ROHINI

COLLEGE OF ENGINEERING AND TECHNOLOGY

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DEPARTMENT OF AGRICULTURAL ENGINEERING

AI3601 POST- HARVEST TECHNOLOGY

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UNIT V: CROP PROCESSING

CO5: To use different post-harvest operations and processing methods of harvested crops.

Parboiling of Paddy

Introduction to Parboiling

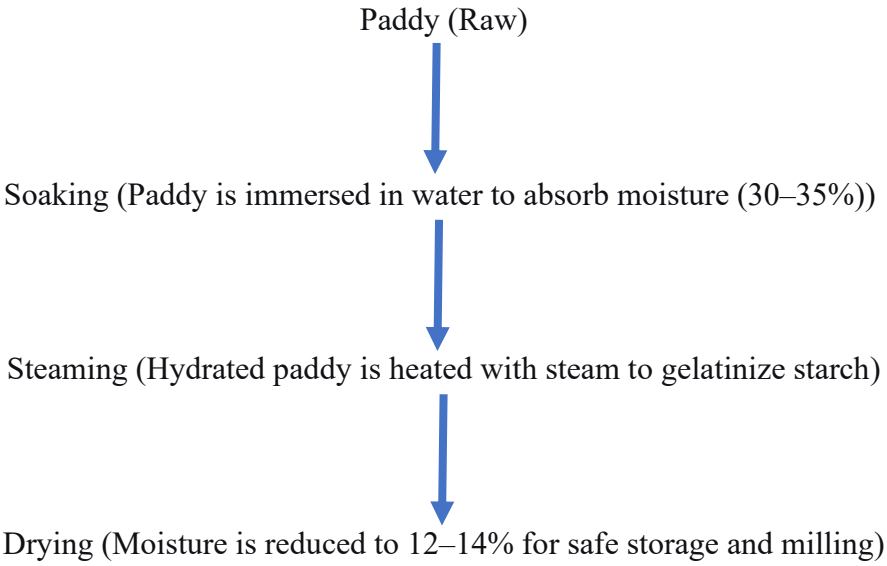
- Parboiling (from "partial boiling") is a hydrothermal treatment process applied to paddy before milling.
- It involves three main stages: Soaking, Steaming, and Drying.
- Parboiling gelatinizes the starch inside the rice kernel, hardens the grain, and causes vitamins and minerals from the bran to diffuse into the endosperm.
- **Purpose:** To improve milling recovery, nutritional value, and storage characteristics of rice.

Objectives of Parboiling

Objective	Description
To increase milling yield	Hardens the grain, reducing breakage during milling.
To improve nutritional value	Water-soluble vitamins (B-complex) and minerals from bran migrate into the endosperm.
To enhance storage life	Enzymes (lipase) in bran are inactivated, preventing rancidity.
To ease dehusking	Husk becomes brittle and loosens from the kernel.
To improve cooking quality	Grains remain firmer, less sticky, and do not overcook easily.

The Parboiling Process (Basic Steps)

Regardless of the method, all parboiling systems follow these three essential steps:



Methods of Parboiling

i) Traditional Method

- **Process:**
    1. Paddy is soaked in earthen pots, cement tanks, or rivers/ponds for 3–4 days.
    2. Soaked paddy is boiled in open pans (with water) until the husk starts to crack.
    3. The boiled paddy is sun-dried on mats or floors for 2–3 days.
- **Equipment Used:** Earthen pots, open pans, open yard for sun drying.
- **Quality of Output:** Inconsistent; often discolored (dark), fermented, and with high breakage due to over/under cooking.

ii) Hot Soaking Method (CFTRI Method)

Developed by the Central Food Technological Research Institute (CFTRI), India, to improve upon traditional methods.

- **Process:**
    1. **Pre-heating:** Paddy is pre-heated with hot water (80–85°C) for a short time.
    2. **Soaking:** The pre-heated paddy is soaked in the same hot water for 3–4 hours (water temperature gradually cools).

3. **Steaming:** Steaming is done for 10–15 minutes at atmospheric pressure.
4. **Drying:** Sun or mechanical drying.

- **Advantages:** Reduced soaking time (hours vs. days), better hygiene, lighter color rice.
- **Disadvantages:** Requires controlled heating; not as efficient as pressure methods.

iii) Pressure Parboiling Method

- **Process:**
  1. Paddy is soaked in cold or warm water for 2–4 hours (partial hydration).
  2. The soaked paddy is directly steamed under pressure (1–1.5 kg/cm²) in a autoclave or pressure vessel for 10–20 minutes.
  3. The high pressure forces moisture and heat into the kernel rapidly.
  4. Drying is done mechanically.
- **Advantages:**
  - Very quick process (total time 4–6 hours).
  - Complete gelatinization.
  - Produces attractive, golden-yellow rice (highly preferred in some markets).
- **Disadvantages:**
  - High capital cost (pressure vessels).
  - Requires skilled operation.
  - Can cause over-gelatinization if not controlled.

iv) Modern Continuous Parboiling Systems

Large-scale rice mills use continuous systems for high throughput.

- **Process:**
  1. **Continuous Soaker:** Paddy moves through a long tank of hot water on a conveyor.
  2. **Continuous Steaming:** Conveyor carries soaked paddy through a steam chamber (often with live steam).
  3. **Continuous Dryer (Fluidized Bed):** Hot air dries the paddy in a continuous flow.
- **Advantages:** Fully automated, consistent quality, high capacity (several tons per hour).
- **Disadvantages:** Very high initial investment.

Comparison of Parboiling Methods

Feature	Traditional Method	Hot Soaking (CFTRI)	Pressure Method	Continuous System
Soaking Time	3–4 days	3–4 hours	2–4 hours	1–2 hours
Steaming	Open boiling	Atmospheric steam	Pressure steam	Continuous steam
Drying	Sun drying (2–3 days)	Sun/mechanical	Mechanical	Continuous mechanical
Color of Rice	Dark, uneven	Light cream	Golden yellow	Consistent golden
Milling Yield	Moderate (low head rice)	Good	Excellent	Excellent
Capital Cost	Very low	Moderate	High	Very high
Skill Required	Low	Moderate	High	Very high

Merits (Advantages) of Parboiling

<u>Advantages for Milling</u> (Processor Benefits):

1. **Higher Head Rice Yield:** Grains become harder and more resistant to breakage during shelling and polishing (5–10% higher than raw rice).
2. **Easier Dehusking:** Husk becomes brittle and loosens, reducing power consumption in shellers.
3. **Less Brokens:** Milling of parboiled paddy produces fewer broken kernels.
4. **Bran Removal:** Bran becomes softer and easier to remove during polishing.

Advantages for Nutrition (Consumer Benefits):

1. **Nutrient Retention:** Vitamins (thiamine, niacin) and minerals from the bran migrate into the endosperm. Parboiled rice is more nutritious than highly polished raw rice.
2. **Loss of Nutrients Minimized:** During washing and cooking, parboiled rice loses fewer nutrients because they are sealed inside the gelatinized starch.

Advantages for Storage and Cooking:

1. **Longer Storage Life:** Enzymes (lipase) that cause rancidity in bran are destroyed; parboiled rice can be stored for longer periods.
2. **Insect Resistance:** Gelatinization makes the kernel harder and less attractive to storage insects.
3. **Cooking Properties:** Grains remain separate, fluffy, and do not stick together; they absorb more water and swell more than raw rice.

Demerits (Disadvantages) of Parboiling:

Disadvantages in Processing:

1. **Higher Processing Cost:** Requires additional equipment (soaking tanks, steamers, dryers) and energy (fuel for steam, electricity).
2. **Longer Processing Time:** Even with modern methods, it adds several hours to the overall milling process.
3. **Requires Skilled Labor:** Modern parboiling plants need trained operators to control temperature, pressure, and moisture.

Disadvantages in Quality:

1. **Discoloration:** Improper processing (especially traditional methods) can lead to dark, unappealing rice.
2. **Odor Development:** If soaking is prolonged, fermentation can occur, imparting an unpleasant smell to the rice.
3. **Harder Texture:** Parboiled rice takes longer to cook than raw rice, which may be undesirable for some consumers.
4. **Loss of Aroma:** In aromatic rice varieties (like Basmati), parboiling can destroy the delicate aroma.

Disadvantages in Nutrition (Specific Cases):

1. **Fat Soluble Vitamins:** Some fat-soluble vitamins may be lost during processing.
2. **Protein Denaturation:** Excessive heat can denature proteins, slightly reducing biological value (though impact is minimal).

Market Limitations:

1. **Consumer Preference:** In some regions, consumers strongly prefer the taste, texture, and appearance of raw (non-parboiled) rice.
2. **Price:** Parboiled rice is often slightly more expensive due to additional processing costs.