Whole grain products from CSIR-CFTRI

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Mysuru – 570 020
CSIR – Central Food Technological Research Institute (CFTRI), Mysore (A constituent laboratory of Council of Scientific and Industrial Research, New Delhi) came into existence during 1950 with the great vision of its founders, and a network of inspiring as well as dedicated scientists who had a fascination to pursue in-depth research and development in the areas of food science and technology.
Organization structure of CSIR - CFTRI

- DIRECTOR GENERAL
  CSIR

- RESEARCH COUNCIL
- DIRECTOR
  CSIR-CFTRI

- R & D DEPARTMENTS

- MANAGEMENT COUNCIL

- FINANCE & ACCOUNTS

- ADMINISTRATION

- SUPPORT DEPARTMENTS

- STORES & PURCHASE
Greetings from CSIR-CFTRI!

The Central Food Technological Research Institute, since its inception on October 21, 1950, has been striving towards facing one of the country's biggest challenges of achieving food and nutritional security. With the ever increasing population and demand for arable lands, it is not surprising that a country with agriculture as its occupation is fraught with apprehensions to keep its people self sufficient and healthy. Concerns over food security have existed throughout history. Providing ‘adequate quantity of quality food at affordable prices’ has become a challenge, leaving people undernourished. Malnutrition among rural children is almost a phenomenon. The World Bank has described malnutrition as ‘India's silent emergency’. This problem needs to be resolved, with the effort of every Indian citizen. As an Institute, we have the important and responsible roles in providing solutions.

For the last six decades CFTRI has been contributing enormously towards the growth of food technology in the country. Commendable success has been achieved in all its intervention programs, resulting in many nutritious products for the benefit of people of all age groups. Some of the technologies that found their way to the market space have been very well received and have made a great impact in the day to day life of every Indian. Our highly efficient and energetic scientific staff, ably assisted by our support departments, have conceptualized and delivered many brilliant products and technologies. With the growing technology and skills among the young researchers and students, we are sure to achieve much more.

We, at CFTRI look forward to every opportunity to serving the nation. It will be a pleasure to take you along with us, if you are a potential scientist, student, industrialist or an entrepreneur with a similar passion. This web interface will help you with the relevant information you are seeking for.

Good Luck!

Thank you for visiting our website!

(PROF. RAM RAJASEKHKARAN)
Director, CSIR-CFTRI
Departments at CSIR - CFTRI

- BIOCHEMISTRY
- FLOUR MILLING BAKING & CONFECTIONERY TECHNOLOGY
- MOLECULAR NUTRITION
- FOOD PACKAGING TECHNOLOGY
- SENSORY SCIENCE
- GRAIN SCIENCE & TECHNOLOGY
- SPICES AND FLAVOUR SCIENCES
- FOOD PACKAGING TECHNOLOGY
- MEAT & MARINE SCIENCES
- FRUITS & VEGETABLES TECHNOLOGY
- PLANT CELL & BIO-TECHNOLOGY
- MICROBIOLOGY & FERMENTATION TECHNOLOGY
- PROTEIN CHEMISTRY & TECHNOLOGY
- MICROBIOLOGY & FERMENTATION TECHNOLOGY
- LIPID SCIENCE
- FOOD ENGINEERING
- FOOD SAFETY & ANALYTICAL QUALITY CONTROL LABORATORY
- INFESTATION CONTROL & PESTICIDES
- SUPPORT DEPARTMENTS
- HUMAN RESOURCE DEVELOPMENT
Human Resources Development Department

- M. Sc (Food Technology) course
- M. Sc (Nutritional Biology) course
- Short term training courses
- Ph.D programmes:
  - Other Universities
  - AcSIR
- Project Thesis and Dissertation
- Recruitment of PAs
GST Dept – notable achievements

- Hot soaking method of parboiling – FIRST TIME IN THE WORLD developed at GST Department and given to public FREE OF COST!! Late 1960s
- Curing of paddy Late 1960s to early 1970s
- Worked on producing rice from tapioca starch (known as Synthetic rice) since cost of rice was prohibitively high during those days Late 1960s to early 1970s
- Instant ready mixes – viz., Idly, Vada, Dosa, Jamun, Jilebi, Chakli, Muchchorai, Tengolal, Rasam, Sambar, Bisi bele bhath, Pongal, Urd Bhath, Imli Poha, etc. Late 1970s to early 1980s
- Developed the pressure type destoner machine During 1970s
- Developed Mini Dhal Mill and distributed the same free of cost across the country for augmenting farmer’s income During late 1980s
- In association with PCT Department developed “Energy food formulation” for distribution in schools
- Developed the 1TPH maize dry milling system using indigenous machinery 1995 – 2000
- Many sponsored and in-house projects taken up leading to development of many new technologies 2000 onwards
Synthetic rice plant

Synthetic rice hand graded by women

Millet vermicelli

Pulse based soup

Jowar flakes

Mini Dhal Mill
Hot soaking method of parboiling
Same set up used for Curing of paddy

1TPH Maize Dry Milling Plant

Destoner
Grain processing is an ancient technology of India.

~5000 years ago Sudama (Kuchela) gave rice flakes to Lord Krishna.

Concept of eating whole grains mentioned in Vedas.

Vedas and Upanishads mention the type of food to be eaten by us (from the womb to the tomb and beyond).

Aryans classified food materials on the basis of their nature and use such as शूखधान्य (cereals), शमिधान्य (pulses), फल (fruits), शाकि् (vegetables), पयोवर्ग (milk products), मध्यवर्ग (alcoholic beverages) and मांसवर्ग (animal products).
GRAINS

CEREALS

MAJOR
- PADDY
- SORGHUM
- MAIZE
- BARLEY
- OATS

COARSE
- WHEAT

MILLETS
- BAJRA
- RAGI
- MILLETS

PSEUDO
- AMARANTHUS
- BUCK WHEAT
- QUINOA

PULSES

MAJOR
- BENGAL GRAM
- RED GRAM
- BLACK GRAM
- GREEN GRAM

MINOR
- HORSE GRAM
- KIDNEY BEAN
- MOTH BEAN
- COW PEA
- LENTIL

So many grains!!
GRAIN PROCESSING MEANS DIFFERENT THINGS TO DIFFERENT GRAINS AND DIFFERENT PEOPLE

PADDY
- baby plant (embryo)
- young bud (plumule)
- young root (radicle)
- tiny hole (micropyle)
- stored food in 2 seed leaves (cotyledons)

WHEAT

MAIZE

JOWAR

BARLEY

PIGEON PEA
- seed coats

QUINOA

MILLET

STRUCTURE, SHAPE, SIZE & COMPOSITION OF GRAINS ARE DIFFERENT FROM ONE ANOTHER
Common grain processing avenues

Cooked whole
- Rice, dhal

Germination
- Raw, Cooked

Wet grinding
- Idli, Vada, Dosa

Dehulling
- Dhal, millets, brown rice

Puffing
- Rice, horse gram, wheat

Dry Grinding
- Sev, Bajji, Bonda, flour,

Some eaten raw

Some eaten raw
# GRAINS & THEIR PRODUCTS

<table>
<thead>
<tr>
<th>Grain</th>
<th>Processing Methods</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>Parboiling, Milling, Flaking, Puffing, popping, size reduction (flour), extrusion/sheeting</td>
<td>Milled rice (raw &amp; parboiled) Flakes, Popped &amp; Puffed rice, vermicelli/ noodles</td>
</tr>
<tr>
<td>Wheat</td>
<td>Milling, baking, extrusion/sheeting, popping</td>
<td>Flour- atta, maida, soji (Chapati, roti, naan, bakery products, noodles), dhalia, tortilla, kakada</td>
</tr>
<tr>
<td>Maize</td>
<td>Dry milling, wet milling, popping</td>
<td>Flour, soji, grits – for breakfast cereals and brewery, pop corn, starch</td>
</tr>
<tr>
<td>Grains &amp; Millets</td>
<td>Processes</td>
<td>Products</td>
</tr>
<tr>
<td>------------------</td>
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</tr>
<tr>
<td>Sorghum &amp; millets</td>
<td>Size reduction, popping, malting</td>
<td>Roti, mudde (stiff porridge/dumpling), malted grains, Popping</td>
</tr>
<tr>
<td>Oats, barley</td>
<td>Flaking, malting, brewing</td>
<td>Flakes, brews</td>
</tr>
<tr>
<td>Small millets</td>
<td>Grinding with or without refining</td>
<td>Unleavened pancakes, thick &amp; thin porridge, kheer</td>
</tr>
<tr>
<td>Pulses</td>
<td>Milling, grinding, puffing</td>
<td>Dhal, flour, puffed grains</td>
</tr>
<tr>
<td>Quinoa</td>
<td>Refining, grinding</td>
<td>Whole grain preparations, laddoos, Chocolates</td>
</tr>
<tr>
<td>Chia</td>
<td>Whole grains</td>
<td>Ice cream, Chocolates</td>
</tr>
</tbody>
</table>
**PROCESSES DEVELOPED:**

1. DRY & WET HEAT PARBOILING
2. CURING OF FRESHLY HARVESTED PADDY
3. DETECTION BASMATI ADULTERATION
4. MALTRED WEANING FOOD
5. REFINED MILLET FLOUR
6. NOODLES FROM CEREALS AND MILLETS
7. TAMARIND POWDER
8. CORIANDER DHAL “SUPARI”
9. CONTINUOUS CEREAL FLAKING

**SYSTEM FOR**
- RICE, JOWAR, MAIZE, MILLETS, RAGI, OATS, PULSES
10. ENTERAL FOOD FORMULATIONS
11. INFANT FOOD FORMULATIONS
12. HALWA MIX FORMULATION
13. WHOLE GRAIN DRINK MIX
14. MULTI GRAIN FLAKES
15. DIABETIC RICE
16. CONVENIENCE RAGI FLOUR FOR MAKING “MUDDE”
17. COMPOSITE LENTIL CHIPS
PRODUCTS DEVELOPED:

◆ INSTANT TRADITIONAL FOODS
◆ READY MIXES FOR:
  ○ IDLI
  ○ VADA
  ○ DOSA
  ○ JAMUN
  ○ JILEBI
  ○ CHAKLI
  ○ MUCHCHORAI
  ○ RASAM
  ○ SAMBAR
  ○ SPICE MIXES
  ○ BISIBELE BHATH
  ○ PULIOGARE
  ○ PONGAL
  ○ URD BHATH

◆ MAIZE BASED PREPARATIONS
◆ ORANGE PEEL CURRY
◆ SHELF STABLE JOWAR FLOUR
◆ IMPROVED MAIZE FLOUR
◆ LOW FAT CHAKLI MIX
◆ PILLOW SHAPED SNACK PRODUCT
MACHINERY DEVELOPED:

1. INTEGRATED RUBBER ROLL SHELLER HULLER
2. PADDY PARBOILING PLANT (2 & 4 TPH)
3. HEAVY DUTY CEREAL ROLLER FLAKER
4. SIMPLE DHAL MILLING SYSTEMS:
   - HAND OPERATED DHAL MILL
   - MINI DHAL MILL
   - VERSATILE DHAL MILL
   - MINI VERSATILE DHAL MILL
5. MINI GRAIN MILL
6. PAPAD PRESS
7. PADDY CRACK DETECTOR
8. 1TPH MAIZE MILLING PLANT
9. MILLET MILLING PLANT
10. TINY RICE MILL
OPTIMALLY MILLED BROWN RICE

VERMICELLI NOODLES FROM GRAINS

MALTING OF RICE, WHEAT AND SORGHUM

MAIZE ROTI FLOUR MIX

SHELF STABLE ROTI FROM NON-WHEAT CEREALS AND MILLETS

COMPOSITE LENTIL CHIPS

PUFFED MOTH BEAN SNACKS

MULTI-GRAIN BASED LOW-FAT FORTIFIED SNACK

MULTI-GRAIN BASED HEALTH DRINK MIX
Recent products from CSIR-CFTRI
Ready to Cook Multi Whole Grain Mix for Drink / Porridge

- Whole cereal based multi grain food for all age groups.
- An ideal blend to provide the benefits of nutrients and nutraceuticals in whole grains of ragi, pearl millet, sorghum, wheat, maize and barley.
- Rich in dietary fibre, proteins, vitamins, minerals and antioxidants compared to refined grains.
- Low carbohydrate digestibility, high antioxidant and vitamin E activity.
- Diet rich in whole grain foods & other plant foods and low in total fat, and cholesterol may help to reduce the risk of heart disease and certain cancers.
- Low cost and can be produced at rural scale.
Finger millet based multigrain Semolina

- Ragi, brown rice, wheat and pulse based RTC semolina mix
- Good source of protein, minerals, vitamins, insoluble, soluble, total dietary fibre and nutraceuticals.
- Can be made with minimum infrastructure.
WHOLE SORGHUM BASED SWEET MIX (HALVA)

- Ragi/ Sorghum/ wheat, rice, pulse and nuts based ready to cook mix
- Rich in fibre, protein, iron, calcium, thiamine, etc.
- Ideal for school children
- Rural facilities sufficient to manufacture
Consumption of highly refined rice can lead to diabetes, metabolic disorders, cardiovascular diseases. So there is a need for minimally polished and brown rice.

Brown rice palatability can be improved by mild polish. But it will trigger lipase activity, FFA development, oxidation and storage problems.

Optimization of industrial scale hydrothermal treatment (HTT), continuous LSU drying and abrasion polishing result in a process for acceptable optimally milled brown rice with maximum retention of nutrients and nutraceuticals having 6-8 months shelf stability.
Convenience food products from unpolished red rice

- Convenience products prepared using brown broken/whole red rice is rich in protein, minerals, soluble, insoluble and total dietary fiber
- Compared to polished rice flour content of nutraceuticals like polyphenols, flavonoids, oryzanol, etc., are high

Cooked products:
- Red rice
- Rice Roti (Pathiri)
- String hopper (idiappam/noolappam)
- Instant Product

Ready to prepare multipurpose flour

Instant Vermicelli/ Noodle

INSTANT BREAKFAST STRINGS (Iron Fortified)
Wellness rice flour made from germinated whole red rice is rich in -

- GABA which improves the brain function and reduces the blood pressure;
- Gamma oryzanols having cholesterol lowering and anti-inflammatory property;
- Polyphenols having antioxidant activity.
- Superior to currently available refined rice flour with respect to minerals and fibre content.
- Wellness rice flour can be used for the preparation of traditional foods.
Instant Wellness Rice Flour

- Instant germinated red rice based wellness flour can be used for the preparation of traditional sweets such as Laddu, Barfi etc., by mixing with milk, jaggery and coconut.
- This flour is having GABA, oryzanol, polyphenols, fibre etc.
- Can act as phytonutrient rich high calorie sweet for children.
QUICK COOKING GERMINATED AND DEHYDRATED (QCGD) BENGAŁ GRAM

- GERMINATED PULSES GENERALLY TAKE LONG TIME TO COOK
- QCGD GRAM COOKS IN 3 – 5 MIN
- TIME AND ENERGY SAVING
- SHELF STABLE FOR 6 MONTHS
- HAS BEEN SUCCESSFUL WITH OTHER PULSES ALSO
QCGD PULSES

WASH

SOAK

SPROUT

HEAT TREATMENT

TREATMENTS

DRY

PACK
LEGUME BASED HIGH PROTEIN SOUP MIXES

- SOUPS ARE APPETIZERS
- DRY SOUP MIXES EXISTING SINCE 1940
- APPROPRIATE PRE-TREATMENTS TO REMOVE BEANY FLAVOUR
- DRY SOUP MIXES PREPARED FROM MINOR PULSES
PROCESSING OF HORSE GRAM FOR VALUE ADDITION
EXPANDED HORSE GRAM DHAL

- HTST TREATMENTS & PROCESSING
- EXPANSION – 2 TIMES
- IMPROVED DIGESTIBILITY
- REDUCTION IN ANTINUTRITIONAL COMPONENTS
- FUNCTIONAL PROPERTIES IMPROVED
- COULD BE USED AS AN INGREDIENT IN HEALTH BARS
PRODUCT FORMULATIONS

- Legume based High protein Soup mix
- Horse gram Papad
- Boondi
- Dhal analogue (ongoing Project)
- Sambar / Rasam mix
- Noodles
- Horse gram – extract “Kattu”
FLAKING

HEAD FLAKES

SIFTING

DRYING

ROASTING

SOAKING

GRAINS

PROCESSING

BROKENs
MULTI GRAIN FLAKES

- Flakes from non-conventional grains – maize, sorghum, pearl millet, legumes such as horse gram – along with some oats and barley
- Rich in proteins, fibre, polyphenol, antioxidants; tastes good
- Costs less than the commercial muesli
- Can be stored for 4 months
Technologies from GST
<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
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<tbody>
<tr>
<td>Beverage mix from malted Ragi</td>
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<tr>
<td>Cereal flakes – jowar</td>
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<tr>
<td>Composite lentil chips</td>
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<tr>
<td>Composite vermicelli based on ragi flour</td>
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<tr>
<td>Convenience flour from ragi suitable for stiff porridge (<em>mudde</em>)</td>
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<tr>
<td>Decortication of finger millet (<em>Ragi</em>)</td>
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<tr>
<td>Expanded Horse Gram</td>
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<tr>
<td>Fermented &amp; dehydrated Dosa &amp; Idli mix</td>
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<tr>
<td>Finger millet (<em>Ragi</em>) based <em>murukku</em> mix</td>
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<tr>
<td>Finger millet based multigrain semolina for preparation of upma, kesari bhath &amp; similar products</td>
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<tr>
<td>Flaked Jowar RTE low fat, sweet &amp; savoury snacks</td>
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<tr>
<td>Flaking Foxtail Millet</td>
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<tr>
<td>Flaking of Ragi</td>
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<tr>
<td>Food for Diabetics</td>
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<tr>
<td>Improved maize flour</td>
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<tr>
<td>Instant moringa leaf products</td>
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<tr>
<td>Instant moringa leaves soup mix</td>
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<tr>
<td>Instant Traditional foods</td>
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<tr>
<td>• Imli poha</td>
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<td>• Pongal</td>
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<td>• Rasam</td>
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<td>• Sambar</td>
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<td>• Pongal</td>
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<td>• Urd bhath</td>
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<td>• Imli poha</td>
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<td>• Puliogre</td>
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<tr>
<td>• Bisibele bhath</td>
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</tbody>
</table>

For technical queries please contact:
Head, Technology Transfer and Business Development Department, CSIR – CFTRI, Mysuru – 570 020
Email: ttbd@cftri.res.in
Legume based ready to fry snacks
Low fat expanded green snack using Moringa
Maize Chips
Malted Ragi Flour - enzyme rich
Millet based cookie
Moth Bean Dhal Puff
Multigrain based fortified snack
Multigrain instant semolina
Multigrain Sweet Mix
Processed besan (bengal gram) suitable for sev and boondi
Protein rich ragi vermicelli
Puffed moth bean based sweet & savoury snacks
Pulse based papads
Quick cooking, germinated and dehydrated pulses

Ragi based papads
Ready to eat low fat maize snack from Milled maize grits
Ready to eat low fat snack like - Chakli & Tengolal
RTC Multigrain whole mix for drink - porridge
RTE snack mix from puffed coarse cereals and legumes
Shelf stable jowar flour
Shelf stable optimally milled brown rice
Shelf stable roti from non wheat cereal and millet
Snacks - Flaked Spicy Maize Snack

For technical queries please contact:
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IN CONCLUSION:

- Concept of eating whole grains is traditionally known in India.
- Indian cuisine promotes eating whole grains.
- Efforts to be put in place to promote consumption of whole grains considering all sections of population and demographics.
- A multi-prong approach to address this effort to be studied.
- Basket of technologies, depending on target sector, are available at CSIR – CFTRI.
- CSIR – CFTRI can also undertake development of new technologies based on whole and multiple grains to address target specific requirements.
Some interesting machines
CONTINUOUS CHAPATI MACHINE

- **Capacity**: 600 - 800 Chapathis/hr
- **LPG consumption**: 3 kg/h
- **Power**: 7.5 HP
- **Chapati size**: 160mm dia x 1.5mm thick
- **Machine dimension**: 6m x 1m x 2m
AUTOMATIC IDLI MACHINE

- Automatic batter dispensing
- High capacity = 1200 idlis/h
- Hygienic – untouched by human hand
- Uniform & consistent product
All operations in the Dosa making - from batter dispersion, depositing and spreading on the hot plate to toasting / roasting & oil application are organized in a systematic way.

At the end of the pre-determined residence time, the hot Dosas are rolled and discharged.

Capacity: 400 Nos/h
Continuous Vada machine
Continuous Poori machine
Tiny Rice Mill (domestic model)
Automatic lemon cutting machine (8 pieces 1 stroke)
Continuous *Laddoo* making machine

... the list goes on!
LITTLE BY LITTLE... ... ... WE CAN BUILD A LOT!!