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Comparison of parboiled and white rice obtained from ten varieties cultivated in Benin

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Abstract

Physico-chemical grain quality traits and nutritional contents were evaluated in parboiled and non-parboiled samples of ten rice varieties produced in Benin. These included four existing varieties cultivated in Benin (BL 19, BERIS 21, IR 841 and TOX 4008) and six newly introduced varieties (NERICA 1, NERICA 2, NERICA 4, NERICA-L 14, NERICA-L 20 and NERICA-L 56).These traits were compared with those of two popular brands of imported rice; Special rice (non-parboiled) and Arosso (parboiled). Results show that non-parboiled grains were harder in the locally produced varieties than in Special rice. Non-parboiled grains of NERICA 1, NERICA 2, NERICA-L 56 and BL 19 had lower homogeneity than Special rice; and non-parboiled grains of the locally-produced rice showed higher alkali spreading values than Special rice. The physical characteristic (hardness, chalkiness, grain homogeneity, alkali spreading value, water uptake) of parboiled of the ten rice varieties analyzed was almost similar to the imported rice brands Arosso (parboiled).The protein, vitamin B_3, vitamin B_{12}, sodium, magnesium and calcium contents detected in the 10 tested rice varieties are not significantly different from the values found in imported rice. However the mean overall lipid content is low in the parboiled rice as compared with non-parboiled rice of the same variety: 0.29% and 0.85% respectively. Like imported parboiled rice, local parboiled rice varieties tested are easy to cook as well as non-parboiled samples of local varieties NERICA 4, NERICA-L 14, NERICA-L 20 and BL19. But NERICA 1, NERICA 2, NERICA-L 56, BERIS21, TOX4008 and IR841 do not cook easily because the warping of grains during cooking .The result of sensory evaluation indicated that the parboiled forms of NERICA 2, NERICA-L 20, BERIS 21, BL 19 and IR 841 were more appreciated by the panelist than their non-parboiled form. Non-parboiled forms of NERICA 1, NERICA 4, NERICA-L 14, NERICA-L 56 and TOX 4008 were preferred by panelists than their parboiled forms.

Introduction

Like many countries in Africa, the consumption of rice has increased in Benin republic (WARDA, 2008). It is currently the second most consumed cereal after maize in the country with annual per capita consumption reaching about 30 kg (Adégbola and Sodjinou, 2003). Total annual demand rose to about 210,000 tons in 2010, of which about 151,000 tons produced locally (Ministère de l'Agriculture de l'Elevage et de la Pêche, 2010). The gap is filled by imports. Gankoué (2012) has reported that two imported brands, Special Rice and Arosso, are the most brands preferred by consumers in Benin for non-parboiled and parboiled rice respectively. It has also been reported that despite the higher prices for imported rice, consumers prefer it rather than the locally produced rice because of its best quality (Adégbola and Singbo, 2005). Improving the grain quality of locally produced rice to increase its acceptability by consumers is an important aspect of increasing local production and reducing reliance on imported rice. Parboiling is a post-harvest process that improves grain quality (Sareepuang *et al.*, 2008), improving the nutritional status of the rice, reducing breakage rate at milling, changing cooking characteristics and imparting different eating characteristics (Hardi, 2011). But while certain rice varieties are preferred by consumers in their parboiled form, others are not, because of their intrinsic characteristics (i.e. amylose content, color, etc.), their taste, texture and ease of cooking. In this study, physico-chemical grain quality traits, including some nutritional contents, were evaluated in parboiled and

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non-parboiled (white rice) samples of existing local varieties and newly introduced NERICA varieties, and compared with the two imported rice brands mostly consumed in Benin, that are Arosso (parboiled rice) and Special rice (non-parboiled). In addition to the physico-chemical quality evaluation, a sensory test was carried out using the same materials.

Materials and Methods

Rice varieties

Pure samples from ten paddy rice varieties locally produced were used: four existing varieties cultivated in Benin (BL 19, BERIS 21, IR 841 and TOX 4008) and six newly introduced varieties (NERICA 1, NERICA 2, NERICA 4, NERICA-L 14, NERICA-L 20 and NERICA-L 56). A 5kg sample of each variety was divided into two parts. One part was directly milled to obtain non-parboiled rice, while the second was parboiled before milling using an improved parboiling method (Fofana *et al.,* 2011; Houssou and Amonsou, 2004). Samples of Special rice (non-parboiled) and Arosso (parboiled rice) were used as controls.

Moisture content

For each rice sample, five grams were dried in an oven at 105°C for 72 hours, after which their final weight was recorded. The difference between the initial and final weights was expressed as percentage, showing the moisture content of the sample.

Chalkiness

Two hundred whole rice grains were selected randomly and visually assessed for chalkiness. A score of 1 (less than 10% chalkiness), 5 (10–20% chalkiness) or 9 (over 20% chalkiness) was given to each sample according to the standard evaluation systems of the International Rice Research Institute (IRRI, 1996).

Grain homogeneity ratio

For each sample of rice, 10 g (m_0) were taken and manually sorted under a magnifying glass in order to separate homogeneous grains (m_1) from non-homogeneous grains (m_2), and weighed. Grain homogeneity ratio = (m_1/m_0) x100.

Grain hardness

Grain hardness was measured for ten grains from each sample, using a Kiya grain hardness tester (Fujihara Seisakusho LDT, Japan). The handle was initially turned to the left to make room to place a grain on the sample table; it was then turned to the right until a cracking sound was heard. When the rice cracks, a black pointer returns to the zero point and a red pointer remains to give a reading indicating the hardness of the grain in kg.

Water uptake ratio

Eight grams of milled rice from each sample were weighed and put into a wire mesh cooking basket. The initial weight of the cooking basket added to the weight of raw rice (W1) was recorded. The cooking basket was lowered into 160 ml boiling water in a 400 ml beaker with the regulator of the hot plate switched to ‘high’. After 1 minute, the regulator was turned to ‘low’ and the beaker was covered with a watch glass. The sample and the cooking basket were then removed and held erect for two minutes for the water to drain off. The final weight of the cooked rice and cooking basket (W2) was then measured. This determination was carried out in triplicate. Water uptake ratio = (W2-W1)/8.

Alkali spreading value (ASV)

Six intact grains of milled rice were incubated in 10 ml of 1.7% KOH at 30°C for 23 hours. The degree of spreading was measured on a seven-point scale: 1 = grain not affected; 2 = grain swollen; 3 = grain swollen, collar incomplete and narrow; 4 = grain swollen, collar complete and wide; 5 = grain split or segmented, collar complete and wide; 6 = grain dispersed, merging with collar; 7 = grain completely dispersed and intermingled.

Protein and lipid

Proximate compositions of the rice samples were evaluated using standard AOAC (1985) methods. The nitrogen content was evaluated using the micro-Kjeldahl method and crude protein was determined as Nx6.25 as reported by Pearson (1976).

Lipid was determined gravimetrically after Soxhlet extraction with hexane (150–200 ml). Twenty grams (20 g) of rice flour were weighed and placed in a cellulose capsule that was put in the chamber of a Soxhlet extractor, which also contained hexane in the still pot. Keeping the extractor at constant temperature of 60°C for five hours gradually dissolved the lipid, and the siphon effect equipment allowed the accumulated lipid to be extracted. Once the extraction finished, the hexane was evaporated, usually on a rotary evaporator, and the fat was weighed bath (AOAC, 1990).

Determination of vitamin B_3 and vitamin B_{12}

The method used was based on the separation of the two vitamins by high performance liquid chromatography (HPLC) using a reverse phase C18 column and UV detection at 272 nm. The separation was first optimized according to polarity and pH. To achieve the various optimization tests, 20 µl of vitamin solutions were injected. These vitamins were then dissolved in the dark in 100 ml of a mixture containing water (94v/v), acetonitrile (5v/v) and acetic acid (1v/v) and heated in a water bath at 65°C, stirring until dissolved.

Determination of mineral composition

Minerals such ascalcium, sodium and magnesium were determined after wet-ashing by concentrated nitric acid and perchloric acid (2:1 v/v). Aliquots were used to estimate sodium and potassium using ionic chromatography methods (Khalil and Manan, 1990).

Determination of cooking properties of rice samples

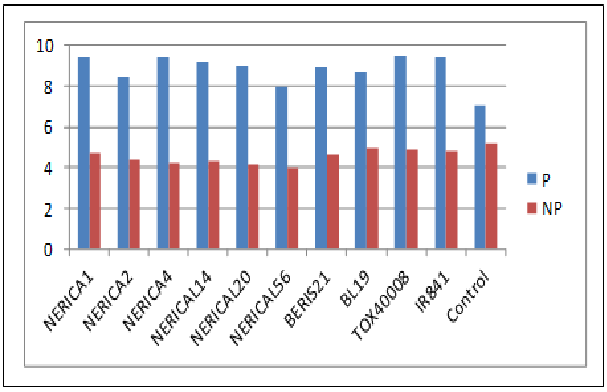
Five experienced women who prepare and sell cooked rice in schools and restaurants were selected to evaluate the cooking properties of the ten varieties of parboiled or non-parboiled rice samples. For each variety, 500 g of non-parboiled rice and the same quantity of parboiled rice were cooked by these women under the same conditions. An automatic gas stove giving a constant intensity of fire was used to cook all the rice samples. During the cooking, the evaluators' impressions were collected based on parameters such as swelling capacity, stickiness, cooking time, ease of cooking and overall cooking behavior of each rice. To facilitate a comparison, parboiled and non-parboiled samples of each variety were cooked at the same time. Once cooked, the rice samples were immediately submitted to the panel of tasters for a sensory evaluation.

Sensory evaluation of cooked rice samples

For the sensory evaluation, cooked parboiled and non-parboiled samples of each rice variety were submitted to a panel of 15 trained rice consumers. Each panelist recorded their preferences of each sample based on sensory attributes such as aroma, color, easiness of chewing, stickiness, taste and overall acceptability.

Statistical analysis of data

The results of physico-chemical, nutritional, cooking and sensory evaluation were synthesized and processed through the software Microsoft Excel 2007. The analyses were performed in duplicate or in triplicate. Statistical Analysis System Software: SPSS version 11 was used to carry out a one-way analysis of variance (significance level $p < 0.05$) from a calculated mean.



P= Parboiled rice, NP = non parboiled rice (non parboiled rice).

Figure 1. Grain hardness

Results and Discussion

Physical properties of rice samples

Physical properties such as moisture content (%), chalkiness, homogeneity ratio (%), grain hardness (kg) and Alkali Spreading Value (ASV) of parboiled and non-parboiled samples from ten locally produced rice varieties are presented in Fig. 1 and Table 1. Among the physical properties of rice, hardness is the most important because it maximizes the milling yield while minimizing the losses due to breakage (Islam *et al.*, 2004). In present work, results obtained indicated that whatever the variety, if the sample was parboiled, it was significantly ($p < 0.05$) harder than if it was non-parboiled. The parboiling treatment applied to the samples consisted of soaking paddy rice in hot water, thereafter steaming it and drying it in the sun. As reported by many authors, this treatment contributes to the gelatinization of starch and to improving the hardness of rice (Islam *et al.*, 2002; Poritosh *et al.*, 2006). No significant difference ($p > 0.05$) in hardness was observed between the varieties. However the overall mean value of hardness recorded for parboiled samples of local rice was higher (8.26 kg) than the hardness of imported parboiled rice Arosso (7.09 kg). When evaluating the effect of parboiling on physical and cooking parameters, Fassinou (2007), as well as Padua and Juliano (1974) concluded that hardness is the most obvious reason for the long shelf life of parboiled rice as compared to non parboiled rice. Based on these results, all the parboiled rice tested could have longer shelf life than Arosso. On the other hand, the chalkiness of a rice grain is another indicator of rice quality. According to Srinivas and Bhashyam (1985), there is a relationship between the chalky grains and the presence of cracks which can cause rice grain breakage during milling. In the present study, the chalkiness score of both

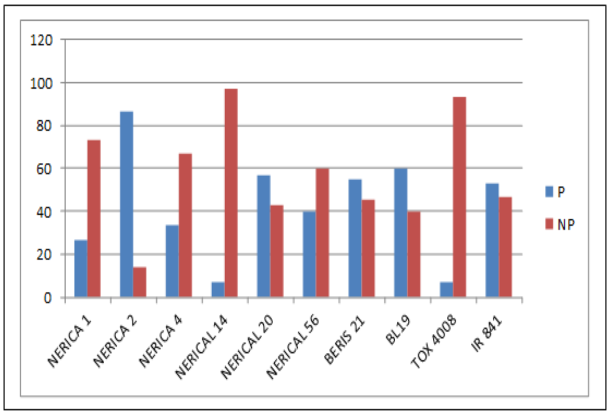
Table 1. Physical and functional properties of parboiled and non-parboiled rice

Variety		Moisture content (%)	Chalkiness	Homogeneity (%)	Alkali Spreading Value
NERICA 1	P	12.08	1	77.15 ±0.78	6
	NP	13.25	9	28.75±1.48	4.5
NERICA 2	P	12.60	1	81.35±3.04	4.33
	NP	13.40	5	40.49±0.88	3.5
NERICA 4	P	12.75	1	86.72±0.56	3
	NP	13.49	5	86.25±1.48	3.5
NERICA-L 14	P	12.33	1	88.65±2.06	5.66
	NP	13.59	5	88.75±1.32	3.5
NERICA-L 20	P	11.88	1	82.2±1.56	3
	NP	12.49	5	86.28±0.79	2
NERICA-L 5 6	P	12.67	1	89.7±1.41	6.5
	NP	13.46	5	64.37±0.7	2
BERIS 21	P	12.03	1	91.3±1.56	6.5
	NP	13.24	1	95.52±0.74	1.5
BL 19	P	11.17	1	78.35±1.49	5.66
	NP	11.96	5	57.15±1.30	2.66
TOX 4008	P	13.09	1	85.26±1.64	6.5
	NP	13.31	1	88.73±2.02	3.5
IR 841	P	12.18	1	90.38±1.82	5
	NP	13.48	1	91.41±2.01	2
Arosso	P	12.64	1	96.65±1.21	4
Special	NP	13.34	1	87.24±2.49	1

Arosso and the local parboiled rice samples varieties analyzed was one (table 1). Some of the non-parboiled local rice varieties – BERIS 21, TOX 4008 and IR 841 – also scored one. A low chalkiness score is an indicator of good quality rice. Fofana *et al*. (2011), while comparing parboiled and non-parboiled rice, obtained a low chalkiness score for parboiled rice, perhaps related to soaking temperature (80°C) that was used during the parboiling process (Houssou and Amonsou, 2004).The use of lower soaking temperatures (60–70°C) gives a higher chalkiness score (Tchatcha, 2012).

Grain homogeneity is another physical quality parameter of rice appearance; the more rice grains are homogeneous, the better the rice is appreciated by consumers. Like Arosso, all the tested parboiled rice samples were homogeneous, with a mean value greater than 85% (Figure. 2).

For the non-parboiled rice samples, the majority of grains were homogeneous. The samples of BERIS 21, IR 841, NERICA-L 14 and TOX 4008 were more homogeneous at 95%, 91%, 88.75% and 88.73% respectively; while non-parboiled grains of NERICA 1 and NERICA 2 were not very homogeneous at



P: Parboiled ; NP: Non parboiled rice.

Figure 2. Consumer’s preference of tested rice varieties (% of responders)

28.75% and 40.49% respectively. High homogeneity of parboiled rice grains was also obtained by Fofana *et al.* (2011).The high homogeneity of the non-parboiled samples in the present study might due to the degree of purity of the paddy varieties used and the good production and post-harvest practices that the samples underwent during testing, having been collected from a research station where every treatment for paddy rice is under control.

Table 2. Nutritional characteristics of rice varieties (uncooked)

Variety	Treatment	Proteins (%)	Lipids (%)	Mineral (mg/100g)			Vitamins (µg/100g)	
				Calcium	Sodium	Potassium	B3	B12
NERICA 1	P	7.78±0.12	0.18±0.02	0.36	0.30	21.27	53.85	16.77
	NP	7.89±0.04	0.81±0.02	1.28	0.55	20.50	54.58	17.00
NERICA 2	P	8.04±0.10	0.25±0.02	0.14	0.28	15.70	55.38	16.82
	NP	8.20±0.06	0.56±0.02	1.23	0.52	13.18	55.54	16.97
NERICA 4	P	8.77±0.14	0.28±0.02	0.73^{a}	0.23	9.04	55.36	16.85
	NP	8.81±0.06	0.96±0.02	0.14	0.14	23.51	54.68	17.00
NERICA-L14	P	7.88±0.06	0.27±0.02	0.09	0.24	23.38	55.04	16.82
	NP	8.05±0.04	0.80±0.16	1.17	0.40	19.05	54.80	17.07
NERICA-L 20	P	6.53±0.05	0.30±0.02	0.01	0.30	17.12	54.98	16.68
	NP	6.91±0.13	1.29±0.03	0.67	0.20	15.80	54.79	16.80
NERICA-L 56	P	6.65±0.09	0.31±0.03	0.14	0.13	20.76	59.03	16.89
	NP	6.55±0.05	1.10±0.03	0.00	0.10	16.34	54.66	16.99
BERIS 21	P	8.07±0.20	0.40±0.02	0.03	0.39	22.58	54.28	16.72
	NP	8.23±0.13	0.86±0.02	1.20	0.35	14.42	55.04	16.94
BL 19	P	8.54±0.17	0.40±0.02	0.06	0.40	22.60	53.87	16.55
	NP	8.83±0.09	0.69±0.02	0.86	0.41	17.30	53.73	16.81
TOX 4008	P	7.76±0.12	0.52±0.05	0.07	0.08	24.08	54.94	17.03
	NP	7.96±0.06	1.25±0.03	0.90	0.08	14.24	52.20	16.96
IR 841	P	7.66±0.06	0.32±0.02	0.13	0.13	22.57	55.00	16.74
	NP	7.87±0.07	1.17±0.02	0.95	0.12	10.99	55.13	17.01
Arosso	P	7.84±0.02	0.29±0.02	1.73	0.70	13.24	58.44	17.11
Special rice	NP	8.60±0.07	0.21±0.02	1.13	0.28	19.86	54.81	17.14

P: Parboiled; NP: Non-parboiled
Values represent means of duplicate analysis for mineral and vitamin; and triplicate for protein and lipid.

ASV is related to the gelatinization temperature of rice flour and thus to the amylose ratio (Bahmaniar and Ranjbar, 2007; Fofana *et a*l., 2011). A weak ASV is related to the slow speed of digestibility. In the current study, parboiled rice samples had a mean ASV of 5.11 which is higher than those of non-parboiled samples (2.85) indicating that parboiled rice might be more digestible than non-parboiled. The results obtained from this study indicated that, with the exception of NERICA 4 and NERICA-L 20, the remaining of local parboiled rice varieties tested had better ASV than Arosso that had an ASV of 4. The same tendency was observed for non-parboiled rice samples of which ASV were superior to that of Special rice (ASV = 1). These results suggest that almost all ten tested rice varieties had better digestibility than the two imported varieties.

Nutritional characteristics of rice samples

Protein, lipids, vitamins (B_3 and B_{12}) and minerals (sodium, magnesium and calcium) were determined for each sample of rice and the results are presented in Table 2. The work of Eggum *et al*. (1984) indicated that during the parboiling process, steaming for between 20 and 60 minutes had no adverse effects on the protein of parboiled milled rice. The average steaming duration used for the parboiled samples tested in this study was about 40 min. No significant difference ($p > 0.05$) was observed between the protein content of parboiled and non-parboiled rice. However the overall mean protein content of the parboiled rice samples was 7.96%, while for the non-parboiled samples the mean protein content was 7.7%. Among the parboiled samples, NERICA 2, NERICA 4, NERICA-L 14, NERICA-L 56, BERIS 21and BL 19 showed protein content slightly greater than the Arosso used as control. In the group of non-parboiled rice samples, only BL 19 had protein content relatively superior to Special rice (Table 2).

Regarding lipid content, a significant difference ($p < 0.05$) was observed between parboiled and non parboiled rice samples (Table 2). The overall mean lipid content of the parboiled rice samples (0.29%) was lower than the equivalent non-parboiled samples (0.85%). The lipid content of imported parboiled rice (0.29%) is almost the same as that of the parboiled

Table 3. Preferences of female rice cooksbased on culinary performance of each variety

Varieties	Shape	Easy to cook	Cooking duration (min)	Swelling capacity	Stickiness
NERICA 1	P	Yes	30	1328	No
	NP	No	21	1224	Yes
NERICA 2	P	Yes	30	1255	No
	NP	No	25	1265	Yes
NERICA 4	P	Yes	29	1346	No
	NP	Yes	23	1021	No
NERICA L14	P	Yes	33	1235	No
	NP	Yes	22	1204	No
NERICA L20	P	Yes	33	1235	No
	NP	Yes	21	1350	Yes
NERICA L56	P	Yes	24	1369	No
	NP	No	19	1166	No
BERIS 21	P	Yes	22	1287	No
	NP	No	20	998.3	Yes
BL 19	P	Yes	24	1298	No
	NP	Yes	19	1227	No
TOX 4008	P	Yes	22	1134	No
	NP	No	19	1030	No
IR 841	P	Yes	29	1365	No
	NP	No	20	1249	Yes
Arosso	P	Yes	30	1245	No
Special Rice	NP	Yes	22	1370	No

P: Parboiled; NP: Non-parboiled

local varieties. The same observation was made for the non-parboiled rice samples. Although non-parboiled NERICA-L 20, TOX 4008, IR 841 and NERICA-L 56 had relatively high lipid contents (1.29%, 1.25%, 1.17% and 1.1% respectively), the lipid content of all ten samples, as well as the two controls, did not exceed the limit of 1.7% set by FAO (1994) for good conservation and prevention of rice turning rancid during storage.

Vitamins B_3 and B_{12} and minerals

A significant difference ($p< 0.05$) for vitamin B3 was observed between the parboiled and non-parboiled samples, with the B_3 contents of parboiled rice samples higher than the non-parboiled samples. Among parboiled samples, NERICA-L 56 had the highest vitamin B_3 content (59.03 µg/100g) whereas NERICA 1 had the lowest (53.85 µg/100g) (Table 2). The non-parboiled rice BERIS 21 had the highest content of vitamin B3 (55.04 µg/100g) while TOX 4008 the lowest (52.2 µg/100g). This implies that, as it is the case of vitamin B1 (Sareepuang *et al.*, 2008), parboiling improves also the quality of rice regarding the content of vitamin B_3.Within each group no significant difference ($p> 0.05$) was observed for vitamin B_3 among the tested varieties. As for vitamin B_{12}, no significant difference ($p> 0.05$) was observed between parboiled and non-parboiled rice. Also no significant difference was observed within each group of rice.

Regarding mineral content, the data in Table 2 show that for the parboiled rice samples, the sodium content of Arosso was higher (0.7%) than in samples of local rice (mean value = 0.24%), while for non-parboiled samples, sodium levels were similar in local (0.29%) and imported (0.28%) varieties. Magnesium content in local rice samples was found globally high compared with imported rice, except for parboiled IR841. The calcium content in imported parboiled rice was higher than in local rice samples, while for non-parboiled rice, no significant differences in calcium content were observed between local and imported rice. The data collected in this study for these three minerals did not show a clear tendency to conclude that parboiling has either a positive or a negative effect on rice. Nevertheless, many studies have reported that leaching of sodium, calcium and magnesium during parboiling that make parboiled rice less rich in these minerals than the non-parboiled equivalent (Heinemann *et al.*, 2005; Sareepuang *et al.*, 2008; Rohman *et al.*, 2014).

Cooking quality and sensory properties of rice samples

The cooking quality of the selected parboiled and non-parboiled rice varieties was evaluated. It is observed that, like the imported parboiled rice

Arosso, all parboiled rice samples were easy to cook. Equally, Special rice and the non-parboiled rice samples: NERICA 4, NERICA-L 14, NERICA-L 20 and BL 19 are also easy to cook. Meanwhile NERICA 1, NERICA 2, NERICA-L 56, BERIS 21, TOX 4008 and IR 841 were not easy to cook (Table 3) because the water needed renewing during cooking to avoid warping of rice grains. However at laboratory scale, all parboiled rice samples took more time to cook than non-parboiled samples. In the present work, the average time taken (27.6 min) to cook 500 g of parboiled rice is significantly ($p< 0.05$) longer than the time (20.9 min) required for cooking the same quantity of non-parboiled rice. Sareepuang *et al.* (2008) argue that the longer cooking time of parboiled rice may due to strong cohesion between the endosperm cells, which are tightly packed, making starch grains hydrate at a slower rate. Economically the longer cooking time of parboiled rice involves more combustibles (fuel, gas or firewood) and therefore higher cooking costs. But after cooking, the average weight of parboiled cooked rice obtained (1285 g) was significantly greater than the weight obtained for non-parboiled rice (1173.5g). Moreover, during the cooking process, it was observed that the non-parboiled samples that were not easy to cook (NERICA 1, NERICA 2, NERICA-L 56, BERIS 21, TOX 4008 and IR 841) produced a lot of foam. According to the women cooking the rice, the production of this foam was linked to the type of starch content in the varieties. When these varieties were washed, it was noted that water was milky, which could explain their cooking behavior.

Based on sensory attributes such as aroma, color, easiness of chewing, stickiness, taste and overall acceptability the evaluation made by the 15 trained panelists on the different cooked rice samples indicated that the parboiled forms of NERICA 2,NERICA-L 20, BERIS 21, BL 19 and IR 841 were appreciated by more than 53% of the panelists rather than in their non-parboiled form. Non-parboiled forms of NERICA 1, NERICA 4, NERICA-L 14, NERICA-L 56 and TOX 4008 were preferred by more than 60% panelists (Figure. 2). Both forms of BERIS21 and IR841 were appreciated by the panelists. But after cooking, parboiled rice of NERICA 1, NERICA-L 14 and TOX 4008 were not appreciated by panelists. As reported by Adégbola and Singbo (2005) it is during and after cooking that consumers most appreciate the quality of rice. Indeed after cooking, rice must have at least a characteristic aroma and taste that differentiate it from other dishes such as boiled fresh corn.

Conclusion

This study presents evidence that the quality of the majority of ten rice varieties, produced locally in Benin, was similar to the two imported rice brands, Arosso (parboiled) and Special Rice (non-parboiled). Parboiled and non-parboiled samples of local varieties BERIS 21 and IR 841 were appreciated by panelists for their quality attributes of color, aroma, taste and easiness of chewing. Parboiled NERICA 2, NERICA-L 20, BERIS 21, BL 19 and IR 841 and non-parboiled NERICA 1, NERICA 4, NERICA-L 14, NERICA-L 56 and TOX 4008 were also preferred by panelists. Parboiled NERICA-1, NERICA-L 14 and TOX 4008 were not appreciated at all by panelist. The results of this study can help local rice processors and traders in promoting the locally-produced rice, by triggering the consumers' awareness about the quality of local rice in comparison with the imported varieties.

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