Field Scientific Report

Participatory Processing Diagnosis of Gari/Eba in Nigeria

Understanding the Drivers of Trait Preferences and the Development of Multi-user RTB Product Profiles, WP1, Step 3

Umudike, Nigeria, September 2019

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Ethics: The activities, which led to the production of this manual, were assessed and approved by the CIRAD Ethics Committee (H2020 ethics self-assessment procedure). When relevant, samples were prepared according to good hygiene and manufacturing practices. When external participants were involved in an activity, they were priorly informed about the objective of the activity and explained that their participation was entirely voluntary, that they could stop the interview at any point and that their responses would be anonymous and securely stored by the research team for research purposes. Written consent (signature) was systematically sought from sensory panelists and from consumers participating in activities.

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ABSTRACT

This report examined the activity 4 (Step 3) RTBfoods processing diagnostics on Gari/Eba product profile in Nigeria. The Processing activity was carried out in South East region of Nigeria (Abia State, Ossah Ibeku in Umuahia North Local Government Area). Four (4) champion Gari Processors were selected from the study area for the activity and also four (4) Cassava varieties chosen based on the information derived from the activity 3 of what traits constitute good and bad variety. The Cassava varieties used were TMS 01/1368, TMS 98/0505, TMS 01/1412 and Nwaocha (Which is a local variety). Exactly 35kg each of the four varieties was used for the processing diagnostics and distributed among the four processors randomly and coded thus; Variety A, B, C and D. The result showed that the best processing yield was obtained for the variety Nwaocha with a yield of 24.0% (w.b) followed by TMS/98/0505 with 20.0%. This can be explained by their high dry matter content at raw material level. Conversely the lowest yields have been obtained with the varieties TMS/01/1368 and TMS/01/1412 with 10.0 and 14.7% yield respectively; these two varieties had the lowest dry matter content at raw material level. Empirically, it was observed from the study that Nwaocha and TMS/98/0505 performed better than other varieties selected for the study, even though Nwaocha did not come out fine because of processor effect during processing, all the processors gave credit to Nwaocha especially, as the best cassava variety being selected Therefore, effort should be made to develop/select varieties with high starch, dry matter and low moisture and low fibre content for food security and income.

Key Words: Gari-Eba, participatory processing, processing diagnosis, local processing methods, characteristics, Nigeria

1 STUDY AREA

The study was carried out in South East Region of Nigeria. (Abia State, Ossah Ibeku in Umuahia North Local Government Area).

GPS Location: Lat 5323.70N

Longitude: 7287.266E.Altitude 133.10

2 RAW MATERIAL CHOICE

The choices of varieties were influenced based on the information derived from the activity 3 survey of what traits constitute good and bad variety. All the cassava varieties used for processing were 12 months of age and harvested during the rainy season.

- Variety A = TMS/01/1368 (Improved)

The leaf colour of TMS/01/1368 is purple green, while the colour of the petiole is dark green. Central leaf lobe shape is lancelet, the growth habit of stem is straight; the stem colour is dark brown. Outer root skin colour is brown and the inner root skin colour cream/white. However, the root flesh colour is yellow then the root neck length is short.

- Variety B = TMS/01/1412 (Improved)

Variety B (TMS/01/1412) has basically the same characteristics with Variety A (TMS/01/1368)

- Variety C = Nwaocha (local variety)

The morphological characterization of Nwaocha revealed that it has a light green leaf, with green purple petiole. The stem colour for this cassava variety is golden, root outer skin colour is light brown, and the root inner skin is cream in colour, while root pulp colour is pure white. In addition to its characteristics, Nwaocha root is large in size and cylindrical in shape; with high root yield, early maturity, and moderate starch and pure white gari colour, however, the root neck length is short. The plant is the umbrella type, the growth habit is erect, and also the branching is dichotomous.

- Variety D = TMS/98/0505(Improved)

The leaf colour is of this particular variety is purple green just like Variety A and Variety B. In this variety (D), central leaf lobe shape is elliptic. The petiole colour green purple, growth habit is straight, silver green is the stem colour. The outer root skin colour is light brown, inner root skin colour is white/cream, root flesh colour is white and it has no root neck. There is the presence of flowers in Varieties A, B and D.

A B C D

Figure 1: (a, b, c and d): Cassava varieties (A: TMS 01/1368, B; 01/1412, C: Nwaocha, D: TMS 98/0505)

3 PRODUCT PROFILE PROCESSING

The four (4) varieties (35kg each) that were used for the study was distributed among the four processors randomly and coded thus; Variety A, B, C and D. However, the time allotted for each activity was recorded; the quantity of water used was also recorded. The experiment started with peeling to toasting. Questions were asked during each activity and the answers to those questions also recorded; for instance, peeling was the first stage of the experiment, questions asked were, for instance, *please how is the peeling of this cassava?*

4 RESULTS

4.1 Material characteristics

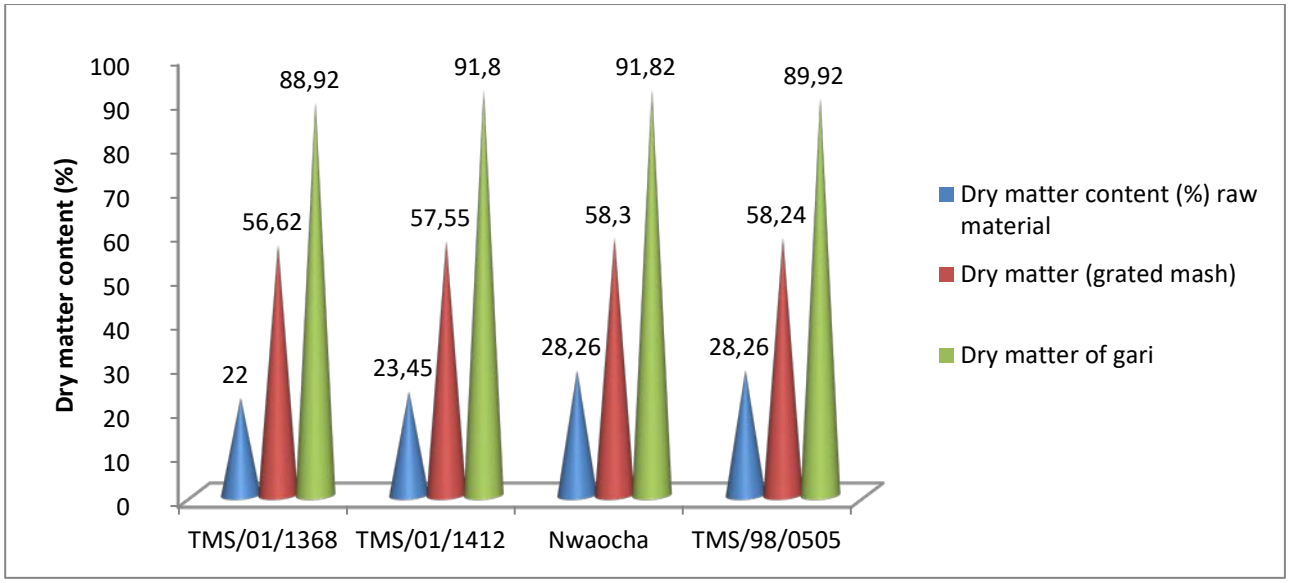

Figure 2: Dry matter Content

Generally, Dry matter content of the four varieties recorded values ranging from 22% (TMS/01/1368) to 91.82% (Nwaocha). Specifically, the dry matter of the raw material ranged from 22% (TMS/01/1368) to 28.26% (Nwaocha and TMS/98/0505 each), for the grated mash 56.62% (TMS/01/1368) to 58.3% (Nwaocha) while the dry matter of gari ranked highest at 91.82% (Nwaocha). However, TMS/01/1368 ranked lowest for dry matter content of raw material, while Nwaocha and TMS/98/0505 has the highest percentage rating of dry matter content of the same raw material, which was significantly different at 1% level of probability.

T-test Statistics						
		Mean	N	Std. Deviation	Std. Error Mean	t
Pair 1	Nwaocha and TMS/98/0505	28.2478	9	.03073	.01024	451.6923***
	TMS/01/1368	22.0500	9	.02739	.00913	

Dry matter of grated mash was highest in Nwaocha (58.3%) and low in TMS/01/1368(56.62%). This shows that Nwaocha has a high dry matter in grated mash.

Nwaocha rated (91.82%), this was followed by TMS/01/1412 (91.8%). The above result showed that Nwaocha and TMS/01/1412 has the highest dry matter of gari, although not significantly different.

According to Olaiya and Salami (2017), dry matter content of cassava is affected by a number of factors such as age of plant, season, location of planting and variety.

4.2 Qualitative information collected on the raw material

Some Questions that was asked on raw materials during processing that gave good information were: *Please can you access the fresh cassava you are peeling?* Do you like it? Does it look like the cassava you harvest from your farm? Processor D mentioned thus; *I like it, yes it looks like the cassava I usually harvest from my farm only that the skin is a little bit hard to peel.* Processor A said, *"The Cassava root head will be strong and will not be watery, and should contain a lot of starch, I prefer white colour and small sized roots, (but not very small in sizes)".* Thereafter, processor C, interjected and said, *"It will have moderate tubers that are not large. If they are too large they will be watery and it will have weight*". However, the processors also indicated the bad aroma from cassava will be noticed when you harvest and leave for 2 days after harvesting.

4.3 Product profile process description

4.3.1 Unit operations of product profile process

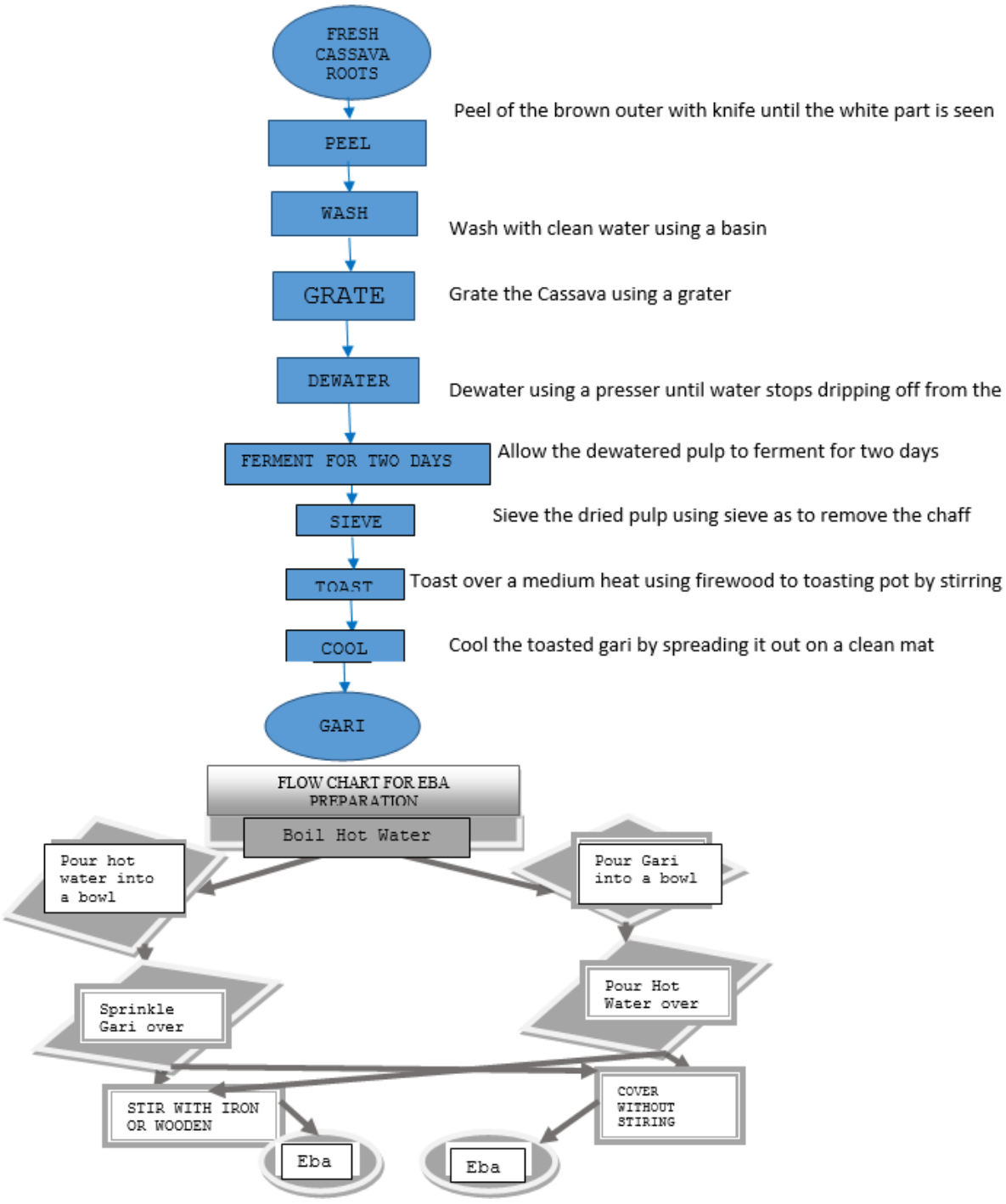

Figure 3: Unit operations of product profile process

4.3.2 Unit operations characterization

Peeling

The peeling yield varies from 65.3% to 85.3%, showing significant difference between the 4 varieties (Appendix 1). Nwoacha has the highest peel yield of 85.3% followed by

TMS/01/1412(80.0%) and TMS/01/1368 (65.3%) having the least peel yield. As regards the productivity, our results ranged between 11.2 and 36.0 kg/hour/operator. The highest productivity was obtained with the variety TMS/01/1412 and the lowest with the variety TMS/98/0505 with a productivity of 11.2 kg/hour/operator. This can be linked with qualitative data collected.

Regarding qualitative data, the answers to those questions according to each processor was, "it's easy to peel, the root is big, the skin is dried and dark in colour, it is fresh and will not be watery".

On the other hand, some varieties (Var. D – TMS/98/0505) used for the experiment were discredited, *like, "this cassava is not easy to peel, I do not like it"*. The processors mentioned other traits of fresh cassava root that is also suitable for good quality end product; for instance, *the cassava should be heavy like heavy wood*, *it should have smooth skin.*

The cassava was peeled with kitchen knife. The peeled weight was recorded.

Figure 4: Peeling of the Cassava root by the processors

Washing

This is the second stage of the experiment; where the cassava was washed in big basins and bowls with water. According to the processors, the cassava must be properly washed to remove dirt and stains that might reduce the quality of a good gari or eba. The processors indicated; *"cassava should be smooth so that washing it will be very easy. This is as a result of good peeling".* While the washing of the cassava root was going on, some questions were asked like, please can you tell us your experience; a processor answered; *it is smooth as I am washing it, because it is well peeled*. The productivity of this unit operation ranged between 85 and 192 kg/hour/operator. The variety TMS/98/0505 needs a meticulous washing which could be linked to the low peeling productivity measured and difficulties to separate skin of the flesh.

Grating

This operation is the only one which is mechanized. This is traducing by a very high productivity ranging between 127.5 and 384 kg/hour/operator.

Even though the entire environment where the cassava was grated was noisy, but the enumerators were able to ask their questions like, how is the grating of all these cassavas. The operator answered and said that the grating was very easy because the cassava root was fresh and has less bone/stick in it. This could be linked with season because in the wet season roots have much moisture and also to dry matter content of the variety.

The cassava roots were well grated. They were grated with a grating machine immediately after washing. The cassava roots were grated twice to avoid much chaff. It is considered by processors that gari/eba with chaff is a bad product. In fact, the processors suggested that the fresh roots be grated twice. In their own words they said thus; *please grind it the second time*

because of bone and thread!" a processor exclaimed. The good reason for second grating is to have a quality end product. After grating about 160ml of oil was added to each of the white mash before bagging. The survey by Quaye *et al*. (2009) in Ghana revealed the following major aspects and considerations for adopting a new cassava processing technology: (1) affordability of the technologies in term of cost implication and profit margin, (2) efficiency of the machine, (3) labour required to operate the machine and (4) simplicity.

Figure 5: Grating of Cassava root

Dewatering

The mash was also weighed and put into bags ready for dewatering. The mash was dewatered after two days and was ready to be sieved.

Figure 6: Dewatering of cassava mash

Our results indicate that the dry matter content of the different mashes after 48hours ranged between 56.62 and 58.30%. This result showed that whatever the initial dry matter content, the dewatering operation is allowed to obtain a mash with a desired level of dry matter. This indicates also that the following toasting operation in order to be well carried out needs a mash with these characteristics.

Sieving

Sieving was the fifth stage of the experiment, and it was done after fermentation of the mash. The mash was well dried, which made the mash very easy to sieve. The sieving was done with gari sieve made of wood and plastic strings with tiny opening that will never allow chaffs to pass through it. The yield (% w.b) ranged between 30.8 and 56.5%. The highest yield was

obtained with the variety TMS/01/0505 and the lowest with the variety TMS/01/1412 (30.8%). We can assume that the yield of this operation is linked with the dry matter of the raw material. The productivity ranged between 39.0 and 44.4 kg/hour/operator for Nwaocha and TMS/01/1412 respectively. The result also showed that TMS/01/1368(6.0% w.b) and TMS/01/1412(6.0% w.b) had the higher residual chaff, and Nwaocha and TMS/98/0505 with the lowest as 1.3 and 0.8% w.b. respectively.

Figure 7: Sieving of the mash

Toasting

This is the final stage of the experiment; the gari mash was well dried and toasted with a round big pot (called *agbada* in Ibo). Each processor was allowed to toast their gari mash.

Our results show that the yield (% w.b) ranged between 42.9 and 59.5% for TMS/01/1368 and TMS/01/1412 respectively.

The productivity ranged between 2.1 and 3.3 kg/hour/operator.

The appearance of the gari that was toasted came out bright, smooth and well dried with small seeds, except *Nwaocha* that used more fired wood (probably because not well dewatered and needed more heat to toast it dry), according to the processor, the gari did not dry well and the fire wood was wet, that affected the gari quality. The gari was powdery like wood ash. This can be attributed to processor effect. Every dry gari mash is always easy and interesting to toast, if it is well dried and sieved. Any gari mash that do not dewater properly is difficult to toast. Gari toasting should be stress-free (not laborious). Finally, good quality cassava gives good quality product such as when it has good taste, attractive colour, smooth gari, good texture without lumps and others. A well toasted gari will give a good eba.

Figure 8: Agbada (toasting pans)

Figure 9: Gari products

4.3.3 Process overview

Yield

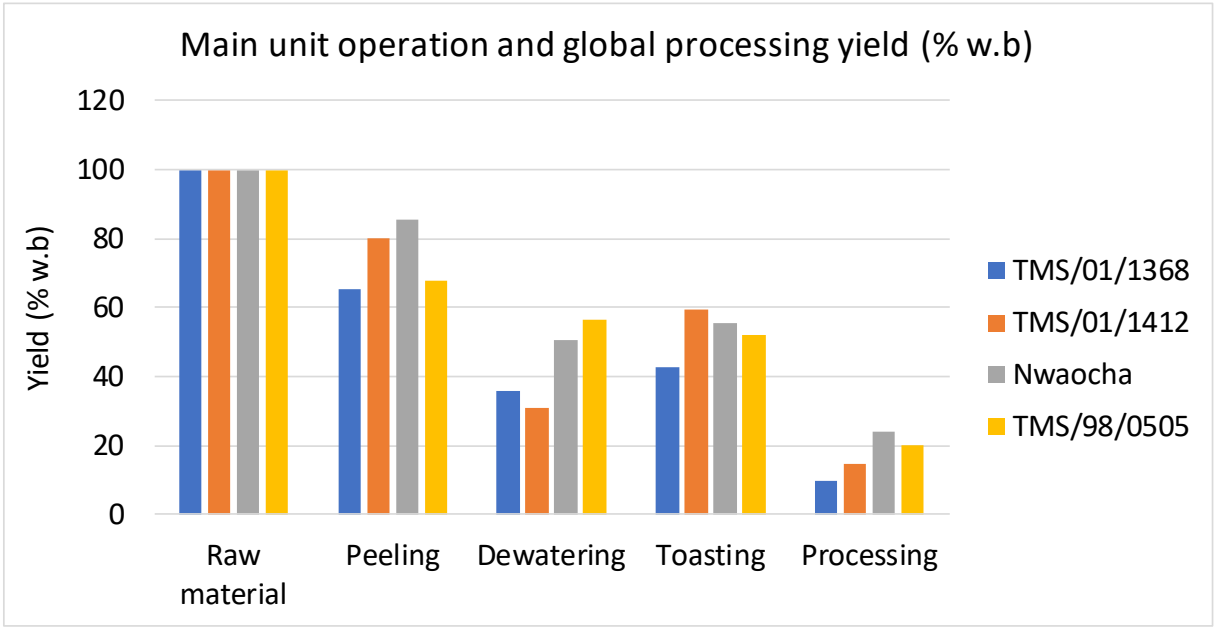

Figure 10: Main unit operation and global processing yield (% w.b)

Figure 10 showed that the best processing yield was obtained for the variety Nwaocha with a yield of 24.0% (w.b) following by the TMS/98/0505 with 20.0%. This can be explained by their high dry matter content as raw material for both of them recording a value of 28.26%. Conversely the lowest yields have been obtained with the varieties TMS/01/1368 and TMS/01/1412 with 10.0 and 14.7% respectively; these two varieties had the lowest dry matter content as raw materials. Figure 10 allowed us also to observe that for the peeling unit operation, the variety Nwaocha obtained the best yield with 85.3% (w.b). We can also observe that the both improved varieties have the lowest yield at dewatering. This can be explained also by their low dry matter content.

Productivity

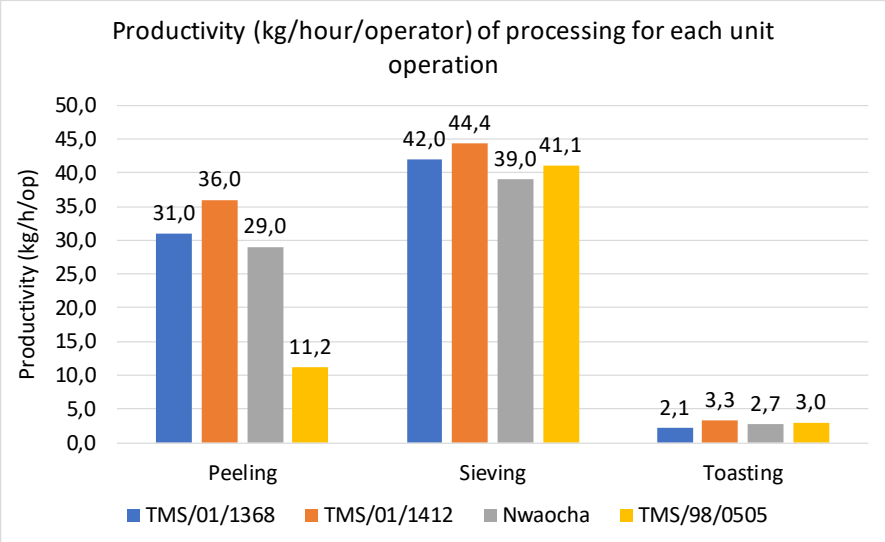

Figure 11: Productivity (kg/hour/operator) of processing for each unit operation

The time allotted for each activity were recorded and allowed to evaluate the productivity of each unit operation for each studied variety. Our results (Appendix 1) showed that washing and rasping had the highest productivity ranging between 85 and 192 kg/h/operator and 127.5 to 384 kg/hour/operator respectively.

The above result showed also that variety D (TMS/98/0505) recorded lowest peeling productivity, washing time and grating time, it means that in as much as it is not easy to peel, then washing it may not be easy as well as the grating.

The 3 others varieties had similar behaviour in terms of productivity, during processing.

Regarding the different unit operations we observed that important differences of productivity could be observed between each of them. It appears also that 2 unit operations can be considered as bottleneck for this process are the peeling and the toasting unit operations.

Qualitative information during processing:

The cassava must pass through all the processing steps with absolute care, otherwise, the gari and eba will not have good quality. It must be well peeled, good washing, good grating; it must be well dewatered with good fermentation, well sieved and finally good toasting. In appearance, the gari will look smooth, and attractive, it will not be powdery like ash. Colour will be milk white or yellow. The texture would always be dry and heavy when touched so that it will not float on water, the seed will not be big with good aroma like burnt clay (ñoño). Any step that is not properly handled will lead to poor gari quality.

End-product processors appreciation

Figure 12: Eba from different varieties

Table 1: End-products descriptors

Colour		Textural		Taste		Flavour	
High quality	Poor quality	High quality	Poor quality	High quality	Poor quality	High quality	Poor quality
Colour will be milk white or yellow	Burnt , dirty or dull colour	It should be dry and heavy with small seeds when touched, must be smooth and moldable	Big lumps or powdery like wood ash, or gummy when being molded	Sweet or sour taste	Rotten taste	good aroma like burnt clay (ñoño).	Offensive or bad odour as a result not processed immediately (after 2 days). Burnt gari odour

Colour		Textural		Taste		Mouth feel
High quality	Poor quality	High quality	Poor quality	High quality	Poor quality	High quality
Colour will be bright, if oil is added it should be yellow and if oil is not added it should be milk colour.	dark or dull colour	It should be moldable, and not stick to the hand during molding It should pass through the gullet freely without sticking. It should be soft but not too soft so it will not be difficult to swallow. It should be smooth without lumps	It will be brittle and difficult to mold Hard to swallow Sticky to the hand when molding. Has lumps that make molding and swallowing difficult	sour taste	Rotten taste	Smooth and non-sticky

Table 2: Preferred and non-preferred p/varieties

Preferred	Non-Preferred
Nwaocha was chosen as the best because its agronomic traits like wrinkled skin, the root is very strong and not watery, has big roots. Then in the postharvest, the processors mentioned that the gari yielded more with bright gari colour.	**TMS/01/1368** does not yield much gari also, it is watery. The root skin looks watery. The physical appearance of this variety is looks like the root is not matured and has less starch. It also has low dry matter content. A processor said, this variety is good for gari but not good for fufu.
TMS/98/0505 was selected as one of the preferred cassava varieties. The reason was that, it has close traits as Nwaocha cassava variety.	**TMS/01/1412** is less preferred because: (i) it has less starch, high moisture, It's very light when prepared into eba. This variety is just the opposite of Nwaocha.

5 CONCLUSION

Empirically, it was observed from the study that Nwaocha and TMS/98/0505 performed better than other varieties selected for the study, even though Nwaocha did not come out fine because of some processor effect during processing, all the processors gave credit to Nwaocha especially, as the best cassava variety being selected. Therefore, efforts should be made to develop/select varieties with high starch, dry matter and low moisture and low fiber content for food security and income.

6 REFERENCES

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7 APPENDICES

7.1 Annex 1: Summary table of quantitative data

	Dry matter content (%)			Yield (% wet basis)					Productivity (kg/hour/operator)				
Variety	Raw material	Grated mash	Gari	Peeling	Dewatering	Residual chaff	Toasting	Processing	Peeling	Washing	Grating	Sieving	Toasting
TMS/01/1368	22.00	56.62	88.92	65.3	35.7	6.0	42.9	10.0	31.0	147.0	294.0	42.0	2.1
TMS/01/1412	23.45	57.55	91.80	80.0	30.8	6.0	59.5	14.7	36.0	180.0	360.0	44.4	3.3
Nwaocha	28.26	58.30	91.82	85.3	50.8	1.3	55.4	24.0	29.0	192.0	384.0	39.0	2.7
TMS/98/0505	28.26	58.24	89.92	68.0	56.5	0.8	52.1	20.0	11.2	85.0	127.5	41.1	3.0

7.2 Annex 2: Overview of quality traits of raw product, gari and eba

	Raw Product		Processing				Cooked				
	Agronomic Characterisitcs	Technological Characteristics at each step of the process					Sensory Characterisitics				
		Peeling	Washing	Grating	Dewatering	Sieving	Toasting	When you look at	When you touch	When you smell	Taste (mouth)	Texture when you chew
TMS/01/1368	Yellow root, very big and strong.	Easy to peel	Easy to	Easy to grate	Watery	Easy to sieve, Little chaff	Easy to toast, Low gari yield	very beautiful	very smooth and dry	Good smell	Sweet taste	dry and sweet
TMS/01/1412	Yellow root	Easy to peel	Easy to well	Easy to grate	Watery	Easy to sieve	Easy to toast, Has no weight	Very bright	Very smooth and dry	Good smell	Sweet taste	Dry and sweet
Nwaocha	Wrinkled skin, big root, very strong and not watery	Easy to peel	Easy to wash	Easy to grate	Less water	Not very easy to sieve	Not very easy to sieve because its not well dried	Not very bright because its not well dewatered	Dry gari	Good smell like a burnt ash (oñoño)	Sour taste	Dry , sweet and smooth
TMS/98/0505	The root colour is light brown and the flesh colour is white	Hard to peel		Not easy to grate	Less watet	Easy to sieve	Easy to toast	bright		Good smell	Good taste	Sour taste, dry, strong and smooth in my mouth. YesIlike it.

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