

Participatory Processing Diagnosis of Boiled Yam in Nigeria

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

Umudike, Nigeria, February 2020

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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

The study assessed boiled yam product profile in Nigeria. It was carried out in the South-east region of Nigeria. (Onueke, Ebonyi State). The people were one of the major yam farmers and consumers in South-east, Nigeria. The study was conducted using 4 processors and 4 yam varieties which was coded thus' Variety A, B, C and D; each processor had one variety that was randomly picked. The varieties used were, TDA11000477, TDA1100203, TDR1100497 and TDR11/00101. They were obtained from the African Yam Improved barn at NRCRI Umudike. The yam tubers were selected to represent good and bad yams after a pilot sensory evaluation. The yam has been stored for 5 months in the barn before use. The time allotted and quantity of water used for each activity was recorded. The qualitative and quantitative information was taken at every step of the processing. The raw tubers and the final products were also accessed. The result indicated that TDA1100497 has the highest (37.58%) dry matter while TDR110203 with the dry matter of 29.7% is the lowest. TDR1100497 has the highest starch yield (23.20%) while TDA11000477 having the lowest (16.4%). TDR1100497 has the highest peel yield of 90.7% while TDA11000477 having the least peel yield at 84.62%. The variety with the highest washing time is TDA11000477 at 30 seconds while the variety with the lowest washing time is TDR1100497 at 23 seconds. The highest cooking time was 17.01 kg/hour/operator with TDA11000477 variety, variety with the lowest cooking time was TDR11/00101 at 13.33 kg/hour/operator. It was also discovered that TDA11000477 has the highest browning rate of 3+ while browning effect was not observed in the *D. rotundata* varieties used. Browning of yam had a tremendous effect on the acceptability of the yam final products. TDR 11/00101 gave the best end product while TDA11000477 gave the worst end product. TDR varieties are more preferred because of their white colour, sweet taste, easy to cook, smooth tuber, soft after boiling and mealy nature.

Keywords: Boiled Yam, Processing and South East Nigeria

1 STUDY AREA

The study was carried out in the South East Region of Nigeria. (Onueke, Ebonyi State). The people are one of the major Yam farmers and consumers in the Southeast, Nigeria.

GPS Location:

Latitude: 6.15540

Longitude: 8.03794

2 RAW MATERIAL CHOICE

The varieties used were, **TDA11000477**, **TDA1100203**, **TDR1100497** and **TDR11/00101**. They were obtained from the African Yam Improved barn at NRCRI Umudike. The yam tubers were selected to represent good and bad yams after a pilot sensory evaluation. The yam has been stored for 5 months in the barn before use.

TDA11000477 The skin is dark brown and has a lot of strong hair. The skin is tough and very difficult to peel. The rate of browning is high ranking 3+ at the scale of 0 to 3+. From looking at it the pounded yam will be dark and brittle. It will be difficult to pound to form dough. The boiled yam will not be mealy.

TDA1100203

The skin is dark brown and it also has a lot of hairs. The skin is tough and difficult to penetrate with a knife, making peeling difficult. The rate of browning is 2+ at the scale of 0 to 3+. The pounded yam and yam will be brown and not attractive to eat.

TDR1100497

The colour of the skin is light brown; the skin is soft and light. It will not be difficult to peel. As I cut there is little or no colour change. The flesh is white. It will have starch and will be easy to pound and chewing the boiled one will be pleasant in the mouth. The shape is round and smooth

TDR11/00101

The colour of the skin is light brown, the skin is light and it will be easy to peel. The rate of browning is 0 but the head region is darkening a little but can be cut off or ignored. The yam will be easy to pound and it will form dough quick. The boil yam will be strong in the month; it will not melt. The shape is round and smooth

3 PRODUCT PROFILE PROCESSING

The study was conducted using 4 processors and 4 yam varieties which was coded thus' Variety A, B, C and D; each processor had one variety that was randomly picked. The yam was processed as shown in Fig. 5 (flow chart). However, the time allotted and quantity of water used for each activity was recorded. The qualitative and quantitative information was taken at every step of the processing. Before processing, they accessed the raw tubers and also the final products were accessed.

4 RESULTS

4.1 MATERIAL CHARACTERISTICS

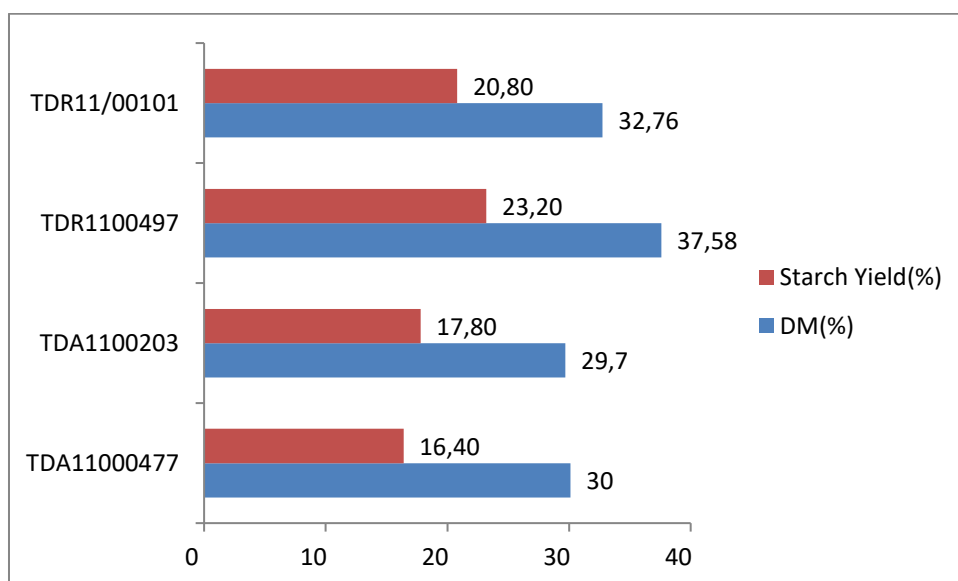


Fig. 1: Dry matter content and Starch Yield

4.1.1 Dry matter Content and Starch Yield

The dry matter content of the 4 varieties recorded ranges from 29.7% to 37.58%. The percentage of dry matter shows that the TDR varieties ranked higher than the TDA varieties with TDA1100497 having the highest of 37.58%, the lowest is TDR110203 with the dry matter of 29.7%. The percentage of Starch yield shows that TDR1100497 has the highest starch yield (23.20%). The TDA varieties also ranked lower with TDA11000477 having the lowest (16.4%) in the study area (Fig. 1).

	Anova		
	Varieties	Mean	N
A	TDR1100497	37.58000	3
B	TDR11/00101	32.76333	3
C	TDA11000477	30.02667	3
D	TDA1100203	29.71333	3

4.2 QUALITATIVE INFORMATION COLLECTED ON THE RAW MATERIAL

Some Questions that was asked on raw materials during processing that gave good information were: Among the selected varieties you will process for that participatory study, which variety is your favourite for making the [the product under study]? Why?

Processor A said thus: *my best is variety C(TDr /100497), the yam is smooth. When I peel it will not be difficult, it will also look smooth after peeling because it has no hair. It will be white. I know it is white because I pinched it and saw the flesh.* Processor B said; “*varietyC is good for boiled yam because it is smooth, and the appearance is good.*

Processor C. said; “*variety B is the best for boiled yam because it is soft and also good for porridge. The cooking time is short while processor D said; “variety D. it has sweet taste when cooked,it easy to cook (faster), the aroma is sweet, it has white colour and is usually soft (brisky)*

4.2.1 Product profile process description

Unit operations of product profile process

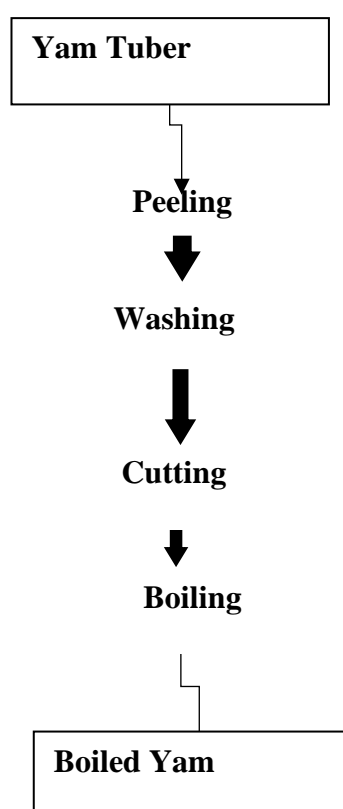


Figure 2: A flow diagram of boiled yam in South-east Nigeria

4.3 UNIT OPERATIONS CHARACTERIZATION

4.3.1 Peel Yield and Processing Time

The first stage of operation is peeling, the peeling yield ranges from 84.62% to 90.7% showing significant difference between the 4 varieties (Appendix 1). TDR1100497 has the highest peel yield of 90.7% followed by TDR11/00101 (89.4%) and TDA11000477 having the least peel yield at 84.62%.

Concerning the productivity, results ranged between 1.2 to 2.0kg/hour/operator. The highest productivity was obtained with the variety TDA1100203 followed by TDA11000477 (1.8 kg/hour/operator) and TDR1100497 as the lowest at 1.2 kg/hour/operator. This can be linked with the quantitative data collected.

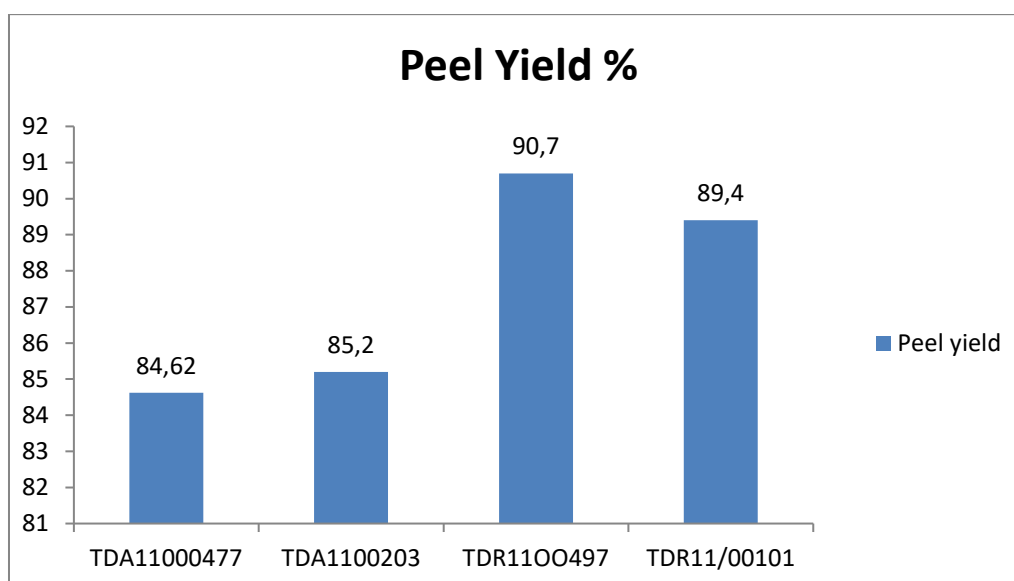


Fig. 3: Peel Yield of yam tuber for each variety understudy

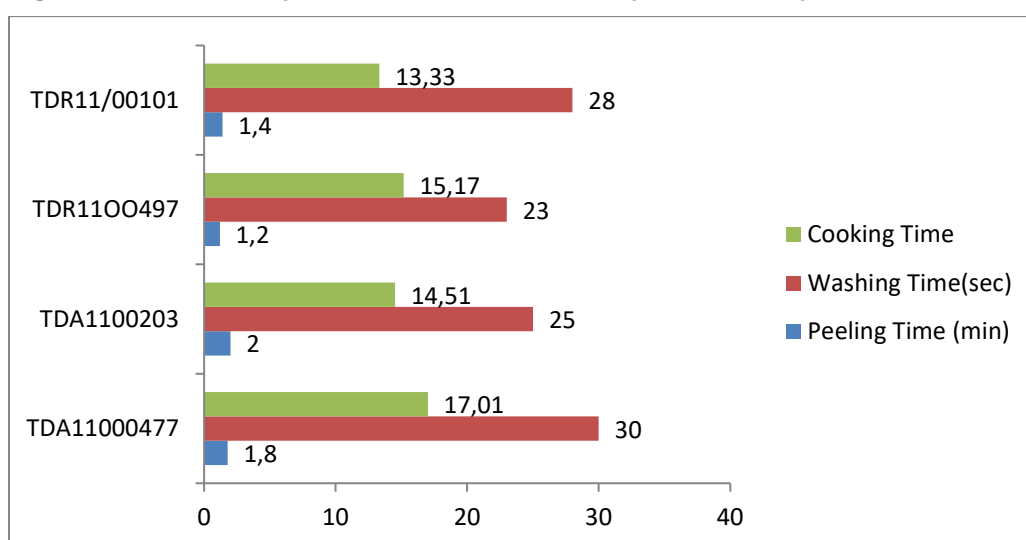


Fig. 4: Processing Time of yam tuber for each variety understudy

Washing

This is the second stage of the experiment, where the yam is washed and put in a cooking pot. According to the processors, the yam must be properly wash to avoid dirt and stain which will

make the yam unattractive. The productivity of this unit operation ranged between 23 seconds to 30 seconds. The variety with the highest washing time is TDA11000477 at 30 seconds while the variety with the lowest washing time is TDR1100497 at 23 seconds.

Cooking

This is the final stage of the operation after washing, the yam is put in a pot and place on fire to be cooked. The cooking ranged between 13.33 and 17.01 kg/hour/operator. The highest cooking time was 17.01 kg/hour/operator with **TDA11000477** variety, followed by TDR1100497 variety at 15.17 kg/hour/operator while the variety with the lowest cooking time was TDR11/00101 at 13.33 kg/hour/operator.

Weight of Yam after cooking

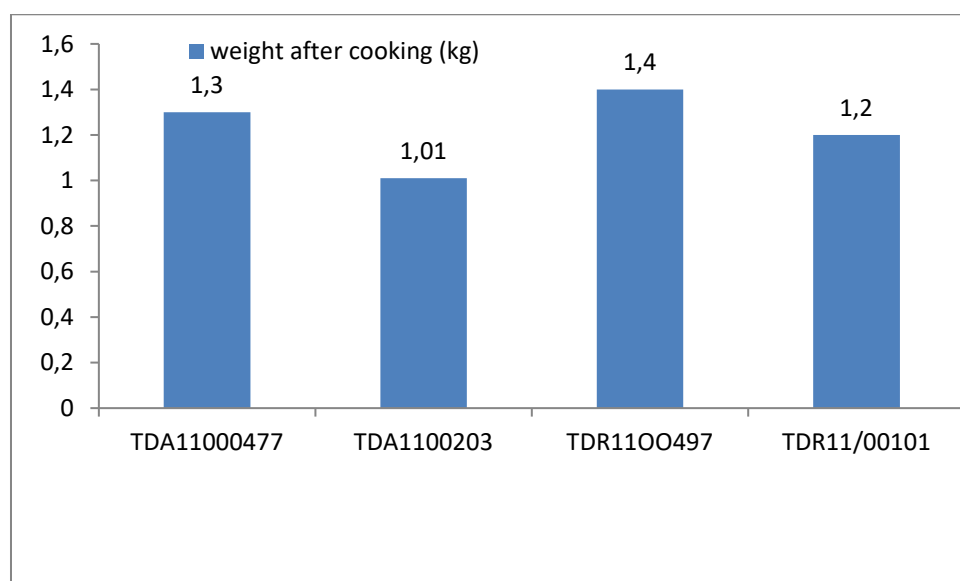


Fig. 5: Weight of Yam after cooking

Discolouration of washing and cooking water

Table 1: Level of Discoloration of washing and cooking water

Variety	Discoloration of washing water	Discoloration of the cooking water
TDA11000477	1	1
TDA1100203	2	2
TDR1100497	3	3
TDR11/00101	3	3

The cooking water and washing water were accessed using the scale of 1 to 3 where 3 is not coloured, 2 is moderately coloured and 1 is extremely coloured as shown in the table above. The *D. rotundata* varieties have less coloured water while the *D. alata* varieties were High with TDA TDA11000477 having the highest. When washing, it still gave bad colour, and very slimy.

Rate of Browning

From Table 2, The rate of browning shows that TDA11000477 has the highest browning rate of 3+ followed by TDA1100203 (2+), both *D. alata*. The browning effect was not observed in the *D. rotundata* varieties used. This had a tremendous effect on the acceptability of the Yam final products.

Table 2: Rate of browning

Variety	Browning
TDA11000477	3+
TDA1100203	2+
TDR1100497	-
TDR11/00101	-

4.3.2 Results of the processors' evaluation of the end-produce ready to eat (Boiled yam)

In the end product assessment, the processors were asked to assess the end product of boiled yam Processor D (TDR 11/00101) said; “The colour is good (milk colour). It is sweet like honey and it is soft, when touched I noticed it has starch, it is not sticky in the month.

Processor C said;” TDR1100497 is attractive yes it is sweet. It was not sticky it is easy to chew and swallow. It was smooth in the month

Processor B (TDA1100203) said thus; “It is good a little, the colour is not as bad as A. I like it slightly because the taste is good. It was ok when I touched it but not very good. It was a little hard when I chewed it.

Processor A (TDA11000477) answered and said: “I don’t like it because of the colour; I do not like anything about it, because it was not good when touched. It appears slippery and too soft it is collapsing in the mouth. The taste is bad.

5 PROCESSING OVERVIEW

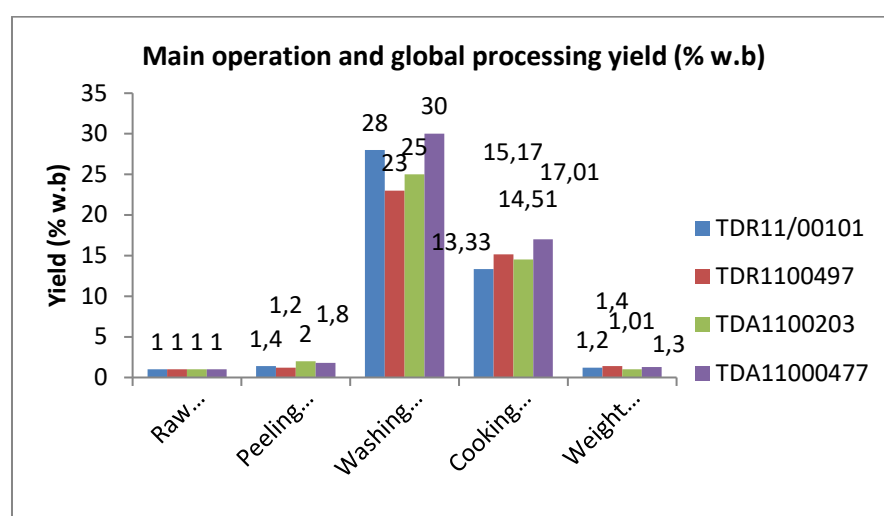


Figure 6: Main unit operation and global processing yield (% w.b)

Figure 6 showed that the best processing yield was obtained for the variety TDR1100497 with a yield weight of 1.4 kg (w.b) followed by TDA11000477 with 1.3 kg. This can be explained by their high dry matter content as raw material for both has dry matter content of 37.58% and 30.0% respectively. Conversely, the lowest yields have been obtained with the varieties TDR11/00101 and TDA1100203 with respectively 1.2kg(32.76%) and 1.01kg (29.7%) of dry matter content.

The figure 6 allowed also to observe that for the peeling unit operation the variety TDA1100203 obtained the highest peeling time of 2mins followed by TDA11000477 with 1.8mins. We also observed that both TDA11000477 and TDR1100497 has the highest cooking time of 17.01mins and 15.17mins respectively while the varieties with the lowest cooking time are TDA1100203 and TDR11/00101 with 14.51 and 13.33 mins respectively.

6 PRODUCTIVITY

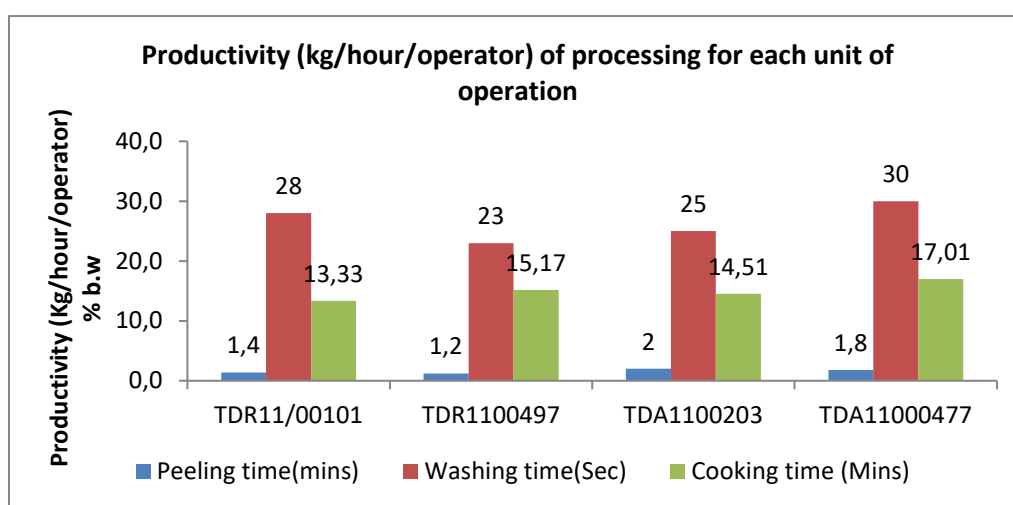


Figure 7: Productivity (kg/hour/operator) of processing for each unit operation

The time allotted for each activity were recorded and allowed to evaluate the productivity of each unit operation for the four (4) varieties under study. Our results (Appendix 1) showed that cooking time had the highest productivity with respectively productivities ranging from 13.33 and 17.01 kg/hour/operator and the varieties were TDA11000477 (17.01mins) and TDR1100101 (13.33mins) as the least. Also, the result showed that cooking time came out the least ranging from 23 to 30 seconds for TDA11000477 (30secs) and TDR1100497 (23secs).

The above result showed also that TDA1100203 recorded the highest peeling productivity of 2.0kg/hour/operator while TDA1100497 recorded the lowest peeling productivity at 1.2kg/hour/operator. The result showed that TDA11000477 recorded the highest productivity in both washing and cooking, the variety also came second in peeling productivity. There is no much variation in the other 3 varieties in terms of productivity, during processing.

Regarding the different unit operations we can observe that important differences of productivity could be observed between each of them. It appears also that 2 unit operations can be consider as most importantfor this process are the washing and the cooking unit operations

7 DISCUSSION AND CONCLUSION

7.1 SYNTHESSES AND CONCLUSION

The result of the study shows that there are differences in varieties of yam as accessed by processors in different unit of Operations.

During peeling it was noted that the peeling time increases as peel loss increase. There were differences in washing time and discoloration of washing water. The higher the rate of browning, the slimier and longer washing time.

Cooking of the yam had differences, the cooking of the yams that has high rate of browning were more difficult to cook especially the head region. But the white ones had less cooking time and does not discolour cooking water.

During the assessment of the boiled yam, it was noted that all the processors prefer white yams. The preferred taste is sweet. The mealy yam was ranked higher than the soggy ones. The percentage dry matter and starch could be attributed to the texture and mouth feel of the boiled yam. The aroma of the white yam was also preferred

8 APPENDICES

8.1 ANNEX 1: END PRODUCT DESCRIPTORS

Table 3: End product descriptors

		Dry matter content (%)	Starch Yield (%)	Rate of browning		Peeling unit operation			Wash ing	Quantity of water	Time of cooking(min)	weig ht after cook ing
Proces sor #	Variety #					M (kg) initi	(%) peel Yield	Time (min)	Time(sec)			
1	TDA110 00477	30	16.4	3+		1	84.62	1.8	30	1.litters	17.01	1.3
	TDA110 0203	29.7	17.8	2+		1	85.2	2	25	1	14.51	1.01
	TDR11O O497	37.58	23.2	1+		1	90.7	1.2	23	1	15.17	1.4
	TDR11/ 00101	32.76	20.8	1+		1	89.4	1.4	28	1	13.33	1.2

8.2 PREFERRED AND NON-PREFERRED P/VARIETIES

Table 4: Preferred and non-preferred p/varieties

Preferred Varieties	Non-Preferred Varieties
TDR1100497	TDA11000477
TDR11/00101	TDA1100203

Table 5: Overview of quality traits of raw yam, yam processing and boiled yam

Name of varieties	Raw product				On the cooked					
	Agronomical characteristics	Technological characteristics at each step of the process			Sensory characteristics					
		Peeling	Shaping/ washing	Example	When you look at	Texture when you touch	When you smell	Taste (In mouth)	Texture when you chew	After-taste
TDA 11000477	94% establishment rate, Early maturing, 40.2 t/ha, Cylindrical in shape, Smooth in south and rough in N. Central, Slight oxidation after 1 hr	Easy to peel, smooth skin,	Cylindrical, No itching, slippery, slight oxidation		White colour	Not good at hand, Slippery and soft, mealy,		Sweet taste	Collapses in the mouth	
TDA 1100203	84% establishment rate, Mid maturing, 42.1 t/ha, Smooth	Easy to peel, smooth skin,	Cylindrical in shape, Slight oxidation		White colour	Moderately soft, mealy, smooth,		Good taste, sweet taste	A little hard when chewed	

Name of varieties	Raw product				On the cooked					
	Agronomical characteristics	Technological characteristics at each step of the process			Sensory characteristics					
		Peeling	Shaping/ washing	Example	When you look at	Texture when you touch	When you smell	Taste (In mouth)	Texture when you chew	After-taste
	across location, Slight in less than 1 hr	light skin	during washing							
TDR 1100497	87% establishment rate, late maturing, 36.7 t/ha, Cylindrical in shape, Smooth across location.	Smooth skin, Easy to peel, light skin,	Itches slightly, slippery, no oxidation		Attractive. White colour	Not sticky, mealy, soft	Good aroma,	Sweet	Easy to chew, smooth in th mouth	Easy to swallow
TDR 11/00101	74.6% establishment rate, early maturing, 34.8 t/ha, Cylindrical in shape, Smooth across location, slight oxidation rate.	Smooth skin, Easy to peel	Cylindrical, No oxidation, slippery		Good colour (Milk colour)	Soft when touched, mealy,	Good aroma,	Sweet (Like honey)	Not sticky in the mouth	



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