retinol, night blindness, vitamin A deficiency, zinc status, folic acid status, vitamin B12 status, thiamine status, cognition, and physical performance. Many more support the acceptability and safety of extruded fortified rice that have been conducted in over 25 countries globally.
This manual describes in detail the process to blend fortified kernels with milled, non-fortified rice in order to produce fortified rice. It describes the equipment required, its integration with a typical rice milling facility, and important quality control (QC) aspects.

Process of Rice Fortification

Rice fortification is very similar to wheat fortification from a regulatory, public health and nutrition perspective. However, the method of fortifying rice is very different to that of fortifying wheat. Common method of rice fortification uses extrusion technology.

Extruded rice shaped kernels (also known as Fortified Rice Kernels-FRK) are made up of rice flour, vitamins and minerals and resemble polished raw or parboiled rice grains in size and shape. These fortified kernels keep the nutrients intact even after cleaning, washing and cooking. Level of fortification need to be followed as per the Food Safety Standards (Fortification of foods) Regulation, 2016.

The major steps in producing fortified rice are as follows:

I.) Sourcing of Fortified Rice Kernels (FRK) from a manufacturer

ii.) Blending 1 part of Fortified Rice Kernel with 50 to 200 parts (generally 1:100) of polished raw or parboiled rice.

iii.) Bulk Storage and Packing

The Rice mill/warehouse, equipped with a dosing and blending system, is essentially the facility where fortified rice can be produced. These facilities shall comply with all Good Manufacturing Practices (GMP), and food-safety guidelines as per FSSAI standard guidelines. The manufacturing and food safety practices must comply with all the statutory and regulatory guidelines of the country/state/region where the product is manufactured. Utmost care is to be taken in manufacturing and handling of fortified kernels because the finished product will be mixed with rice and distributed for consumption to consumers from different segments of the population.

1. Production of Fortified Rice Kernel (FRK)

This section provides an overview of the process to be followed for manufacturing FRK & Fortified Rice using extrusion technology.

Fortified Rice Kernel is an extruded rice shaped grain made from rice flour, vitamins and minerals using extrusion technology. A detailed
The process flow of production process is as follows:

Figure 1: Flow of Production Process of FRK

a) Raw material Selection

The first decisive step in making good fortified rice is the selection of appropriate raw material. The challenge in selecting a compatible specification of ingredients is very critical, as the rice produced should be strong enough to sustain the shelf life and to meet the cooking quality of regular rice grains. Receiving, storage and handling of raw material need to be conducted as per the process.

Major ingredients include:

i. Rice flour
ii. Food grade Vitamin and Mineral premix
iii. FSSAI approved Acid regulators and emulsifiers (Pentasodium Triphosphate - INS 451 (i), Citric Acid INS 330 etc)
iv. Potable Water (IS 10500 : 2012)

Rice flour: Clean Broken rice at an initial moisture content of 11-12% is ground to flour using 30-60 mesh sieve. Rice flour is very hygroscopic in nature hence the raw material and final produce need to be handled properly as per GMP.

Vitamin and Mineral Premix: Composition of vitamin premix has to meet the recommended specifications as per Food Safety Standards (Fortification of Food) Regulations, 2016.

Emulsifier / Acid Regulator / Antioxidants: FSSAI approved emulsifiers/ acid regulators/ antioxidants (Pentasodium triphosphate IS 451 (i) / Citric
Acid IS 330 etc.) shall be used as per the allowances prescribed in Food Safety Standards (Fortification of Food) Regulations, 2016.

**Water**: Water is used in manufacturing of Fortified rice as a solute which penetrates the starch structure of the flour and helps in gelatinization of starch. Potable water (complying Indian standards for Potable water standards IS 10500 : 2012 amended on 1st June, 2015) shall be used for mixing of ingredients.

b) **FRK Production Process**

**Mixing of Raw Material**: Proper mixing of appropriate quantity of raw material in the mixer is very important to attain desired quality of the FRK. Calculated amounts of hot water should be added to the raw material mixer to achieve better gelatinization.

**Extrusion Process**: An uniformly hydrated mixture with set moisture content obtained from the mixing step is passed through a preconditioner, where steam is used to achieve partial gelatinization of starch. On successfully passing out of preconditioner, the hydrated mixture passes through the twin-screw extruder where it is partially cooked and takes shape of tiny pallets similar to the shape and size of normal rice grains. The shape and size of these kernels can be adjusted to resemble local rice varieties.

Extrusion is the most critical process of the entire FRK production process and hence a due consideration should be given to the extrusion parameters like temperature and the rotation speed of cutters.

**Drying**: A continuous flow of uniform shaped FRK is received from the extrusion process through pneumatic conveying with higher moisture content.

The basic purpose of the drying process is to reduce the moisture content of the final product to a range of 11-13% with a stable shape of these grains.

c) **Quality Assurance/ Quality Control (QA/QC)**

After receiving the final product from drier, the Quality of the FRK
needs to be analyzed before packing them in bags. The FRK producer is responsible for ensuring raw material quality, in process quality, batch inspections and checks of final product before dispatch. A detailed QA/QC plan is attached in the annexure 1.

d) Packing and Dispatch
On the test results complying the standard quality requirements, the final product shall be dispatched from the manufacturing facility to the blending/warehousing facility.

e) FRK Producer
Currently there are a few active FRK producers in India and the number is growing slowly. Any player who has extrusion equipment can become FRK producer with slight modifications in their facility.

2. Production of Blended Fortified Rice
This section includes, procedure for production of blended fortified rice composed of fortified rice kernel and regular rice. The regular rice (any variety) can be blended with FRK (resembling regular rice) to obtain fortified rice as per the regulatory and market requirements.

Blender and dozer combination is applied to get uniform blending of FRK and polished raw or parboiled rice in ratios ranging from 1:50 to 1:200. Blending can be either batch or continuous depending on the capacity to achieve and a homogeneity of the blended produce. (+15% Coefficient of Variance - COV)

a) Batch blending process using the Blenders: The typical process consists of two hoppers of which one is filled with FRK and the other is with regular rice. These two hoppers will be connected to a dosing system which will be controlling the grain flow and feeding to the blender. The dosing system feeds the rice in 1:100 w/w ratio to the blender. Blender blends the mixture to produce a homogenous 'Fortified Rice' with COV within+15%. After blending, the blended Fortified rice will be taken out for packing from the outlet which is controlled by a gate valve. The entire system can be controlled using a Programmable Logic Controller (PLC) making the process an automatic one. But only caveat is, level of automation increases the cost of the blending system.
The batch mixing mechanism requires a blender, a dosing system, pneumatic controls, a PLC board and supporting structures to arrange the systems in order (frames, gate valves etc). The cost of the blending mechanism differs based on the capacity of the blender, extent of supporting structures (like hopper capacity, silos etc.) and structural civil support. It ranges from Rs.10-50 lakhs depending on the extent of integration and automation.

The process is explained pictorially below:

\[\text{Figure - 2 Process flowchart of batch blending using a blender}\]

\[b) \text{ Continuous blending using the existing equipment:}\] In another method, where rice mills have large cylindrical graders, Graders can be used as blenders. The system can be integrated using a dosing system to dose the FRK in required quantities before the regular rice enters into the graders. This method is a continuous feeding method and can help to increase the productivity while maintaining the
uniformity of the blend (below 15% CoV). It is important to calibrate the doser/feeder as per the desired quantity of the fortified kernels in the final fortified rice (Figure 3). To obtain the uniform blending, the vibratory feeder should discharge the fortified grain to match the flow of regular rice in the rice grading cylinder. Note it is possible to opt for whatever combination of dosing system and continuous blender and also tailor the integration framework according to suitability to the particular operation.

The continuous blending mechanism using the existing infrastructure such as cylindrical graders, diversion valves and silos will require only dosing system to integrate in the rice mill setup. The dosing system installation ranges from Rs.5-15 lakhs based on the type of dosing equipment and the level of automation.

**Figure 3: FRK Blending Arrangement in a Rice Mill**

c) **Choice of blending systems:** When selecting the blenders, available blenders should be evaluated based on several criteria, including existing set-up of the operations, current throughput of the line where the fortification needs to be integrated:

1. Choice of continuous/batch blending depends on the ease to integrate the equipment to current settings and choice of operations
2. Rice mill capacity/throughput
3. Cost of equipment and its operational cost
4. Operational ease
5. Effectiveness of blend (homogeneity achieved), precision mixing; time of blending
6. Gentle mixing (low broken percentage);
7. Suitability to grain blending (potential damage to kernel or product loss)
8. Maintenance and operational costs

d) **Choice of blending mechanism**: The choice of continuous and batch blending depends on several factors. Continuous blending requires less handling operations than batch blending and can handle larger volume as required in a conventional rice milling environment. A continuous mixing system operates simultaneously at three stages:

1. Material proportioning or metering
2. Blending
3. Discharge

Batch versus continuous mixing should be carefully evaluated in the context of the capacity, economics and technological feasibility by each fortified rice manufacturer or rice miller. In some cases, batch mixing might be more advantageous for reasons mentioned below:

1. More flexibility in the process and possibly greater blending homogeneity at various blending time periods
2. Ability to control feeder and blender individually to attain various speeds and time periods
3. Batch mixing can handle smaller volumes and can reduce cost for a lower capacity operation

The rice millers or fortified rice producers has to choose among the available blending options and blenders based on their available infrastructure and capacity of the mill. **Annexure 2** has compared blending mechanisms and blender types broadly for reference.

**B. Quality Assurance Plan**
Small- and medium-sized food-processing businesses all over the world have increasingly become aware of necessity of producing and consuming good quality products. In this context, quality produce is the final product produced as per the customer needs following the specification and limits set by the FSSAI. To meet this standard, the manufacturer puts in a QC system to ensure that the product meets the criteria on a routine basis.
QC refers to a process by which entities review the quality of all factors involved in the production. This approach places an emphasis on three aspects:
1. Elements such as controls, job management, defined and well managed processes, performance and integrity criteria, and identification of records;
2. Competence, such as knowledge, skills, experience, and qualifications; and
3. Soft elements, such as personnel, integrity, confidence, organizational culture, motivation, team spirit, and quality relationships.

QA refers to the systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes, and an associated feedback loop that confers error prevention. This can be contrasted with QC, which is focused on process outputs.

Staff responsible for production of fortified rice can ensure QC by:

1. Inspection of raw material has to ensure that ingredients meet the quality specifications as per Food Safety Standards (Fortification of Food) Regulations, 2016
2. Carrying out checks during the process to ensure that the dosing rate of the raw material (fortified kernels and regular rice), feeder and blending parameters and packaging specifications are correct; and
3. Inspecting the final product to ensure that no poor-quality product is sent to the consumer.

The QC approach is focused on the process whereas the problems that customers may face can also occur elsewhere in the production and distribution chain. A detailed QA/QC plan for FRK producer and FR producer is attached in the Annexure 1 and Annexure 3 explains about the QC method to identify the homogeneity of the blended rice.

C. Quality Assurance and Quality Control (QA&QC)
In order to ensure quality production of Fortified rice, the standard food safety guidelines will need to be followed stringently. The staff
will need to know and learn the following in relation to food safety.

The major food preparation practices that are contributing to major food borne disease are improper holding temperatures, poor personal hygiene, inadequate cooking, contaminated equipment, and food from an unsafe source. To check these practices at every stage an ideal QA plan is prepared and can be found in the annexure 1 of this document.

1. **Contamination** : Food becomes hazardous by contamination. Contamination is the unintended presence of harmful substances or microorganisms in food. Food can become contaminated from chemical, physical or biological sources. Regular testing, of final produce and raw material (as mentioned in annexure 5a), is important to keep contamination away.

   - **Microbiological hazards**: Biological hazards come mainly from microorganisms including bacteria, viruses and parasites.
   - **Chemical hazards**: Chemical hazards include substances such as cleaning solutions and sanitizers.
   - **Physical hazards**: Physical hazards are foreign particles, like glass or metal.

2. **Cross Contamination** : Cross contamination is one of the most common causes of food poisoning. It happens when harmful germs are spread onto food from other food, surfaces, hands or equipment. It’s very important to prepare food safely, to help stop harmful germs from spreading and growing. Cross-contamination of food may be due to,

   - Hands that touch raw foods, such as chicken, then touch food that will not be cooked, like salad ingredients.
   - Surfaces, like cutting boards or cleaning cloths, that touch raw foods, are not cleaned and sanitized, then touch ready-to-eat food.
   - Raw or contaminated foods that touch or drip fluids on cooked or ready-to-eat foods.

The most important tool to prevent food borne illness is good personal hygiene. Personal hygiene is the way people maintain their health, appearance and cleanliness. Not only one can become the victim of
illness, but one can also be the carrier. A cough or sneeze can transmit thousands of microorganisms that may cause disease.

3. **Good Manufacturing Practices:** The manager operations and staff responsible for producing FRK & FR should follow the FSSAI guidelines on food safety and also ensure the necessary approvals from FSSAI for finished products.

The following GMP need to be followed by the staff producing FRK and FR.

- **GMP 1:** Pre Requisite Program - Personal Hygiene and Employees Facility
- **GMP 2:** Pre Requisite Program - Sanitation and Waste Disposal
- **GMP 3:** Pre Requisite Program - Pest Control
- **GMP 4:** Pre Requisite Program - Water
- **GMP 5:** Pre Requisite Program - Preventive Maintenance
- **GMP 6:** Pre Requisite Program - Traceability
- **GMP 7:** Pre Requisite Program - Storage

It is mandatory to follow all regulatory guidelines and specific requirements governed by Regulatory Authority (FSSAI) with regard to product registration, Food Safety, Quality, Labelling and other applicable laws at state and national level. **Annexure 4 a, b and c** have pictorial explanation for reference.
### Annexure 1: Quality Assurance (QA)/Quality Control (QC) Plan for Rice Fortification for FRK producer and Fortified Rice Producer

#### QA/QC plan for FRK 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>Accreditation Board for Testing and Calibration Laboratories (NABL)/FSSAI Accredited Laboratory</td>
<td>FRK Producer</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>NABL/FSSAI Accredited Laboratory</td>
<td>Prepack Supplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CoA for Micronutrient content</td>
<td>Every Batch</td>
<td>Premix Supplier</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>Prepack Supplier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Food Grade Certificate</td>
<td>Every Batch</td>
<td>Premix Supplier</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>Prepack Supplier</td>
</tr>
<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 Heavy metal contaminants</td>
<td>Every Consignment</td>
<td>FRK Producer</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>FRK Producer</td>
</tr>
</tbody>
</table>

### Annexure 1a

#### QA/QC plan for Fortified rice 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>Blended Rice</td>
<td>Blending ratio</td>
<td>Every Batch</td>
<td>Fortified Rice Producer</td>
<td>Fortified Rice blending unit</td>
<td>Fortified rice producer</td>
</tr>
<tr>
<td>2</td>
<td>Blended Rice</td>
<td>Microbial load within prescribed limits</td>
<td>Every Batch</td>
<td>Fortified Rice producer</td>
<td>NABL/FSSAI Accredited Laboratory</td>
<td>Fortified rice producer</td>
</tr>
</tbody>
</table>
### Annexure 2: Comparing the mixing operations and types of blenders

#### Comparison of Batch mixing and Continuous mixing operations

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>BATCH MIXING</th>
<th>CONTINUOUS MIXING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital cost</td>
<td>Lower</td>
<td>Higher (relatively)</td>
</tr>
<tr>
<td>Mixer-ancillary (Dosing &amp; Controls)</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Operating Cost</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Flexibility</td>
<td>More</td>
<td>Specific</td>
</tr>
<tr>
<td>Proportion of Ingredients</td>
<td>More accurate</td>
<td>Depends on integration of dosing system</td>
</tr>
<tr>
<td>Capacity</td>
<td>Can handle smaller and also varying volumes</td>
<td>Can handle much larger volumes</td>
</tr>
<tr>
<td>Mixing efficiency</td>
<td>Depends on operation</td>
<td>Depend on system design</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Suitable for warehouse blending</td>
<td>Suitable for Large medium Rice mills</td>
</tr>
</tbody>
</table>

#### Types of mixers and their applications

<table>
<thead>
<tr>
<th>TYPES OF MIXERS</th>
<th>MIXING ACTION</th>
<th>APPLICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary blender</td>
<td>Tumbling action involves roll and fall of the particles</td>
<td>Cannot be much efficient when the blending ratio of one commodity to another is very low</td>
</tr>
<tr>
<td>Ribbon blender</td>
<td>Mixing in trough, gentle mixing involves forward movement of material.</td>
<td>Can be used in large continuous system; broken percentage will be low</td>
</tr>
<tr>
<td>Pan Mixture</td>
<td>Blades moves with different angle.</td>
<td>Good option in batch mixing</td>
</tr>
<tr>
<td>Blending by metering</td>
<td>Continuous mixing with metering devices.</td>
<td>Can handle big volume in continuous system; Initial capital costs are relatively high</td>
</tr>
<tr>
<td>Z blade mixture</td>
<td>Two contra rotating blades, it is not very common for dry mixes</td>
<td>Generally used to mix liquids and powders; not suitable for us as this increases broken Percentage</td>
</tr>
<tr>
<td>High Speed Impeller</td>
<td>Impeller throwing material outwards the wall.</td>
<td>Not suitable for our purpose as it increases the broken percentage</td>
</tr>
<tr>
<td>Fluidized Forsberg mixture</td>
<td>Highly efficient and precision, gentle mixing in short time</td>
<td>Good for batch maxing, can be made online as retention time is around 2 min.</td>
</tr>
</tbody>
</table>
Annexure 3: Quality Control (QC) method to test homogeneity of blending at rice mill/ blending site - Instruction Manual

This quality control method tests the presence of fortified rice kernels in a blended batch of fortified rice and the homogeneity of the fortified rice.

What is in the kit?
1. 250ml beaker
2. 50ml beaker calibrated to measure 50 grams of rice depending on the variety being used for blending
3. 100ml bottle of Chemical Reagent
4. Dropper
5. Tray
6. QC method instruction manual
7. Standard Operating Procedures
8. Bag

Who can use the kit?
1. Rice miller: to test the level of blending in different batches
2. Regulatory Authorities: to monitor the blending homogeneity at rice mills/warehouses

How to use the kit?
1. Collect a sample of 200-500 grams from 10% of the blended fortified rice consignment using the BIS method.
2. Take 50 grams of rice from the collected sample using standard sample reduction techniques
3. Spread the 50g rice sample onto the tray.
4. Prepare a 1% chemical reagent in water using these steps:
   a. Fill 250ml beaker with 100ml of water
   b. Add approximately 1ml of the chemical reagent to the water, using the dropper.
   c. Stir until the solution turns bright orange in colour.
5. Pour the 1% chemical reagent into the tray and mix with the rice sample by tilting the tray or mixing with the dropper. Break-up any lumps that form.
6. Mix the sample until the solution turns from orange to violet-blue (10-15 seconds).
7. Carefully drain most of the chemical solution into the 250ml beaker. Keep the kernels in the tray.
8. Fill 50ml beaker with water and add it to the kernels in the tray.
9. Count all of the discolored fortified rice kernels and document the findings. Re-count to confirm findings.
10. Discard the tested sample and wash hands.
11. Sign the records after noting the results.
Standard operating procedure to test the consistency of iron-fortified blended rice

Step 1: Take 30 grams of blended fortified rice from the batch using the small bucket.
Step 2: Funtas 30 grams into the test tube.
Step 3: Prepare the test solution in the large beaker by adding 1 ml of Potassium 40% solution to 100 ml of water and homogenize using a stirrer.
Step 4: Mix the test solution into the test tube.
Step 5: Mix sample with the solution by tilting the test tube to 15 degrees and 150 ml from the test tube to about
Step 6: Incubate the solution for 2 hours.
Step 7: Count the swelled fortified grains and record the number.
Step 8: Wash your hands.

Annexure 4 a: Instructions for safety and hygiene in fortified rice production area

- Wash your hands
- Wear uniform
- Wear hair net
- Wear shoe cover
- Don’t wear jewelry
- Don’t chew tobacco
- No smoking

Annexure 4 b: Guidelines for storage of fortified kernels and fortified rice

- Dedicated area for storage of RM/PM/EG
- Make a note of all the receiving inventory
- Visually inspect all items and look for signs of container damage
- Store raw materials in cool dry place
- Reject unacceptable goods and note on invoice
Annexure 4 c: Guidelines for prevention of physical hazards

**PHYSICAL HAZARDS**

- Dirt
- Hair
- Nails, nuts and bolts
- Insects
- Broken glass
- Staples
- Plastic fragments
- Bits of packaging material

Annexure 5: Record Templates
Annexure 5a: Receipt of raw materials (for FRK producer)

1. Receipt of Raw Materials

<table>
<thead>
<tr>
<th>Date</th>
<th>Material (Broken No. Rice/ Vitamin Premix)</th>
<th>Batch (MT)</th>
<th>Supplier Name</th>
<th>Supplier COA received? (Yes/No)</th>
<th>Signature</th>
<th>Remarks</th>
</tr>
</thead>
</table>
Annexure 5.b: Preventive maintenance record
2. Preventive Maintenance Record

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Description</th>
<th>Equipment Code</th>
<th>Check Points</th>
<th>Set Frequency</th>
<th>Checked on</th>
<th>Next Check date</th>
<th>Signature</th>
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<tbody>
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</table>

Annexure 5c: Monitoring and cleaning record
3. Template for Monitoring of Cleaning Activities at Facility

<table>
<thead>
<tr>
<th>What item/area</th>
<th>How often</th>
<th>How to clean?</th>
<th>Cleaning tools/chemicals required</th>
<th>Responsible person (Name and Signature)</th>
<th>Checked By (Name and Signature)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>Weekly</td>
<td>Monthly</td>
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Annexure 5d: Homogeneity test (of Fortified rice at Rice mill - template)

<table>
<thead>
<tr>
<th>Sample number</th>
<th>Collected On</th>
<th>Tested by</th>
<th>Number of grains</th>
<th>Recorded by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date</td>
<td>Time</td>
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<td>Name</td>
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A forum to promote good health & improved quality of life

The Food safety and Standards Authority of India (FSSAI) has established a Food Fortification Resource Centre (FFRC), within FSSAI, as a “Resource Hub” to focus on:

- Building consensus and engaging all stakeholders and sharing innovations on food fortification.
- Fostering knowledge on food standards and food safety technology and processes, premix and equipment procurement, quality assurance and control.
- Building the capacity for strengthening 'Regulatory Monitoring'.
- Providing evidence based policy recommendations for scaling up staple foods fortification in the public funded programmes like the PDS, ICDS and MDM.
- Promoting awareness on good nutrition, fortification and creating markets for fortified foods.

FOOD FORTIFICATION RESOURCE CENTRE

Encourages food industry to adopt food fortification as an industry norm. Systematically synchronizes the efforts to:

- Strengthen collaborations.
- Catalyse consensus building between government, industry partners and academia.
- Move the agenda of food fortification, as a part of its obligation to support availability of safe and 'wholesome' foods.