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## Post-harvest Operations and Value added Products of Rice

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## Introduction

Globally rice is a major source of energy for large section of population. In India, share of energy intake contributed by cereals is about 57% for rural India and 48% for urban India and rice accounts for 55% and 50% of total cereal consumption in rural and urban regions, respectively. Rice also provides livelihood support to 40% of Indian poor and is cultivated by 56% of the Indian farmers. Rice production has witnessed a surge from 20.58 million ton (Mt) in 1950-51 to more than 112Mt in 2017-18. Post-harvest handling and processing play vital roles in determining the true value of the grain produced. Major post-harvest handling operations in rice include field drying, threshing, shed-drying, cleaning, grading, storage and marketing. Milling is primary post-harvest processing operation, which converts paddy to brown rice, white rice and other grain forms to make it suitable for human consumption. Since, each of the post-harvest handling operations has direct bearing on post-harvest processing operations, it is important to observe carefully all the stages of post-harvest handling to ensure higher mill recovery rate. However the factors like labour scarcity, absence of plain drying floor, limited, limited storage facilities and inelastic demand force the resource poor small and marginal farmers to go for distress sale of grains. It is, therefore, necessary to support the farmers with appropriate technologies, resources and knowledge on post-harvest operations to increase income.

## Major post-harvest operations in rice

**Pre-cleaning:** Cleaning of the rice grains to remove foreign matter such as straw, chaff, dust, sand, etc. Traditionally threshed rice crop is cleaned by manual winnowing, which has several limitations. Improved technologies include seed cleaner-cum-grader, power thresher-cum- winnower, winnower-cum-cleaner have been developed for cleaning at farm level. This is important because the modern rice mills contain rubber roll sheller for milling and these foreign matter can cause wearing and tearing of the rubber rolls. Again, improperly cleaned grains do not meet the quality norms to get the Government's minimum support price.

**Drying:** Rice is harvested at 22-24% moisture content. It should be dried up to 12-14% moisture content within 24 hours for safe storage and further milling operation. Delayed drying may result in non-enzymatic browning, microbial growth and mycotoxin production in parboiled rice. The most common method of drying is open sun drying however it incurs losses. Several equipments have been developed to minimize the storage losses and impart uniform drying of paddy such as re-circulatory solar dryer, heated sand grain dryer, continuous grain dryer, etc.



**Storage:** Losses in storage are contributed mainly due to spillage, damage by insects, mites, rodents and molds and dry matter due to respiration. Mostly, rice is stored in traditional storage structures (made of wood, straw, mud metal drums, etc.) for consumption or sale. The improved structures include RCC ring bin, ferro-cement bin, modified air tight storage by IRRI are being developed for storage of rice for longer period.

**Milling:** Its major objective is to get maximum head rice from paddy. It involves two basic operations: removal of outer cover (known as husk) after which it is brown rice. This brown rice can undergo hydrothermal treatment to obtain parboiled rice or directly move to the second step. The second step is removal of seed coat (called bran) that gives the raw rice. A mini parboiling system has been developed by NRI for parboiling 1 bag paddy (75kg/batch) based on CFTRI method of parboiling. For hulling operation, mostly hullers are used by millers but it produces a noticeable quantity of broken grains as well as provides combined husk and bran which is a loss. Therefore, under the huller subsidy scheme, the hullers are improvised with provision of a paddy cleaner, rubber roll sheller, and husk aspirator of matching capacity to the existing ones.

These post-harvest operations not only push quality produce in the market, but generate some by-products too which if utilized properly, can fetch additional returns to the producers.



## By-products of rice

In general, a rice plant produces rough rice and straw in 50:50 ratio. The rough rice, on milling, gives brown rice, milled rice, germ, bran, broken and husk. Each of these products have unique properties which can be utilized in number of ways.

- a) **Rice straw:** At farm level, it is mainly used for thatching, as cattle feed and as supplement to fuel. Traditionally, it was ploughed back in soil to convert it as bio fertilizer for the next crop. It is used as a bedding material in mushroom production units, as a source of fibers in rope making industry, also utilized in handicrafts industry for making door mates, fancy bags and wall hangings.
- b) **Rice husk:** It is the by-product of milling industry. Previously, it was used as a fuel at household purpose. Due to presence of silica in it, it can be utilized for making semi-conducting materials, amorphous solar cells, sintered glassware etc. Carbon content in husk can be used for making producer gas, activated charcoal, lignins etc. In this direction, National Rice research Institute, Cuttack has developed few stoves for controlled combustion of this husk viz. NRRI husk stove and NRRI husk combustor for use at domestic level.
- c) **Rice bran:** It is one of the most valuable products from rice milling industry. It contains 18-20 % of fat, 14-15 % protein and to some extent of minerals and vitamins. The bran obtained from raw and parboiled rice contains about 12-18% and 18-28% oil respectively. The crude rice bran oil can be used for manufacturing of soap, enamel paints, varnishes, detergent etc.. Now-a-days, it is consumed at household level for cooking as well as in bakery products as it contains nutraceutical chemicals such as oryzanol, tocopherol, and squalene which are beneficial for body.



Rice straw



Rice Bran



Rice husk

## Value-added products of rice

A wide range of product development like processed and canned, ready-to-eat products, vitamin, iron or calcium enriched flaked or puffed rice, flavoured rice, starch extraction from broken rice and so on are nowadays getting popular. Value-added products from organic rice and therapeutic value medicinal rice varieties have good niche in domestic and export markets. Rice-based value added products can be further categorized into the following.

- 1) **Rice-based convenience food products:** Puffed rice, popped rice, rice flakes, rice crackers, canned rice products and quick-cooking packaged rice etc. are some of the convenience food products made from rice.

- a) **Puffed rice:** It is usually made by heating rice kernels under high pressure in the presence of steam, though the method of manufacture varies widely. 'Rice Krispies' are one type of popular breakfast cereal made from puffed rice, and puffed rice cakes are a common snack food.
- b) **Popped rice:** Raw rice is traditionally popped by heating rough rice at higher temperatures about 240°C for up to 45 seconds. The hull contributes to pressure retention before popping. Good popping varieties have a tight hull and a significant clearance between hull and brown rice and when freshly harvested are free of grain fissures.
- c) **Rice flakes:** The production of rice flakes begins with parboiling of rice which helps to soften the grain and prepare it for processing. Once the rice is tender, the cooked grains are rolled and flattened. After the mixture is the desired thickness, the flattened rice is allowed to dry completely. The dried flakes are run through another rolling process to create simple rice flakes.
- d) **Canned rice products and quick-cooking packaged rice:** Sweet and savoury canned rice products are found in many countries. Various types of quick, cooking or 'instant' rice meals or side-dishes, prepared and packaged in different ways, are also available internationally. Instant rice differs from parboiled rice in that it is milled, fully cooked and then dried. There is a significant degradation in taste and texture.





- 2) **Rice based liquid food products:** Rice bran oil, rice based alcoholic beverages; rice vinegar, rice milk, rice syrup, etc. are some of the liquid food products made out of rice.
- a) **Rice bran oil:** Oil extracted from the rice bran and rice germ, is generally known as rice bran oil. Rice bran oil is high in vitamin E, other antioxidants and various plant sterols. Rice bran oil is used for cooking as well as in salad dressings. It is known to have a very high smoke point (over 200C/400F), so that it can be used for all kinds of cooking methods, including those requiring very high heat such as deep frying. It is free of trans fats. Rice bran and germ oil is also used as a nutritional supplement (e.g. in the form of capsules). Rice bran forms 5–8% of grain weight, and is also used for flours, concentrates, and dietary fiber, as well as for other non-human-food purposes.
- b) **Rice-based alcoholic beverages:** The most common is a rice beer produced by boiling husked rice, inoculating the mix with a bit of yeast cake, and allowing the mixture to ferment for a short period. The mash left at the bottom of the container is often prized.
- c) **Rice vinegar:** Rice vinegar is a traditional product from China and Japan. It can range from clear or pale yellow to shades of red, brown and black. It has 4–5% total acidity.
- d) **Rice milk:** In Thailand and the US, milk is made from rice for lactose intolerant people.
- e) **Rice syrup:** Rice syrup is an alternative sweetener, made from cooked brown rice and enzymes, which break down the starch.
- 3) **Rice flour products:** Rice flour is made from ground raw rice (glutinous or non-glutinous). It can

be purchased in its ground form, or ground domestically using a blender, grain mills or traditional pounding methods. Domestically, it can be used in cooking for many purposes. But the following rice-flour products are also manufactured on a large scale. Wet milling is generally used in the making of these products, resulting in the loss of water-soluble nutrients. Some of the rice flour products are-

- a) **Rice noodles:** Flat rice noodles and extruded round noodles are made from wet-milled rice flour. These are eaten with side dishes or in soups.
- b) **Rice-flour cakes and dumplings:** Across Asia, a wide range of sweet and savoury rice-flour-based cakes and dumplings are generally available for purchase as snack-foods from traditional markets, supermarkets, and road-side stalls.
- 4) **Other rice-based products:** Other rice based products include-
  - a) **Rice starch:** Rice starch is used as a thickening agent in food preparation, including infant formula. The granular size of rice starch is relatively small.
  - b) **Germinated brown rice (GBR):** Brown rice refers to the paddy without husk. It is rich in vitamin B1, B2, B3, B6 and iron as compared to polished white rice that we consume daily. GBR is different from normal brown rice in that it has undergone the process of germination; more specifically, the rice embryo is sprouted under suitable environmental conditions.

## Employment potential of rice

Rice-based value added products are in great demand. These can provide substantial employment to the rural youth and farm women. Huge opportunities exist for other industries like rope making units, paper and board making unit, handicraft making units, and other processing units on rice-based consumable items like rice bran oil extraction unit and cottage industries which involves rural women like papad making, vermicelli making, pasta making, baby food making, etc. to come up in rural areas. These units will provide the gainful employment to the rural people as well as reduce the economic losses due to food waste.

## Conclusion

Rural India is endowed with several unexplored opportunities in rice sector with tremendous potential to pull the farming community out of distress. Sensitization about commercialization of value-added products of rice and investments in rice-based cottage industries could be the potential options for uplifting socio-economic status of rice farmers in the country. Priority should be given in this area as one of the alternatives for doubling farmers' income as rice provides livelihood support to 40% of Indian poor and is cultivated by 56% of the Indian farmers.



*Published by :*

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