Field Scientific Report

Participatory Processing Diagnosis of Fufu in Nigeria

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

Umudike, Nigeria, August 2019

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Ethics: The activities, which led to the production of this document, 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

The study assessed Fufu product profile in South east,Nigeria. The study was carried out in South East Region of Nigeria. (Imo State, Umukara,Ihitte Uboma L.G.A and Abia State, Ossah Ibeku in Umuahia North L.G.A). The choice of the location was influenced by the method of preparation of Fufu identified during Activity 3. In Imo state location the method of preparation differs from the method in Abia State. Both locations chosen engage in fufu trade and consumption.

The study was conducted using 4 processors and 4 cassava varieties which was coded thus' Variety A, B, C and D; each processor had one variety that was randomly picked. The varieties used were, TMS 01/1369,TMS 01/1412, Nwaocha, TMS 98/0505. These varieties were carefully chosen after a pilot work to determine the characteristics of the root to get good and bad varieties based on the acceptability of the cassava root by farmers. These varieties were chosen for uniformity. The varieties were obtained from the cassava programme of the National Root Crops Research Institute Umudike.The qualitative and quantitative information was taken at every step of the processing. The raw material , quantity of the intermediate product (fufu mash) was taken note of and the final products (fufu dough) were evaluated by the processors.

The result shows that the dry matter of the fresh root with Nwaocha ranking highest with 26.42%, while the lowest was TMS01/1412 for the two locations of Abia and Imo. In Abia fufu, the percentage dry matter of the mash ranged from 46.64% to 52.08% with Nwaocha having the highest and TMS01/1368 the lowest, while Imo fufu ranked 26.43% to 25.62%, also with Nwaocha and TMS01/1368 ranking highest and lowest respectively. The difference in the dry matter could be attributed to the pores of the materials used in dewatering and also the dry matter of the cassava roots.

In conclusion, it was observed from the result that dry matter content for roots and mash were outstanding for varieties TMS 98/0505 and Nwaocha. This also correlated with the fufu yield increase of 60% and 40% for Nwaocha and TMS 98/0505 respectively. Both varieties also had percentage peeled roots of 78.7% and % which are not so different from other varieties except TMS 01/1412 and TMS 01/1368. The peeling, washing, grating and cooking times among varieties also did not vary much.

Key Words: Cassava varieties,processing methods,fufu mash,fufu dough,processors

1 STUDY AREA

The study was carried out in South East Region of Nigeria. (**Imo State**, Umukara,Ihitte Uboma L.G.A and **Abia State**, Ossah Ibeku in Umuahia North L.G.A).

GPS Location for Ossah Ibeku in Abia State:

Latitude: N5'32'3.702'

Longitude: E7'28'7'266

GPS Location for Umukara in Imo State:

Latitude: N5'3743.96

Longitude: E7'181.243

The choice of the location was influenced by the method of preparation of Fufu identified during Activity 3. In Imo state location the method of preparation differs from the method in Abia State. Both locations chosen engage in fufu trade and consumption. In order to capture the two methods, the two locations were used. (Fufu Imo and Fufu Abia) as will be seen in the context.

1.1 Raw material choice

1 These varieties were carefully chosen after a pilot work to determine the characteristics of the root to get good and bad varieties based on the acceptability of the cassava root by farmers. These varieties were chosen for uniformity. The varieties were obtained from the cassava programme of the National Root Crops Research Institute Umudike. The age of the cassava root was twelve months old and harvested in September (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 is 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, 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

1.2 Product Profile Processing

The experiment was carried out with 4 processors in each location, each processor randomly picked cassava variety that was labelled A to D. Each processor independently processed the fufu as shown in the flow chart for Imo and Abia.

The quantitative data were taken along each processing step as the processing went on. Also, interviews on each processing step were carried out.

The quantity of the intermediate product (fufu mash) was taken note of. The final products (fufu dough) were evaluated by the processors.

1.3 Material characteristics

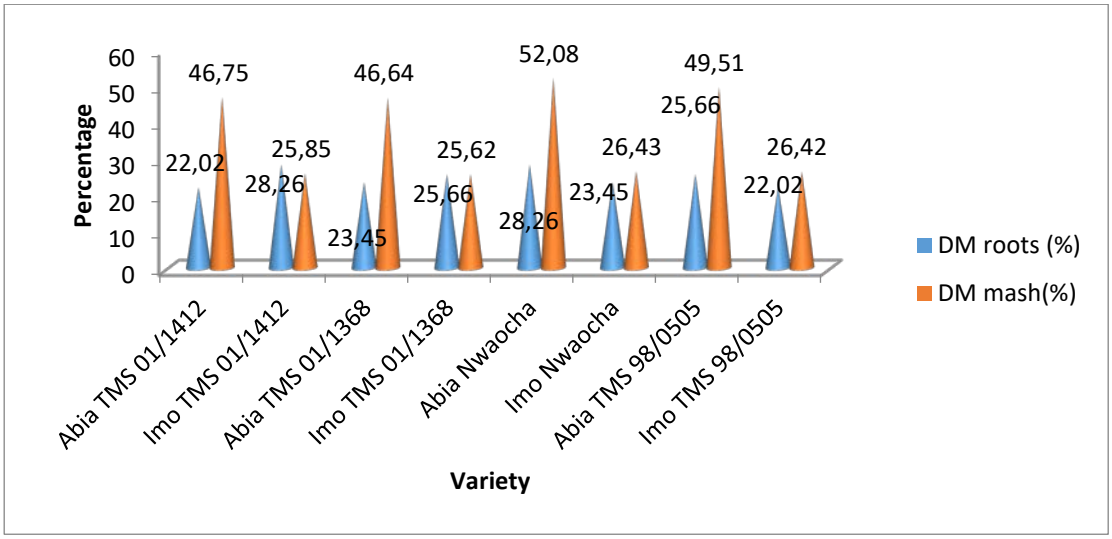


Fig. 2: Dry matter content (%)

Percentage Dry matter of root

The dry matter of the fresh roots recorded shows that Nwaocha ranked highest with the dry matter of 26.42%, the lowest dry matter was TMS01/1412 for the two locations of Abia and Imo. TMS01/1368 and TMS98 /0505 ranked 23.45% and 25.66% respectively for the two locations (Fig. 1). The samples for the dry matter was drawn from the same lot before conveying and processing in different locations. This accounts for the same dry matter for the two locations.

In Abia fufu, the percentage dry matter of the mash ranged from 46.64% to 52.08% with Nwaocha having the highest and TMS01/1368 the lowest. The percentage dry matter of Abia fufu mash ranked higher than that of Imo fufu, which ranged from 26.43% to 25.62%, also with Nwaocha and TMS01/1368 ranking highest and lowest respectively. (Fig. 1). The difference in the dry matter could be attributed to the pores of the materials used in dewatering and also the dry matter of the cassava roots.

Table 1 : Mean of Root dry matter

Variety		1	2	3	4
TMS 01/1412	3	22.0200			
TMS 01/1368	3		23.4500		
TMS 98/0505	3			25.6600	
Nwaocha	3				28.2600
Sig.		1.000	1.000	1.000	1.000

Plate 1 : Imo TMS98/0505 after fermentation

Plate 2 : The fermented TMS01/1412 before sieving

1.4 Qualitative Information collected during processing

Some Questions that were asked during processing that gave good information were: What processing steps may have been conducted badly to make a poor quality [product under study]? What have you "missed" in the processing? Processor B in Imo State said thus: if the material used for fermentation in leaking and you don't know, it might stay for more than 4 days without fermenting While his Abia State

counterpart said: During dewatering, when the mash is not properly dewatered, it will affect the texture of the fufu and make it too soft.

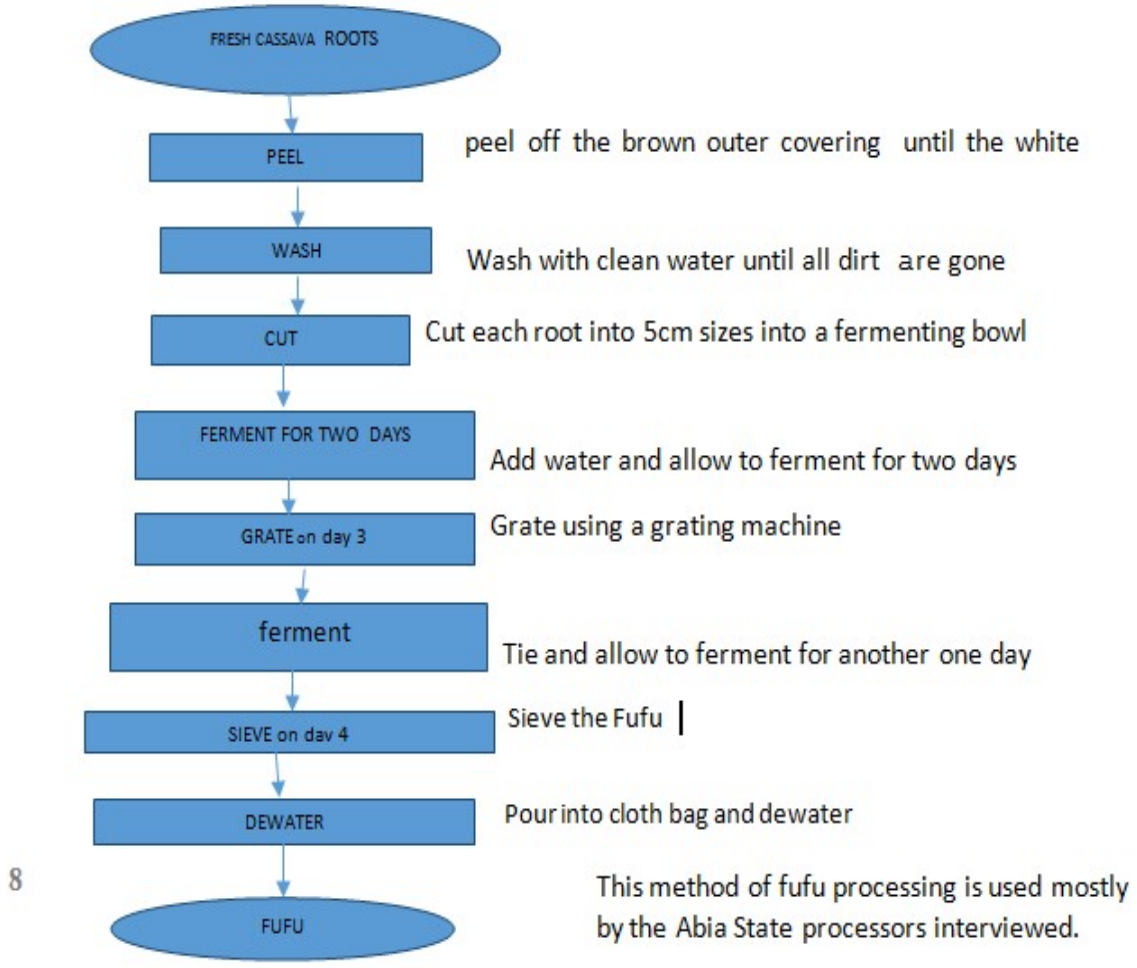
Processor C in Imo State said: When the Cassava is not Properly peeled. Processor D in Imo State said thus: After peeling, if you don't wash the root and soak, it will affect the colour of the fufu and make it dark while in Abia State Processor D said: It smells bad because of long fermentation, it dark because of improper washing or peeling

However, Processor A in Abia State said: During peeling, if you don't peel well, it will affect the fufu. After sieving,if you leave it under the sun for 3-4 days ,it will make the fufu to smell (bad odour). When you don't wash the cassava clean, it will change the colour to dark colour.

1.5 Product Profile Process Description

1.5.1 Unit Operations of product profile

Fig. 3 Flow chart diagram for fufu processing (ABIA STATE METHOD)



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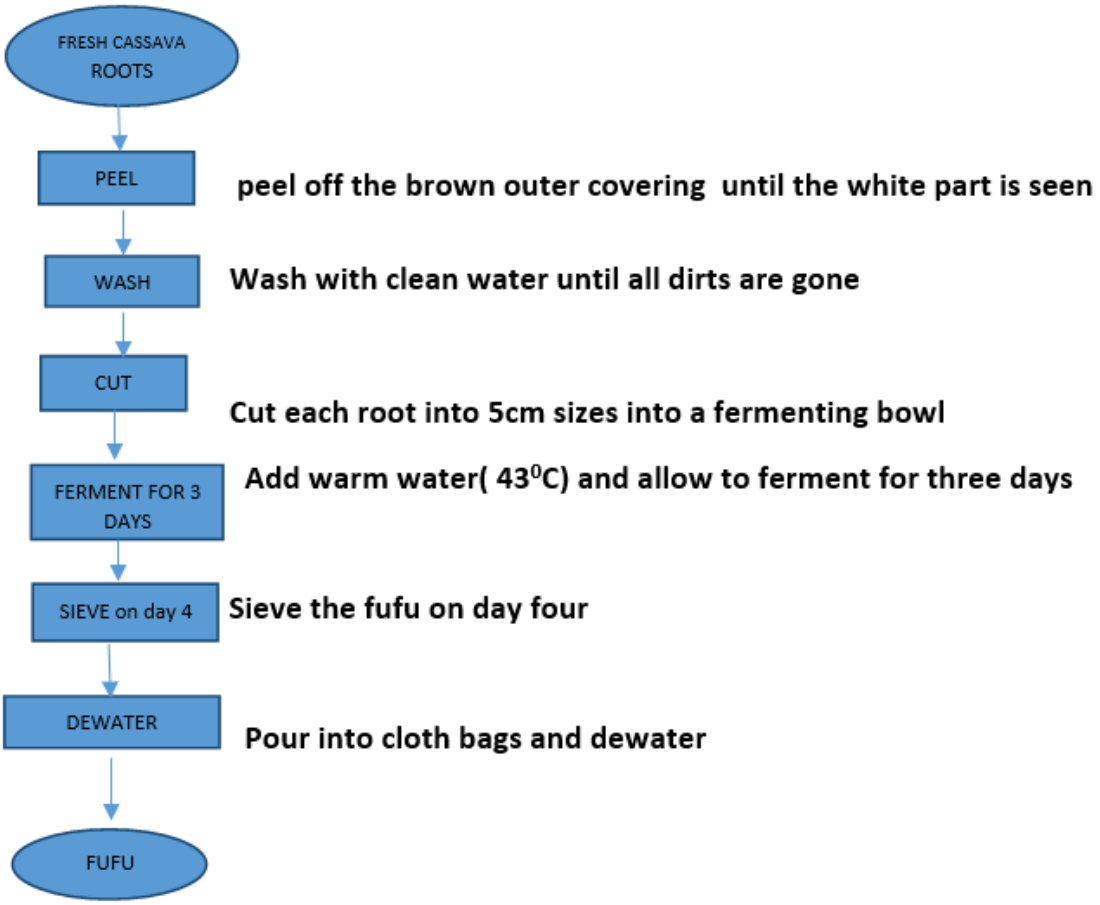
Flow chart diagram for fufu processing (IMO STATE METHOD)



1.5.2 Unit Operations Characterization

Peeling

The peeling yield of the root varies from 68% to 76.7% in Abia State while the Imo state peeling yield ranges from 68% to 93.33%, showing signifcant difference between the 4 varieties in the 2 States (Appendix 1). In Abia State, TMS 01/1412 has the highest peel yield of 76.7% followed by TMS 01/1368 (74%) while TMS 98/0505 has the highest peel yield of 93.3% followed by Nwaocha (84.7%).

Nwaocha has the least peel yield of 68% in Abia State and TMS 01/1412 has the least peel yield of 76.7% in Imo State. The differences in the peel yield could be attributed to the fact that the processors have different ways of peeling, some peel slicing off part of the flesh. Also, the processors in Imo State who do not grate the cassava tend to remove the head region to facilitate fermentation.

In terms of productivity, the result in Abia State ranges from 31.0 to 44.0 kg/hour/operator while in Imo State, the result ranges from 31.0 to 48.0 kg/hour/operator. The highest productivity in Abia State was obtained with the variety TMS/01/1368 at 44.0 kg/hour/operator while the lowest was TMS 01/1412 at 31.0 km/hour/operator. The highest in IMo was obtained with the variety TMS/01/1412 at 48.0 kg/hour/operator while the lowest was Nwaocha at 31.0 kg/hour/operator. The peeling time differs from processor and variety. Each processor had the same quantity of roots to peel and different varieties.

Regarding qualitative data, the answers to those questions according to the processor in Abia and Imo States was, It has big roots. Easy to peel, the roots are clean/bright, nice in appearance, not watery, Easy to ferment, high fufu yield etc.

On the other hand, some varieties Like Nwaocha and TMS/98/0505 were credited and liked most by the processors in both Abia and Imo States because of their appreance, roots sizes, white roots, easy fermentation, high fufu yield etc while TMS 01/1412 and TMS/01/1368 were disliked in the 2 States becuase, the root are watery(high moisture content), less weight, less starch, poor fermentation, floating in water when soaked and also some dislike the yellow colour in fufu.

Figure 4 : peeling of the Cassava root by the processors

Washing

In the second stage of processing , the roots are washed in big bowls or basins with clean water. According to the processors, the cassava must be washed properly to remove dirt and stains that might affect fermentation and also the appearance of the fufu product. One of the processors in Abia State said; " washing the cassava well will give you good loi loi (Fufu) and also give you a good appearance while another processor in Imo State said; "washing helps in fermentation and gives you a good fufu product.

Some questions about their experiences were asked and one processor answered; " the washing was easy and normal and when you did not wash well it will affect the colour. Another processor in Imo State Said; " washing was not difficult because the root is not hard.

The productivity of this unit operation ranged between 3.5 and 5.5 kg/hour/operator with Nwaocha in Imo State at 5.5kg/hour/operator as the highest and TMS 01/1412, TMS/01/1368 at 5.0 kg/hour/operator in Abia State. The lowest is TMS 01/1368 and Nwaocha in both States. According to the processors, if washing does not take place as soon as possible the dirt will stick to the body of the root and will take time to wash.

Soaking

This is the third stage of the experiment, The results of the soaking time show that TMS/01/1412, TMS/01/1368, Nwaocha and TMS/98/0505 for Abia State (48 .0 kg/hour/operator), while TMS/01/1412, TMS/01/1368, Nwaocha and TMS/98/0505 for Imo State were soaked for 96 hours. The two methods are different as Abia fufu was grated after 48 hours.

Grating

This unit of operation has to do with Abia Fufu processing method. The productivity of this operation ranged between 2.0 and 3.51 kg/hour/operator, the variety with the highest grating time is TMS 98/0505 at 3.51 kg/hour/operator (Appendix 1), while the lowest is TMS 01/1412 and Nwaocha with 2.0 kg/hour/operator**.** The cassava roots in Abia State are soaked for 48hrs before grating which also makes it easy to grate because of ther softness of the root due to soaking. During grating the processor answered questions like how is the grating of the roots. One of the processors answered*;" Easy to grate,*

It contains normal water (not too watery), Well grinded mash, The colour is very bright (whitish), No seed or lumps inside.

Sieving time

The sieiving is done after fermentation of the root, the sieving as done with a sieve made of ood and plastic strings with tiny opening that will never allow chaffs to pass through it. The result of this operation ranged between 8.0 and 17.5 kg/hour/operator, the varieties with the highest sieving time in Imo and Abia State are TMS 01/1412, Nwaocha at 17.5 and 15.0 kg/hour/operator respectively. The lowest in Imo State is TMS 98/0505 at 15.5 kg/hour/operator while Abia State is TMS 01/1412 at 8.0 kg/hour/operator. The Imo sieving time was higher than Abia sieving time. This could be because Abia fufu has been grated and sieving was a lot easier .

Cooking

This is the final stage of the experiment, The cooking in Abia is done once by dissolving in water and stirring on fire, there was processor effect and t**he processors used their discretion and experience to end the cooking** while in Imo State the cooking was done twice, first cooking and second cooking. The productivity of this operation in the first cooking ranged between 4 and 12.87 kg/hour/operator in Abia and Imo States while the second cooking in Imo State was done at 7.0 kg/hour/operator across the 4 varieties.

The highest cooking time in Abia State was obtained from TMS 98/0505 while the lowest was obtained from TMS 01/1412 at 12.87 and 8.0 kg/hour/operator respectively. The first and second cooking in Imo State for the 4 varieties were 4.0 kg/hour/operator for the first cooking and 7.0 kg/hour/operator respectively, the time of the cooking was determined from the standard set during the pilot work.

Fufu yield

The productivity of the fufu yield increase in Abia State ranged between 0% to 20% increase with Nwaocha being the highest and TMS 98/0505 being the lowest (Appendix 1), TMS 01/1412 and TMS 01/1368 had no difference with the percentage increase of 4% each.

For Imo fufu, the percentage fufu increase was higher than that of Abia. It ranged between 20% to 60% with Nwaocha having the highest and TMS 01/1412 and TMS 01/1368 with the lowest**.**The difference in fufu dough yield between Imo and Abia could be attributed to the method of fufu preparation. In Imo, the mash is cooked twice and pounded twice. Also, there was no evaporation of water because the mash was cooked in balls which let out little or no water out. While in Abia, the cooking of the mash by stirring in an open oval cooking pot made evaporation of moisture a lot easier thereby reducing the percentage fufu yield.

Fig. 5 : Fufu preparation in Abia and Imo States

Figure 6 : Fufu products

1.5.3 Process Overview

Yield

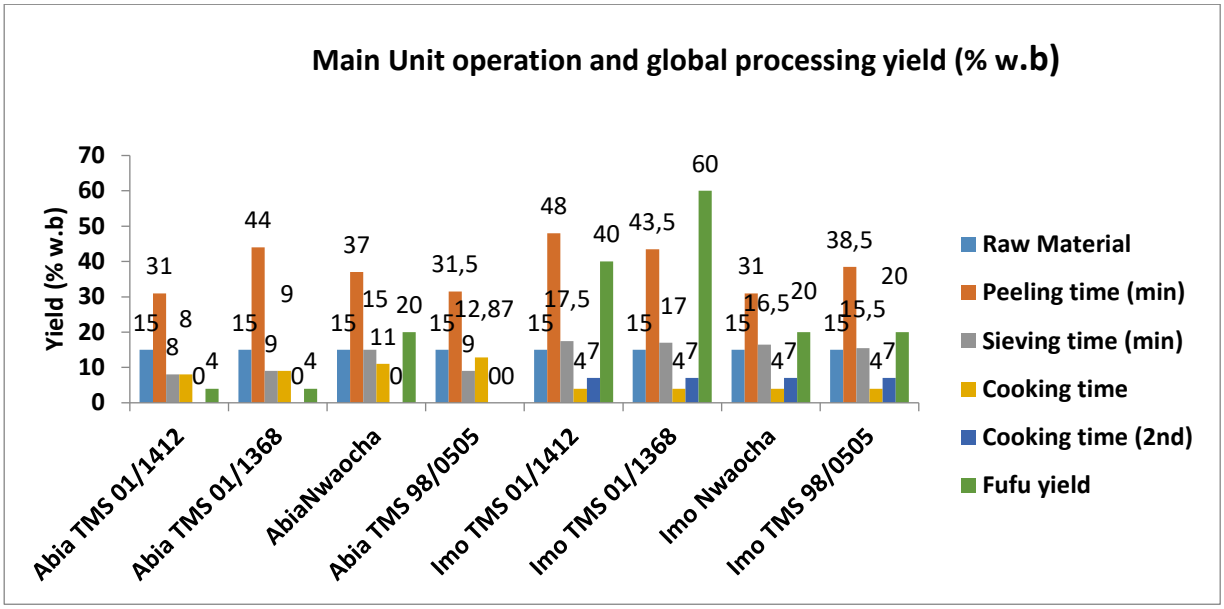


Figure 7 : Main unit operation and global processing yield (% w.b)

The result in figure 10 shows that the best fufu yield in Abia State was obtained from Nwaocha with a yield of 20.0% (w.b) followed by TMS 01/1412 and TMS 01/1368 with a yield of 4.0% for both varieties while the result also showed that in Imo State the highes fufu yield was obtained from TMS 01/1368 with a yield of 60.0% (w.b) followed by TMS 01/1412 at 40.0% (w.b). the Varieties with the lowest fufu yield in Abia was TMS 98/0505 and Imo state are Nwaocha and TMS 98/0505 with a yield of 20%(w.b) each. The high fufu yield of Nwaocha in Abia state could be as a result of the high dry matter content while in Imo State could be processors effect.

Productivity

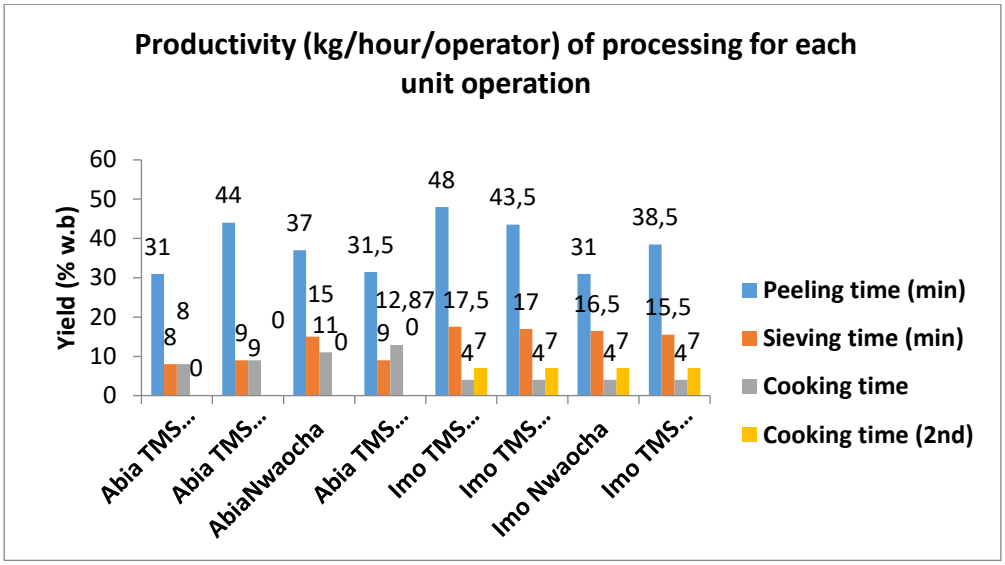


Figure 8 : Productivity (kg/hour/operator) of processing for each unit operation

The time allotted for each activity were recorded and allowed to evaluate the productivity of each unit operation for each studied variety. The results in (Appendix 1) showed that peeling had the highest productivity ranging between 31 to 38 kg/hour/operator followed by sieving at 8 to 17.5 kg/hour/operator. The result above showed that (TMS 01/1412) in Abia State recorded the lowest in terms of peeling and sieving productivity while in Imo state, Nwaocha recorded the lowest in peeling productivity at 31.0 kg/hour/operator while TMS 98/0505 recorded the lowest in sieving at 15.5 kg/hour/operator. TMS 01/1368 and TMS 98/0505 in Abia State had the same sieving time of 9.0 kg/hour/operator respectively. Some varieties had similar productivity in terms of peeling, sieving and cooking unit operations in Abia and Imo states.

2 CONCLUSION

In conclusion, it was observed from the result that dry matter content for roots and mash were outstanding for varieties TMS 98/0505 and Nwaocha. This also correlated with the fufu yield increase of 60% and 40% for Nwaocha and TMS 98/0505 respectively. Both varieties also had percentage peeled roots of 78.7% and % which are not so different from other varieties except TMS 01/1412 and TMS 01/1368. The peeling, washing, grating and cooking times among varieties also did not vary much.

3 ANNEX 1

Processor #	Variety	DM roots (%)	DM mash(%)	Intitial wt roots (kg)	Wt of chaff (%)	Wt of dewatered mash(%)	Wt of mash(kg) for fufu	% fufu yield increase	Peel loss(%)	Peeling time (min)	washing time	Grating time (min)	Sieving time (min)	Cooking time	Cooking time (2nd)
1	Abia TMS 01/1412	22.02	46.75	15	0.6	22	0.5	4	23.3	31	5	2	8	8	
2	Abia TMS 01/1368	23.45	46.64	15	2	28	0.7	4	26	44	5	3	9	9	
3	Abia Nwaocha	28.26	52.08	15	2	45	1	20	32	37	3.5	2	15	11	
4	Abia TMS 98/0505	25.66	49.51	15	3.2	33.6	1	0	30	31.5	4.68	3.51	9	12.87	
5	Imo TMS 01/1412	22.02	26.42	15	3	26.7	1	40	23.3	48	5		17.5	4	7
6	Imo TMS 01/1368	23.45	26.43	15	3.3	36.6	1	60	21.3	43.5	3.5		17	4	7
7	Imo Nwaocha	28.26	25.85	15	1.3	31.7	1	20	15.3	31	5.5		16.5	4	7
8	Imo TMS 98/0505	25.66	25.62	15	3.4	35	1	20	6.67	38.5	4.5		15.5	4	7

Name of varieties	Raw product						On the cooked							
	Technological characteristics at each of the process						Sensorycharacteristics							
		Peeling	Washing	Grating/ Soaking	Fermenting	Dewatering	Sieving	Cooking/ steering	When you look at	Texture when you touch	When you smell	Taste (In mouth)	Texture when you chew	After - taste
TMS 01/1368	Yellow root, very big and strong.	Easy to peel	Easy to wash	Easy to grate in Abia/Soaking in Imo State	Fermenting is done for 2days aftergrating inAbia state/fermentingtakes place 3-4 daysafterso aking	Watery	Easy to sieve, Little chaff	Cooking isdonetwice in Imo state and once in Abia State	Bright colour, high moiture content	Itssticky and soft	Good smell	Good taste		
TMS 01/1412	Yellow root	Easy to peel	Easy to wash	Easy to grate in Abia/Soaking in Imo State	Sameabove	Watery	Easy to sieve	Sameabove	Bright,Highmoisture content and less starch	Itssticky, soft and itdoes not draw	Good smell	Good taste		
Nwaocha	Wrinkled skin, big root, verystrong and not watery	Easy to peel	Easy to wash	Easy to grate in Abia/Soaking in Imo State	Sameabove	Less water	Not veryeasy to sieve	Sameabove	Very bright and has lowmoisture content	It does not stick to the hand, itssmooth	Good smell	Nice Taste		
TMS 98/0505	The root colouris light brownand the flesh colour is white	Hard to peel		Easy to grate in Abia/Soaking in Imo State	Sameabove	Less water	Easy to sieve	Sameabove	White colour, itis high yielding	High yielding, smooth and easy to mould	Good smell	Good taste		

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