



AfricaRice



IMPROVED RICE PARBOILING PRACTICES: Equipment and process description



A Training manual

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1. Introduction

Paddy rice is only fit for consumption when its outer seed has been removed through the process of hulling. Parboiling may take place before or after this process. However, parboiling is necessary so as to obtain rice which is of good quality in terms of its physical, chemical and sensory properties. Therefore, parboiling is an activity of paramount importance and can be defined as a method for processing paddy which helps to mitigate the effects of poor drying (cracking) and improve yield quantitatively and qualitatively as the breakage rate is reduced. It gives the product better consumer appeal, thereby adding value to paddy rice and to the finished product. The process consists in increasing the water content of paddy grains, warming and drying them in preparation for hulling and polishing.

2. Principles and benefits of parboiling

The two major elements in the parboiling process are water and heat.

The benefits of parboiling rice are threefold, as summed up below :

- 1- It reduces the breakage rate during the hulling process ;
- 2- It makes for improved yield ; and
- 3- it helps to reduce losses of nutritive elements during the process of hulling and cooking the rice.

Through the parboiling process, the rice undergoes chemical, physical and sensory changes as follows:

↳ Chemical changes :

- the water-soluble substances (vitamins and minerals) are dissolved and allowed to permeate the grains ;
- the lipoid materials in the endosperm are dissolved ;
- the gelatinised starch appears like a compact and homogeneous mass ;
- Lipoid matter are separated and go deeper into the compact mass of gelatinised starch ; they are therefore less subject to extraction and
- Fat-soluble substances in the germ and the outer part of the endosperm are dissolved and disseminated in the grain.

↳ Physical changes :

- the process of drying makes it possible to reduce the water content of the grain to an optimal level for milling ;

- all latent or active biological processes (germination, proliferation of fungal spores, development of insects at varying phases) are terminated ;
- the milling yield is better and quality is improved as there are less broken grains ;
- parboiled rice, even without milling, can be better stored and for a longer period as germination cannot take place and the compact texture of the endosperm allows it to better resist insect attacks and not to absorb moisture from the surrounding environment.
- Parboiled rice can be conserved longer and is less subject to rancidity.

↳ **Sensory changes :**

The most significant ones are as follows :

- Cooked parboiled rice has better digestibility ratio by reason of its texture and firm consistency; and
- after cooking, the grains are firmer and tend to be less sticky.

3- Items required for parboiling rice with the improved system

There is a large variety of appliances that can be used for parboiling rice. For the purpose of our training, we shall concentrate on the improved system developed by the Food and Agricultural Technology Programme, or **Programme de Technologie Agricole et alimentaire** (PTAA) of the National Institute for Agricultural Research in Bénin (INRAB). Research has been carried out to prove its superior efficiency – technically, economically and environmentally – as compared to the conventional system. The improved equipment for parboiling rice comprises a cast aluminium pot and a galvanised iron steaming pan, in the shape of a truncated cone, which is a bucket-like vessel, with perforations at the bottom and the lower 1/3 of its edge.

		
<p><i>Cooking pot</i></p>	<p><i>Steaming pan</i></p>	<p><i>Improved device</i></p>

It should be possible to place the pot in such a way that that the perforated lower part of the pan can fit into it. This device is available in two types : (1) the smaller size which can handle about 25 kg of paddy per steaming session, and (2) the medium size which can accommodate an average of 45kg per session.

Another crucial material in the parboiling process is the paddy itself, which should be of good quality, should not be too old, and should be relatively free of cracks. Quality of the final product is dependent on that of the paddy used. Other accessories will be needed, in the form of pans, small containers, baskets, stoves (in particular fuel-efficient stoves, to reduce firewood consumption), big stirring spoons, drying areas, tarpaulins or covers made of jute bags, etc.

4. The different steps in the rice parboiling process using the improved equipment

Step 1 : First-stage washing of the rice

Paddy is washed clean in a basin containing a large quantity of water (about 3 litres of water for 1 kg of paddy rice). This washing makes it possible to remove all types of dirt or residues from the paddy (sand particles, grass, etc.) as well as unripe grains. These unripe grains, which float at the surface during washing, are collected using a small basket or a sieve. Sand found at the bottom of the basin is discarded after carefully retrieving the clean paddy. Depending on the amount of dirt it contains, paddy can be washed 2 to 4 times.



First-stage washing of rice paddy

Etape 2 : First-stage draining

Once it has been thoroughly washed, the clean paddy is poured into a basket for the water to drip dry. In this way, all the remaining water used in washing is allowed to drip from the paddy.



First-stage draining

Step 3 : Soaking in hot water



Soaking of paddy

After draining, the paddy is poured in a cast aluminium pot containing clean water. This water should be floating above the product. The solution is then put on a fire and left until temperature reaches approximately 60°C. At this temperature, the women processor can hardly dip her fingers in the water as it is very hot. This marks the end of the heating process.

This single operation during which the paddy is occasionally stirred, will generally last 20 to 40 minutes for a quantity of about 25 kg of paddy. After heating, the paddy is removed from the fire, then left to cool down overnight, i.e. roughly for 12 hours.

Step 4 : Second-stage washing and draining

The paddy is removed from the pre-heating water the following day, washed in clean water then transferred to a clean basket for draining.



Second-stage washing and draining

Step 5 : Pre-cooking the rice with steam

The drip-dry paddy is poured in the steaming pan which has been inserted into a pot containing clean water (about 10 litres). Indeed, water contained in the pot should not touch the bottom of the pan so that the product will not be wet. The water is heated to its boiling point and the vapour generated passes through the holes in the pan to pre-cook the paddy rice. This process will end when it is observed that the husks of some paddy grains have burst or a heavy sound is heard when tapping the grains using the palm of one's hand. Duration of this process is about 13 minutes for 24 kg of paddy.



Pre-cooking the rice with steam

Step 6 : Drying the rice

Steamed paddy is first dried in the sun for about 1 hour 30 minutes, then collected and dried in the shade for the remaining period, which can last for about 16 hours before hulling takes

place. For both purposes, paddy should be properly spread on tarpaulin, canvass or drying areas. Drying the paddy in the sun then in the shade will reduce water content of the paddy to about 21% and 10% respectively.



Drying the rice

According to the women involved in this process, the end of the period of drying in the shade can be determined when the husk can be easily removed by rubbing the paddy between the palms of both hands ; this signals the end of the entire paddy rice parboiling process and hulling of the paddy can then start or paddy can be stored. Hulling can be done using the roller-type or the Engelberg huller, with the operator making sure that the machine is set properly. Breakage rate is about 15% if steaming has been correctly done and the huller properly set.

5. Benefits of using the improved device

1- Rust-resistance

2- Reduced losses during the stage of pre-cooking the rice, as opposed to the conventional method in which the paddy grains at the bottom of the pot are overcooked, leading to considerable losses ;

3- Faster drying compared to the conventional method in which paddy is precooked directly in water and not with steam ;

4- Improved yield at the hulling stage with low rate of breakage and good quality of the rice after hulling, with a uniform colour ;

5- Reduced rate of consumption of firewood and water;

6- Reduced completion time as compared to the conventional method ;

7- Versatility of the device : it can also be used for cooking various local dishes requiring pre-cooking with steam (local couscous from corn, cassava, yam, etc.) ;

6. Maintenance of the device

- Clean the equipment properly before and after use ;
- Do not put the steaming pan in direct contact with the ground as sand particles and other foreign bodies might block the holes ;
- Avoid any shock to the steaming pan so as not to distort it ;
- Always use clean water for steaming.

7. Improving the quality of the parboiled rice- Role of the producers

The quality of any processed product is dependent on that of the raw materials used. Hence the important role of the producer in ascertaining the quality of the parboiled rice as a purveyor of raw materials. The role of the producer is to:

- Provide appropriate varieties
- Ensure good quality seeds are used
- Never allow paddy to come in direct contact with the ground (use tarpaulin and the like)
- Clean the paddy
- Ensure that the quality of the paddy is retained during storage

8. Improving quality of the parboiled rice- Role of the processors

Quality of the parboiled rice is not dependent solely on the raw material used. It is also related to the water and type of paddy used as well as controls carried out during the transformation process. The role of the processor is to :

- Use good quality materials (paddy, water)
- Monitor and adequately control the process (washing, removal of dirt, draining, pre-cooking, drying, hulling).

9. Parboiling rice and the Environment

Parboiling is an energy-intensive activity. In the past, the majority of operators used a type of stove in the form of three assembled stones or simple bricks. There was considerable loss of energy during the parboiling process and therefore the consumption rate of firewood was high.



Traditional stoves requiring a large amount of wood for parboiling

In order to save energy and preserve the environment, several strategies have been developed, involving the use of improved stoves (consuming less energy) as well as rice husk for parboiling activities.



Improved stoves for reducing the amount of wood used for the purpose of parboiling

Research has been going on since 2009 with the aim of improving thermal efficiency during the process of parboiling rice. Several types of stoves have therefore been developed and tested in the rural areas. The stove selected, significantly reduces cracking of the clay during the drying phase and there is better smoke control as the fumes are no longer going in the direction of the user since some holes have been made in the device to serve as a chimney.

However, it is important to continue monitoring this type of stove over a longer period so as to obtain more reliable results.



Research has also been conducted in the use of rice husks as an alternative to firewood, which accelerates deforestation and creates significant environmental problems. Different types of rice husk briquettes have thus been developed and tested. Research is still on to identify the most suitable combination for an optimal yield. People involved in the processing of rice may therefore start by experimenting the rice husks in order to ascertain their suitability and reduce the use of firewood.

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