



What variety of rice is the most appropriate for the parboiling in Gogounou and Banikoara districts in the Northern-Benin?

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ABSTRACT

Objective: Assessment of the parboiling ability of the three (03) most used varieties of rice (*IR 841*, *Oroukokey* and *Burkina*) in the districts of Banikoara and Gogounou (north Benin).

Methodology and Results: Two approaches were used: (i) Parboiling test of the three varieties of paddy rice, (ii) Assessment of the physical quality of the parboiled rice just after husking and also after cooking. For each variety, 40 kg of paddy rice was parboiled by the processors and parboiling parameters were assessed. After husking, a sample of 1 kg of parboiled rice was taken and half (500 g) is cooked. The cooked and uncooked samples were submitted to the 20 consumer's appreciation. The results obtained showed that no significant difference ($p > 0.05$) was observed between the three varieties of rice tested considering parameters: hot soaking duration, steaming duration, amount of water consumed during the hot soaking and during the steaming. The physical assessment of the uncooked rice samples obtained after the drying process showed that the *IR 841* variety is more attractive (54.89 %) compared to the *Burkina* (31.57 %) and *Oroukokey* (13.54 %) varieties. *IR 841* was found to have attractive aroma (50%) than the *Oroukokey* (20%) and *Burkina* (30%) varieties. Considering the cooked form of the three parboiled rice, the panellists preferred *Burkina* variety in the first position followed by the *IR 841* variety and then third *Oroukokey* variety.

Conclusions and application of findings: The three varieties tested (*IR 841*, *Oroukokey* and *Burkina*) can be used for parboiling. But the *IR 841* variety is the best suitable for parboiling compared to the two other varieties because of its husking yield, attractive colour, natural flavour and its good taste highly appreciated by the women rice parboilers.

INTRODUCTION

According to Houssou et al. (2016a), rice parboiling (*Oryza* sp.) is a post-harvest hydrothermal process commonly used for quality maintenance (Ibukun, 2008), improving the nutritional status of the product, reducing the breakage rate upon milling, and imparting

different cooking and eating characteristics from non parboiled rice (Sakurai et al., 2006, Hardi, 2011). Rice parboiling is an activity generating income, practiced mainly in the central and northern Benin by the women processors (Adégbola, 2010). A baseline study carried out in

the framework of the implementation of the project entitled «Ensuring sustainable and sustained Food Security by enhancing local parboiled rice value-chain competitiveness in Gogounou and Banikoara areas in Benin (PARCR)» showed that in the localities of the North of Benin and more specifically in the communes of Gogounou and Banikoara, the parboiling process is practiced in a traditional way, which does not unfortunately lead to a good quality parboiled rice (PARCR, 2016). The same study also showed that the rice varieties processed by the women in these localities are mostly the IR841 and other varieties called *Yorobo* in Banikoara and *Yayi Boni* in Gogounou; the *Oroukokey* variety produced by the

producers of Banikoara and finally a variety called *Burkina-Faso* cultivated in Banikoara (PARCR, 2016). Moreover, the women rice processors of these localities (Banikoara and Gogounou) reported that the weak quality of their rice is sometimes depends on the rice variety used. They estimated that some varieties of paddy rice take a little longer time to be parboiled than others and have an unattractive physical quality (Houssou *et al.*, 2016b). To address these concerns, this study was initiated and aims to assess the aptitude of the parboiling process of the three main varieties of rice used in the communes of Banikoara and Gogounou in order to advise the women processors on the suitable varieties for parboiling.

MATERIALS AND METHODS

Framework of the study and participants: The study was carried out on the field of the site of the Organization for Sustainable Development, the Reinforcement and the Auto-promotion of the Communities' Structures (NGO DEDRAS) in Banikoara, a locality in the department of Alibori in the north of Benin. Twenty (20) women rice processors initially trained on the improved technique of rice parboiling were invited. Ten (10) came from the commune of Gogounou and ten other from commune of Banikoara. These two communes are

among the main communes where rice is parboiled by women in north Benin.

Raw Material: The raw material used in this study consists of three locally produced varieties of rice most commonly used for parboiling in the communes of Banikoara and Gogounou, they are *IR 841*, *Burkina* and *Oroukokey*. It should be noted that of the three varieties concerned, IR 841 is by far the most cultivated for two main reasons: it is promoted by the Benin government, and gives good yields (4 to 6T/ha). The intrinsic characteristics of each of these varieties are shown in table 1.

Table1: Physical characteristics of the three varieties of paddy rice tested

Parameters	Moisture content (%)	Dimensions of the grain(L/l)	Weight of 1000 grains (g)
<i>IR 841</i>	10.55	4.71	27.60
<i>Oroukokey</i>	10.75	4.91	26.28
<i>Burkina</i>	11.2	4.55	24.37

*Classification Long grain $L/l \geq 3.1$

Parboiling equipment used: Improved parboiling equipment developed by Food Technology Program (PTAA) of the National Institute of Agricultural Research of Benin (INRAB) was used (Houssou & Amonsou, 2004). This material has a capacity of 40

kg of dried paddy rice. It consists of a melted aluminium alloy pot and a drying tank (bucket-shaped container with the back and the $\frac{1}{4}$ of the low edge are perforated) (Figure 1).



Figure 1 : Improved parboiling equipment devise of 40 kg composed of a pot (at left) and a steamed tank (at right)

Moreover, other materials such as wash basins (for washing paddy rice), sieves for removing the immature paddy grains during washing, long handles with pallets or rakes to facilitate the display of paddy in the sun, short pallets for stirring /mixing the product during the hot soaking, baskets for draining paddy and tarpaulin made of polyethylene bags was used for drying. Firewood was used for hot soaking and steaming (parboiling) operations.

Methods: The methodology used is summarized in two (02) steps: (i) the parboiling test of the three varieties of paddy rice, and (ii) the physical quality

assessment of the parboiled rice obtained after husking.

Parboiling test of the three varieties of rice: A lot of 40 kg of paddy rice of each of the three varieties was parboiled by the women processors with the improved parboiling method described by Houssou & Amonsou (2004) (Figure 2). At the end of the parboiling process, each sample is dried under sun to an average moisture of about 12% (Figure 3). The parboiled paddy rice obtained for each tested variety was then husked in the same condition using an Engelberg husking machine.

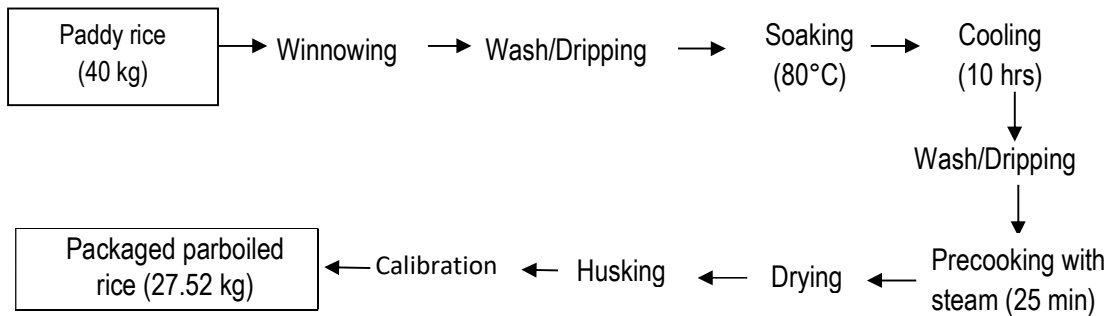


Figure 2: Improved technological diagram of parboiled rice production

This parboiling test was repeated twice for each variety. During the parboiling process, some parameters such as the hot soaking duration, the amount of water consumed by the process during the soaking, the steaming (parboiling) duration and the

amount of water used during this process, the yield of parboiled rice obtained after husking, were determined according to the method described by Fofana *et al.*, (2011) and Houssou *et al.*, (2016c).



Figure 3 : Test of parboiling ability (pre-cooking at the left) and drying of paddy rice pre-cooked(at the right)

Evaluation of the physical quality of rice after husking: After husking, a sample of 2 x 500 g of each of the three parboiled rice were taken. The first 500 g of uncooked parboiled rice was evaluated by 20 women processors on the basis of the quality attributes such as color, breaking rate, presence of blackheads, odour and rice cleanliness. The second lot of 500g of rice was cooked by the women before being assessed by the same women processors who

appreciated the uncooked rice. These participants appreciated the rice prepared on the basis of criteria such as taste, ease of chewing, flavour and texture.

Data analysis: Data from parboiling test of the three varieties and the sensory evaluation were entered using the Excel 2010 spread sheet. Analysis of variance was done of collected data on each parameter tested using SPSS software, version 17.

RESULTS AND DISCUSSION

Technical ability of the rice varieties tested at the drying process: The assessment of the technological parameters of the three varieties tested

during the drying process showed that the duration of the hot soaking is almost identical with an average of 39.5 ± 1.32 minutes (Table 2).

Table 2: Some technological parameters of the varieties tested (Quantity of paddy rice processed = 40 kg)

Parameters	Duration of the hot soaking (min)	Quantity of water consumed during the soaking (L)	Duration of the steam pre-cooking (min)	Consumption of water during the parboiling process (L)	Yield to the husking (%)	Rate of break (%)
IR 841	40.50	6.10	30.50	4.25	70.40	14.94
Oroukokey	40.00	4.20	29.20	4.50	69.69	16.01
Burkina	38.00	4.00	30.70	5.00	66.55	14.19
Average±StD	39.50 ± 1.32	4.76 ± 1.15	30.13 ± 0.81	4.58 ± 0.38	68.8 ± 2.04	15.04 ± 0.91

With regard to the water consumption during the hot soaking, it is found that the IR 841 variety absorbed more water (6.10 L) than the Oroukokey variety (4.20 L) and the Burkina variety (4.00 L). As for the duration of the steam parboiling, it is almost identical for the three varieties tested with an average of 30.13 ± 0.81 minutes. This may be due to the fact that the three varieties have almost the dimension and shape (Table 1), also the same improved traditional stove used to parboil the varieties also can explain that. Indeed, Houssou *et al.*, (2015) have shown that the use of an improved stove influences the parboiling process since it allows a good combustion, a reduction of the quantity of wood and the time of cooking. No significant difference ($p > 0.05$) is

observed in quantity of water consumption during parboiling, however IR 841 variety recorded the lowest water consumption (4.25 L) during the parboiling process compared to the two other varieties used (4.5 L and 5 L). This may be due to intrinsic characteristics such as the nature of the amylose content of the variety as reported by Ejebe (2013) when he studied the effect of rice variety from Nigeria on steeping temperature and time on thermophysical properties of parboiled rice. Husking yield of the IR 841 (70.40%) and Oroukokey (69.69%) varieties were higher with broken ratios of 14.01% for IR 841 and of 16% for the Oroukokey variety. The husking yield values for these two varieties are slightly higher than for the Burkina variety (66.55%)

with a break rate of 14.19% (Table 2). These observed differences are related to the morphological characteristics of the grains. Indeed, when the grains are long and less thick, they break easily during the husking operation (Houssou *et al.*, 2005). This justifies the relatively low yield observed with the *Burkina* variety. Finally, based on the technological parameters measured, the three varieties of rice tested are suitable for parboiling. However, assessment of the physical quality of the cooked and uncooked form of each of the three samples rice by the women processors and the consumers is necessary in order to advice the women parboilers on the most suitable rice variety to be used for parboiling.

Assessment by the panellists of the uncooked and cooked parboiled rice: The results obtained from the uncooked parboiled assessment by the twenty panellists showed that the IR 841 variety was the most attractive (54.89% of the panellists) compared to the *Burkina* (31.57 % of the panellists) and *Oroukokey* (13.54% of the panellists) varieties (Table 3). Moreover *IR 841* was the cleanest (69.56% of the panellists) compared to the two varieties *Oroukokey* and *Burkina* which had the lowest scores respectively for the cleanliness parameter (8.71% and 21.73% of the panellists). Moreover, the *IR 841* variety is naturally more flavoured and attractive (50%) than the *Oroukokey* (20%) and *Burkina* (30%) varieties.

Table 3: Assessment of women processors in relation to the uncooked dried rice, N= 20 panellists

Parameters	Attractive color	Good flavour	Cleanliness	Rank
Varieties				
<i>IR 841</i>	54.89	50	69.56	1st
<i>Oroukokey</i>	13.54	20	8.71	3rd
<i>Burkina</i>	31.57	30	21.73	2 nd

Except the physical quality criteria, the women rice processors found that the parboiled *IR 841* variety resemble to *ARROSSO* rice (imported rice sold on our markets). Besides, the *IR 841* variety is a long and large grain while the *Burkina* variety is a long and less large grain. Thus, based on the physical qualities of the uncooked parboiled rice samples, the processors who participated to the parboiling process test chose the *IR 841* variety as the most suitable for parboiling, followed by the *Burkina* variety and

Oroukokey in the last position (Table 3). On the other hand, the classification was no longer the same concerning the cooked form of the parboiling rice samples. Indeed, the *IR 841* variety was the stickiest (100% of the panellists) according to all the tasters/panellist. After the cooking, the grains of the *IR 841* variety became massive and sticky while the *Burkina* variety showed the best texture (95.45% panellists) followed by the *Oroukokey* variety (4.55% panellists) (Table 4).

Table 4: Assessment of the tasters on the cooked form of the rice

Parameters	Less sticky aspect	Facility of chewing	Good flavour	Good taste	Rank
Varieties					
<i>IR 841</i>	0	80	56.52	42.85	2 nd
<i>Oroukokey</i>	4.55	10	13.04	9.52	3rd
<i>Burkina</i>	95.45	10	30.43	47.61	1st

Regarding the chewing facility, the *IR 841* had the highest score (80% of the panellist) compared to the two other varieties (10% each). According to the panellists, the flavour of the *IR841* was still persistent (56.52% of the panellist) even after cooking compared to the *Burkina* (30.43% of the panellists) and *Oroukokey* (13.04% of the panellist) varieties. According to the panellists, *IR 841* had a good taste (42.85% of the panellist) similar to the one of the *Burkina* (47.61%). The taste of these two varieties was much more appreciated compared to the taste of the *Oroukokey* (9.52%). Considering the cooked form of the three dried rice samples, the panellists chose

the *Burkina* variety in the first position followed by the *IR841* variety and then the *Oroukokey* variety comes in the last position. The 2nd position of the *IR 841* in the overall classification is due to its sticky aspect during the cooking. It is therefore important to determine the most appropriate cooking method for each variety of rice tested for parboiling especially concerning the *IR 841* variety for its promotion close to consumers and restaurants giving that this variety is the most widely promoted in Benin. For this perspective the cooking ability of each of the three varieties is needed.

CONCLUSION

This study showed that the three varieties tested (*IR 841*, *Oroukokey* and *Burkina*) can be used for parboiling. But the *IR 841* variety is the best suitable for parboiling compared to the two other varieties because of its husking yield, attractive colour, natural flavour and its good taste highly appreciated by the

women rice parboilers. Despite the best performances of the *IR 841* for parboiling, it was not the most appreciated by the panellists after the cooking mainly because of its very sticky aspect. Further study is therefore necessary in order to make *IR 841* more appreciated by consumers.

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