*Field Scientific Report*

# Evaluation of the Suitability of New Cassava Genotypes to RTB Users' Needs and Preferences regarding Gari/Eba at NRCRI in Nigeria

## Gender Equitable Positioning, Promotion and Performance, WP5

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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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## Acronyms, abbreviations and definitions

| | |
|---|---|
| **ANOVA:** | Analysis of variance |
| **RTB:** | Roots, tubers and bananas |
| **WP:** | Work package |
| **BMGF:** | Bill & Melinda Gates Foundation |
| **CIRAD:** | Centre de coopération internationale en recherche agronomique pour le développement |
| **PMU :** | Project Managing Unit |
| **SOP:** | Standard operating procedure |
| **Tricot :** | Triadic comparisons of technologies (citizen science approach) |
| **CATA :** | Check-All-That-Apply |
| **JAR :** | Just-About-Right |
| **Complete WP 5 expriment** | A set of varieties that are evaluated from planting, to processing with champion processors and consumer testing with 100+ consumers. |

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# ABSTRACT

This report provides a summarized key evidence to be considered for the WP5 Food Product Profile (FPP) for *Gari*/*eba* in Abia state (South East region) and Benue State (North Central region) of Nigeria. The report brings together all the results from the WP5 activities as described in the WP5 guidelines document. The processing operations of the WP5 trials were conducted by the champion processors in two (2) locations and the activities were monitored by the RTBFoods team. The operations were timed and recorded for each activity. The four (4) processors in each of the 2 locations were given the same quantity of roots of different clones to peel. The peeling time, washing time, weight of root after peel, grating time, fermentation time, weight of dewatered mesh, sieving time, toasting time and *gari* yield were recorded in that order. The consumer testing was carried out using the best preferred clone, intermediate and worst clones with one national and one local varieties as checks. The results were drawn from the following activities: agronomic data, laboratory data, harvest/yield assessment, processing demonstration, product yield assessment and consumer testing results. Eighteen clones of cassava were evaluated for sustainability of new genotypes to RTB users needs and preferences. The result of the agronomic performance of the clones showed that there was no significant difference between the clones both in Abia and Benue states. The result of the Physico-Chemical properties obtained from *gari* products showed that dry matter of the *gari* had no significant difference. The swelling index ranged from 2.04% to 2.23% with F68P007 having the highest. Nwaocha and F9P002 scored highest in starch (62.88% and 62.78%) and lowest in sugar content (5.46013 and 5.3568) for Abia and Benue respectively. In the consumer testing segment, 300 consumers were interviewed in the two (2) locations, Among the 150 consumers interviewed in Abia State, 99 consumers were females and 51 were males while in Benue state 98 consumers were females and 52 were males indicating a significant difference in gender (Chi-square). Results show that many of the consumers were youths. Out of 300 consumers interviewed in Abia and Benue States, 27.3% (38 and 44 respectively) consume *eba* every day. About 44.3% (70 and 63) consume *eba* several times a week both in Abia and Benue state. 21.3% (34 and 30) consume *eba* once in a week in both Abia and Benue state. 3.7% (4 and 7) consume *eba* only several times a month in both states. 3.4% (4 and 6) consumers consume *eba* once in a month in both states. The results also show that the improved clones either performed better or compared favourably with the local checks.

**Key Words: Champion processors, Physico-chemical, Consumer testing, Clones, Pairwise, Ranking, ANOVA, JAR, CATA**

# 1 INTRODUCTION

Cassava food products are the most important staples among rural and urban households in Nigeria. In all locations, cassava has become a very popular crop and is fast replacing yam and other traditional staples of the area, gaining ground increasingly as an insurance crop against hunger. Cassava has been an important crop to both men and women and also as a food security and subsistence crop, but also as a means to generate income independently. Good and poor quality characteristics of *gari*/*eba* were listed in four major categories: Raw material, Processing, Final raw material end product (*Gari*), Final end product (*Eba*).

*Gari*; a dry, crispy, creamy-white or yellow, granular flour (semolina) obtained from cassava roots by peeling, washing, grating, pressing, fermenting (optional), sieving and roasting (Escobar *et al*., 2018), usually consumed in the uncooked form, or added with water, sugar, groundnuts and/or cashew nuts, or cooked into a dough called *eba*—the most widely eaten form or sprinkled on cooked cowpea beans in some Africa countries like Nigeria, Togo and Benin Republic (Adinsi *et al*., 2019). *Eba* is the consumer end product made by sprinkling *gari* into a bowl or pot of boiled water with continuous stirring until dough is formed. (Ogundipe *et al*., 2013).

User's preferences of cassava and cassava products along the value chain are supported by specific root quality characteristics that can be linked to root traits. Therefore, providing an evidence base of user preferred characteristics along the value chain can help in the functional choice of cassava varieties (Ndjouenkeu *et al*., 2021). As indicated by Ndjouenkeu *et al*. (2021), numerous number of improved cassava varieties has been developed; with different quality characteristics, leading to large variability in the processing, use and quality of *gari*. Several studies have assessed The quality and acceptability of *gari* with respect to cassava varieties (Tokula and Ekwe, 2006; Komolafe & Arawande, 2010; Sanoussi *et al*., 2015; Awoyale *et al*., 2020; Ndjouenkeu *et al*., 2021), coupled sometimes to area of production (Sanoussi *et al*., 2015; Olanrewaju & Idowu, 2017; Laya *et al*., 2018) and processing tools and practices (Olaoye *et al*., 2015; Tohnain & Bebnji, 2017).

This report provides a summarized key evidence to be considered for the WP5 Food Product Profile (FPP) for *Gari*/*eba* in Abia State (South East region) and Benue State (North Central region) of Nigeria. The report brings together all the results from the WP5 activities as described in the WP5 guidelines document. The results were drawn from the following activities:

(i) Agronomic data
(ii) Laboratory data
(iii) Harvest/yield assessment
(iv) Processing demonstration
(v) Product yield assessment and
(vi) Consumer Testing results

The experiment were established in Abia and and Benue States. The report will be circulated to a multidisciplinary design team to consider in developing the WP5 Food Product Profile for *gari*/*eba*.

# 2 CONTEXT

## 2.1 Product profile

Eighteen (18) clones were used for the study and distributed in batches among four purposively selected champion processors; these clones were differentiated with codes before the commencement of the processing and consumer testing activities. However, the time allotted for each activity was recorded and questions were asked during each activity and the answers to those questions also recorded. The experiment started with the assessment of the raw material and the traits assessed were; root shape, root skin colour, inner root colour, skin texture and ease of peel (Table 1). The second stage of the study started with peeling, washing, grating, fermentation, dewatering, sieving and toasting. The intermediate product- *gari* was also assessed with traits such as; colour, texture, taste and aroma.

**Table 1: Main characteristics to be included in the evaluation for each food Product Profile (identified from other WPs)**

| Level | Characteristics* |
|---|---|
| Raw material | #1: Root shape<br>#2: Root skin colour<br>#3: Inner root colour<br>#4: Skin Texture<br>#5:Ease of peeling |
| Processing | #1: Peeling time<br>#2:Washing time<br>#3: Weight of peeled root<br>#4: Grating time<br>#5: Fermentation time<br>#6: Sieving time<br>#7: Weight of chaff<br>#8: Toasting time<br>#9: Weight of product |
| End Product* (*Gari*) | #1: Colour<br>#2: Texture<br>#3: Taste<br>#4: Aroma |
| End Product* (*Eba*) | #1: Colour<br>#2: Stretchability<br>#3: Smoothness<br>#4: Stickiness |

**** Quality traits to focus on during WP5 activities (consumer testing, QDA, etc.)***

# 3 METHODOLOGY

## 3.1 Trial composition clones analysed and locations

The RTBFoods processing experiment was carried out with 4 champion processors for the assessment of Uniform Yield Trial (UYT) using 18 clones of cassava with one local and national check in two (2) locations in Nigeria; Benue State (North Central zone) and Abia State (South East zone). Eighteen (18) cassava clones were assessed by four (4) champion processors at different levels of the experiment. The different levels include; raw material (produce), processing and intermediate/end product. At raw material level; the root shape, root skin colour, inner root colour, skin texture and ease of peeling were assessed. At the processing level; peeling time, weight of peeled root, washing time, grating time, fermentation time, sieving time, weight of chaff and toasting time were assessed. At the intermediate product level; *gari* colour, texture, taste and aroma were assessed, while at the end product level; *eba* colour, stretchability, smoothness and stickiness were considered (See Table 1).

The quantitative data (guided interviews) were taken along each level of the experiment. Thereafter, three (3) clones which were a representation of the best, intermediate and worst (TMS13F1053P0010, NR15C1aF9P002, NR15C1AF68P007) respectively were selected alongside the national (TMEB419) and local checks (Nwaocha for Abia and Ichenke for Benue) (Table 2). These three (3) selected clones, plus the national and local checks were used for consumer testing. The clones were placed as 4 batches with best, intermediate and worst in each batch. Placements in batches were done for ease of assessment by the participants, and not get them confused with 18 assessments at once. Hence, the complete experiment include; TMS13F1053P0010,

NR15C1aF9P002, NR15C1AF68P007, TMEB419 and Nwaocha/Ichenke. The scores were generated from the pairwising of each trait from the different processors. There were four (4) processors for gari/eba. Each processor ranked and pairwised all the clones according to their observations, both for root and gari assessment. Then the scores of each trait from each of the processors were summed to get the scores (see appendix 1).

Three hundred (300) Consumers (150 from each zone; 75 for rural and urban each) were invited to test the five (5) products (*eba*) prepared by the champion processors. The locations of consumer testing in Abia State were Ubakala (Urban area) and Ariam (Rural area), while in Benue State the locations were Otukpo (Urban) and Otobi Akpa(Rural).

JAR (Just about Right) and CATA (Check all that Apply) methods were applied. The traits assessed using JAR method were ''Smoothness, Colour, Stickiness and Stretchability, while for CATA, traits like sticky, stretchy, dark in colour, lumps, not easy to mould, scatters, easy to cut, too soft, easy to swallow, heavy weight, white, moderately soft, low yield, high starch, smooth, butter/cream colour, too hard, draw little, yellow, fibre particles, watery were assessed.

**Table 2: Overview of the trials and genotypes used in 2021/2022 (trial location-Abia/Benue States)**

| Complete experiment (Complete activity) WP5 | Genotypes | Crop program official denomination / Local name | Reason for including the variety |
|---|---|---|---|
| | TMS13F1053P0010 | | *Best clone* |
| | NR15C1aF9P002 | | *Intermediate Clone* |
| | NR15C1AF68P007 | | *Worst clone* |
| | TMEB419 | *TME 419* | *National check* |
| | NWAOCHA/ICHENKE | *NWAOCHA/ICHENKE* | *Local check* |

## 3.2 Agronomic evaluation

***Agronomic Parameters Evaluated on the WP5 trials include:***

-Number at harvest
-Plot type
-Root size
-Root shape
-Rot number
-Root colour
-Root number
-Root weight
-Shoot weight
-Weight in air
-Weight in water

## 3.3 WP5 Processing evaluation methodology

### 3.3.1 Flowchart of the processing

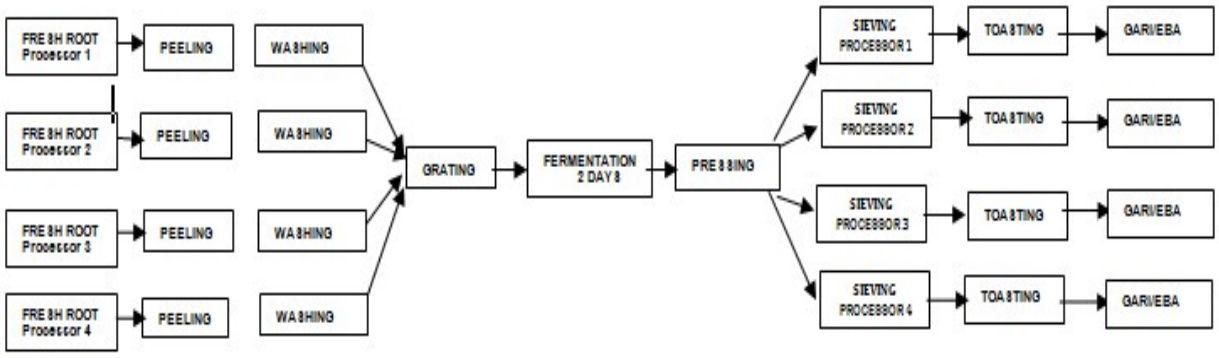


**Figure 1: Flow sheet of the experiment making gari-eba with 4 champion processors**

## 3.4 Measurements on Raw material harvested

The cassava clones/varieties used in the WP5 trials were carefully chosen to determine the characteristics of the root to get good and bad varieties based on the acceptability of the cassava roots by farmers. These clones/varieties were chosen for uniformity (same quantities were assessed to avoid bias) and the traits assessed at the raw material level were; root shape, root skin colour, Inner root colour, root texture and ease of peel. Eighteen (18) clones were assessed (see appendix 1).

## 3.5 Measurements on Intermediate products and/or final products characterization in the laboratory or on the field

The dry matter content was assessed using oven dry method following Adesokan *et al.* (2020) where 5g of homogenized samples was weighed and oven dried at 103$^{o}$C for 16hrs. The results were expressed as percentage loss in moisture. The starch and sugar were done using the method of Otegbayo (2019); this was done using hydrolysis method.

The amylose contents of the flour samples were determined by a colorimetric AACC method. About 100mg sample was gelatinized in the presence of 95% ethanol (1ml) and 1 N NaOH (9 ml) to liberate amylose molecules. Iodine solution (2ml) was added to form an amylose– iodine complex and absorbance was read at 620nm. The amylose contents were calculated by means of a standard curve and expressed as percent of sample dry weight. Amylopectin content was calculated by difference from amylose contents (Udo *et al*., 2021).

The swelling index was measured using the method of Ukpabi and Ndimele (1990). Fifty grams (50g) of each sample was put into a 500ml measuring cylinders. Three hundred mL (300ml) of cold water were added and allowed to stand for 4h before observing the level of swelling. The swelling index was then calculated as the multiple of the original volume. The crude fibre was done using the AOCA 2020 method.

Materials from the lab were taken to the lab same day for commencement of lab tests for Umudike (Abia), while for Benue, the materials were kept in cold rooms until the field staff are ready to leave after the entire field work. The materials were able to get to the labs before 12hrs for commencement of lab work.

**Table 3 Overview of laboratory measurements related to the WP5 work**

| Parameter measured | Methodology used to measure the parameter | On intermediate food product produced in the lab based on fresh material from the WP5 trails (Y/N) | On final food product produced in the lab based on fresh material from the WP5 trails (Y/N) | On intermediate food product processed by the champion processors from the WP5 trails (Y/N) | On final food product processed/prepared by the champion processors from the WP5 trails (Y/N) |
|---|---|---|---|---|---|
| ***On intermediate food product*** | | | | | |
| | Oven drying method AOAC (2010) | yes | No | No | No |
| Amylose content | Colorimetric AACC method | yes | No | No | No |
| Free sugar | Phenol-sulphuric acid method (Dubois *et al* (1956) | yes | No | No | No |
| Starch Content | Phenol-sulphuric acid method (Dubois *et al* (1956) | yes | No | No | No |
| Crude fibre | AOAC (2010) | yes | No | No | No |
| Bulk density | Onwuka (2018) | yes | No | No | No |
| Swelling power | Onwuka (2018 ) | yes | No | No | No |
| Solubility, | Onwuka (2018) | yes | No | No | No |
| Swelling index. | Sanni *et al* (2001) | yes | No | No | No |
| Water absorption capacity (WAC) | Onwuka (2018) | yes | No | No | No |
| Toasting time | | No | No | yes | No |
| Chaff loss | | No | No | yes | No |
| Gari yield | | No | No | yes | No |
| ***On final product*** | | | | | |
| Instrumental Textural analysis | Maziya-Dixon *et al* (2021) | No | yes | No | Yes |
| Sensory analysis using trained panelists | Maziya-Dixon *et al* (2020) | No | yes | No | Yes |

## 3.6 Physico-chemical properties

Figure 2 shows the result of the physic-chemical properties obtained from the *gari* products, indicating that there was no significant difference in dry matter of *gari* (there were no wide variations in the figures). The swelling index ranged from 2.04% to 2.23% (Table 4), with F68P007 giving the highest. Nwaocha and F9P002 scored highest in starch (62.88% and 62.78%) and lowest in sugar content (5.46013 and 5.3568). The amylose content shows that F68P007 has the lowest with the highest Amylopectin. The crude fibre content of the *gari* samples ranged from 2.31% to 2.45%, with TME419 having the highest.

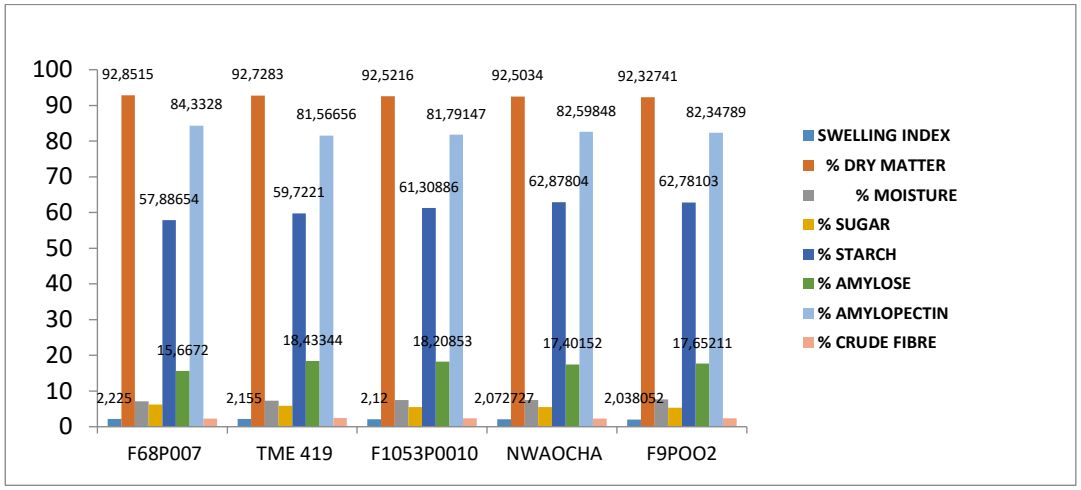


**Figure 2: Physico-chemical properties for Gari Abia State**

**Table 4: Physico-Chemical properties for Gari Abia State**

| Sample Plot No. | Swelling Index | % Dry Matter | % Moisture | % Sugar | % Starch | % Amylose | % Amylo pectin | % Crude Fibre |
|---|---|---|---|---|---|---|---|---|
| **F68P007** | 2.22 | 93.100 | 6.900 | 6.17274 | 57.720672 | 15.5448 | 84.4552 | 2.33 |
| **B** | 2.23 | 92.603 | 7.397 | 6.333768 | 58.0524 | 15.7896 | 84.2104 | 2.3 |
| **TME 419** | 2 | 92.145 | 7.855 | 5.340762 | 62.364864 | 22.4604 | 77.5396 | 2.62 |
| **B** | 2.1 | 92.942 | 7.058 | 5.3676 | 62.586016 | 22.7052 | 77.2948 | 2.68 |
| **F1053P0010** | 2.03 | 92.503 | 7.497 | 4.42827 | 65.903296 | 17.6256 | 82.3744 | 2.16 |
| **B** | 2 | 91.300 | 8.700 | 4.508784 | 66.235024 | 17.442 | 82.558 | 2.13 |
| **Nwaocha** | 1.83 | 92.400 | 7.600 | 5.072382 | 70.105184 | 13.8924 | 86.1076 | 2.03 |
| **B** | 1.89 | 92.443 | 7.557 | 5.152896 | 69.773456 | 13.6476 | 86.3524 | 2.09 |
| **F9POO2** | 1.86 | 91.243 | 8.757 | 4.669812 | 62.033136 | 19.0332 | 80.9668 | 2.41 |
| **B** | 1.80 | 91.300 | 8.700 | 4.804002 | 62.364864 | 19.278 | 80.722 | 2.4 |

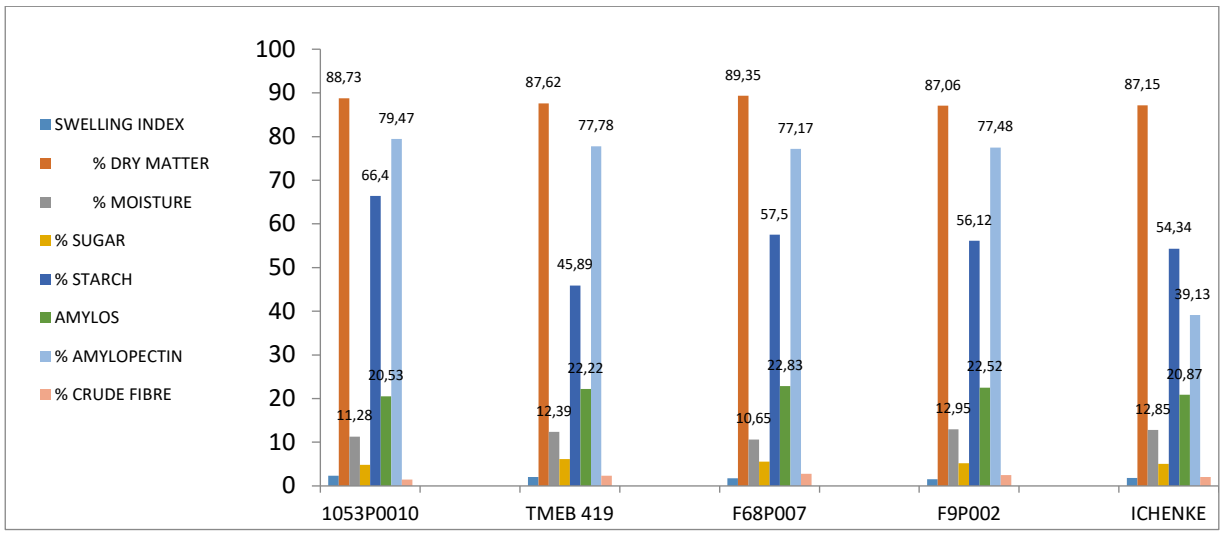


**Figure 3: Physico-chemical properties for Gari Benue State**

**Table 5: Physico-Chemical properties for Gari Benue State**

| | Swelling Index | %Dry Matter | %Moisture | % Sugar | % Starch | Amylos | % Amylopectin | % Crude Fibre |
|---|---|---|---|---|---|---|---|---|
| **F1053P0010** | 2.31 | 88.73 | 11.28 | 4.84 | 66.4 | 20.53 | 79.47 | 1.45 |
| **TMEB 419** | 2.07 | 87.62 | 12.39 | 6.16 | 45.89 | 22.22 | 77.78 | 2.31 |
| **F68P007** | 1.77 | 89.35 | 10.65 | 5.58 | 57.5 | 22.83 | 77.17 | 2.75 |
| **F9P002** | 1.55 | 87.06 | 12.95 | 5.18 | 56.12 | 22.52 | 77.48 | 2.47 |
| **Ichenke** | 1.83 | 87.15 | 12.85 | 5.05 | 54.34 | 20.87 | 39.13 | 2.07 |

From the result in Table 4, F1053P0010 has the highest swelling index, followed by TMEB419, while F9P002 has the least. Meanwhile, F68P007 has the highest dry matter and moisture content. Low moisture content may be an indication of high fibre content and high product output. Also, the result showed that TMEB419 has the highest sugar content, while 1053P0010 has the highest starch and amylopectine content but least in crude fibre.

## 3.7 Processing evaluation with champion processors

### 3.7.1 Processing localities

The RTBFoods processing experiment was carried out in Otobi Akpa, Benue State (North central region) and Umudike, Abia State (South east region). A purposive sampling technique was employed in the selection of the localities where the processing experiments was conducted. The processing locations were selected due to their high production intensity of root and tuber crops (cassava, yam, sweet potato and other minor root crops), proximity and collaboration with the Research Institute.

### 3.7.2 Selecting processors (champion processors)

The champion processors in the two (2) locations were purposively selected based on their wealth of experience. All the processors were females because they dominate in *gari* processing. This was also confirmed by key stakeholders in the community and other processors who served as

informants. All the four processors in the localities are known for their involvement in the production, processing and marketing of cassava products in their area.

### 3.7.3 Evaluation of the processing with the 'champion processors'

The 18 cassava clones from the experimental trial were harvested in 4 batches of 4-5 varieties (each batch was made up of one best, intermediate and worst, with the local check which occurred once at random in any of the batches) per batch in each processing location. The four (4) champion processors were invited to assess the clones according to the batches. Each clone was divided into four (4) equal parts and assessment was done (ranking) based on root shape, root skin colour, inner root colour, root texture and ease of peel. The traits were ranked 5-1, with 5 being the best and 1 being the worst reasons for ranking either best or worst for all the traits was assessed.

### 3.7.4 Monitoring times and quantities, product yield and relative amount of drudgery

The processing operations of the WP5 trials were conducted by the champion processors in two (2) locations and the activities monitored by the RTBFoods team. The operations were timed and recorded for each activity. The four (4) processors in each of the 2 locations were given the same quantity of roots of different clones to peel. The peeling time, washing time, weight of root after peel, grating time, fermentation time, weight of dewatered mesh, sieving time, toasting time and *gari* yield were recorded in that order.

# 4 CONSUMER TESTING

## 4.1 Consumer testing design according the number of clones/products evaluated

Three (300) consumers (150 from each of the experimental location) were randomly selected to test the five (5) *eba* products prepared by the champion processors. The consumers comprised of farmers, processors, marketers, students, civil servants, and traders etc. The locations of consumer testing in Abia State were Ubakala (Urban area) and Ariam (Rural area); while in Benue State the locations were Otukpo (Urban) and Otobi Akpa (Rural). Three (3) clones, one (1) national check and one (1) local check were used for consumer testing and they include; TMS13F1053P0010, NR15C1aF9P002, NR15C1AF68P007, TMEB419 and Nwaocha/Ichenke. The use of JAR (Just about Right) and CATA (Check all that Apply) methods were employed. The traits assessed using JAR method were ''Smoothness, Colour, Stickiness and Stretchability, while for CATA method, traits like sticky, stretchy, dark in colour, lumps, not easy to mould, scatters, easy to cut, too soft, easy to swallow, heavy weight, white, moderately soft, low yield, high starch, smooth, butter/cream colour, too hard, draw little, yellow, fibre particles, watery were assessed.

# 5 RESULTS

## 5.1 Agronomic performances of the clones in the WP5 trials

The results in Table 6 show the agronomic performance of the material used for the WP5 study. In terms of number at harvest, there were significant differences in both locations; with NR15C1aF9P002, TMS13F1053P0010 and NR15C1aF68P007 (Benue) doing better than TMEB419. There were no significant differences in the root size of the clones in Abia but there were in Benue with NR15C1aF9P002 and TMEB419 same, but significantly different from NR15C1aF68P007 and TMS13F1053P0010 (which were same). In terms of root shape, results

show clones NR15C1aF9P002 and NR15C1aF68P007 were same, and significantly different for TMS13F1053P0010 and TMEB419 in Abia in contrast to NR15C1aF9P002 and NR15C1aF68P007 in Benue. Abia recorded zero rots in contrast to Benue with highest number of rots in TMEB419, followed by NR15C1aF9P002 (only two). For root color, all varieties were same in Abia, but significantly different from NR15C1aF68P007 in comparison to Benue with TMS13F1053P0010 and TMEB419 (same) and significantly different from NR15C1aF9P002 and TMEB419 which were also same. There were significant differences among the clones in both locations for root number, root weight, shoot weight, weight in air and weight in water.

**Table 6: Results of the agronomic performance of the WP5 trails per set of varieties that were used for processing evaluation with champion processors and consumer testing (Abia and Benue)**

| **Abia** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **genotype name** | **Number at harvest** | **plot type** | **root size** | **root shape** | **rot number** | **root colour** | **root no** | **root wt** | **shoot wt** | **Weight in air (g)** | **Weight in water (g)** |
| NR15C1aF9P002 | 12a | 1a | 5a | 2b | 0a | 1a | 40b | 14.2 c | 9.6b | 3810a | 450b |
| TMS13F1053P0010 | 13a | 1a | 5a | 3a | 0a | 1a | 61a | 27a | 6.3c | 3720c | 510a |
| TMEB419 | 8b | 1a | 5a | 3a | 0a | 1a | 21d | 10d | 5d | 3460d | 410c |
| NR15C1aF68P007 | 8b | 1a | 5a | 2b | 0a | 3b | 26c | 15b | 10a | 3740b | 380d |
| **Benue** | | | | | | | | | | | |
| NR15C1aF9P002 | 14a | 2c | 7a | 2b | 2b | 2a | 127 a | 56.8 a | 38.6 a | 3710a | 550a |
| TMS13F1053P0010 | 14a | 3b | 5b | 3a | 0c | 1b | 82c | 36.2 b | 19.8 b | 2880d | 420c |
| TMEB419 | 12b | 4a | 7a | 3a | 12a | 1b | 56d | 25.2 d | 17d | 3560b | 320d |
| NR15C1aF68P007 | 14a | 3b | 5b | 2b | 0c | 2a | 122 b | 33c | 12.8 c | 3000c | 480b |

Comparison method=Tukey HSD

Figures with same letters are not significantly different

## 5.2 Evaluation of the processing by champion processors: product quality

### 5.2.1 Pairwise ranking for the fresh root assessment for Abia and Benue States

The result of the pairwise ranking for fresh roots and *gari* intermediate product in Abia and Benue States are presented in Figures 4 and 5. The result of fresh roots assessment shows that in Abia State, F1053P0010 had the most preferred root shape followed by F68P007, in Benue; F68P007 had the most preferred root shape followed by Ichenke. For root skin colour the result shows that TMEB419 is the most preferred in Abia, followed by F9P002, while in Benue, F68P007 and F1053P0010 were the most preferred, followed by TMEB419. Variety F1053P0010 recorded as the most preferred in both locations for root colour, while F9P002 (Abia) and TMEB419 (Benue) were chosen as the least preferred samples. In Abia, the result for skin texture assessment shows that F1053P0010 and F68P007 were the most preferred in Abia, while F1053P0010 is the most preferred in Benue. For ease of peel in Abia, TMEB419 is the most preferred, sample followed by Nwaocha, while F1053P0010 is the most preferred sample in Benue followed by F68P007.

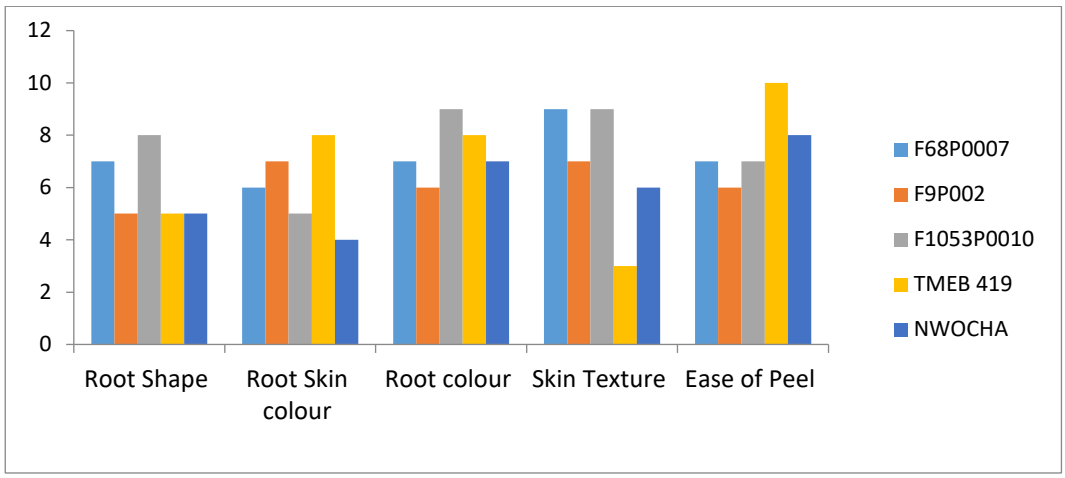


**Figure 4: Pairwise ranking for roots (Abia)**

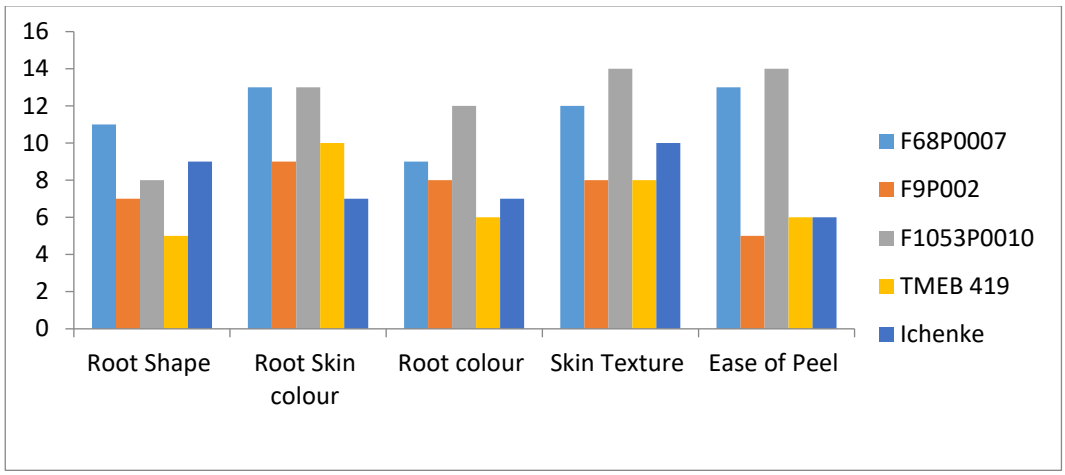


**Figure 5: Pairwise ranking for roots (Benue)**

### 5.2.2 Pairwise ranking for gari product with champion processors of a set of 5 samples in Abia and Benue States

Figures 6 and 7 shows the results of the pair wise ranking of *gari* product for Abia and Benue States. The result for *gari* colour shows that F1053P0010 and TMEB419 were the most preferred colours in Abia and Benue respectively, while F9P002 is the least preferred colour in both states. For texture and taste, F1053P0010 is the most preferred sample in Abia, and TMEB419 most preferred in Benue. The results for aroma show that in Abia, F1053P0010, TMEB419 and Nwaocha were the most preferred, F68P007 was selected as the least preferred, while In Benue state, TMEB419 is the most preferred sample and F9P002 as the least preferred in Benue respectively.

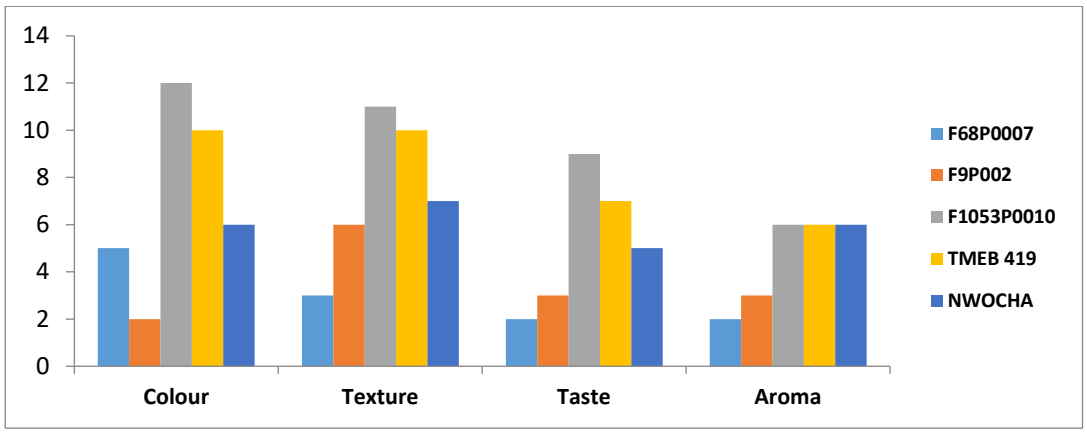


**Figure 6: Pairwise ranking for gari (Abia)**

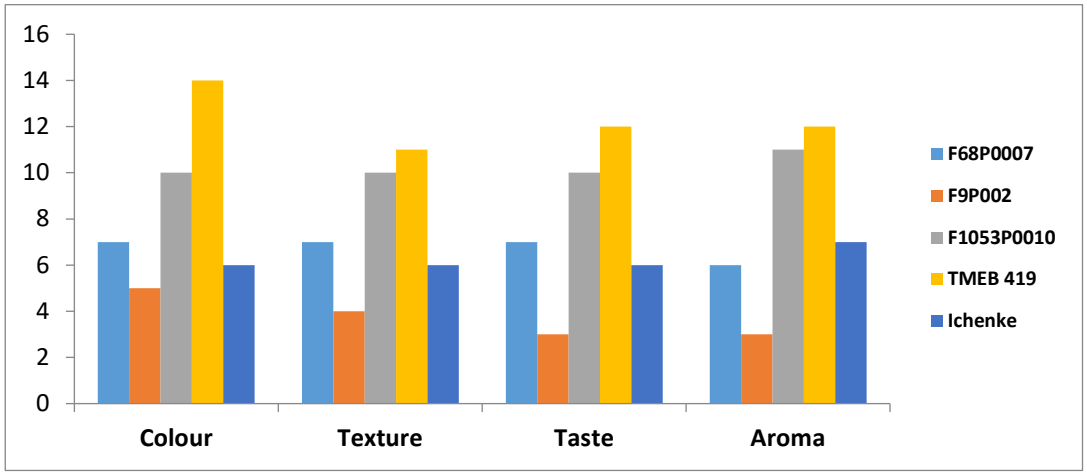


**Figure 7: Pairwise ranking for gari (Benue)**

## 5.3 Consumer testing

### 5.3.1 Using classical "consumer testing"

One Way ANOVA test, using F distribution df(4,750) (right tailed) The difference between the averages of all groups is not big enough to be statistically significant, therefore, there is no significant difference between the overall liking of the clones given that P-value is equal to 0.915863, [p( x ≤ F ) = 0.084137 ]. The test statistic F equals 0.239727, which is in the 95% region of acceptance: [-∞ : 2.3838]. This implies evidence of no significant difference between the means of any pair.

**Table 7 Table 7: Overall liking results using ANOVA analysis and multiple comparison test (Tuckey) for Abia and Benue States**

| **Abia** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pair** | **Difference** | **SE** | **Q** | **Lower CI** | **Upper CI** | **Critical Mean** | **p-value** |
| x1-x2 | 0.2252 | 2.5582 | 0.08802 | -9.6676 | 10.1179 | 9.8928 | 1 |
| x1-x3 | 1.9139 | 2.5582 | 0.7481 | -7.9789 | 11.8067 | 9.8928 | 0.9844 |
| x1-x4 | 1.3642 | 2.5582 | 0.5333 | -8.5285 | 11.257 | 9.8928 | 0.9957 |
| x1-x5 | 3.0464 | 2.5582 | 1.1908 | -6.8464 | 12.9391 | 9.8928 | 0.9174 |

| Abia | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Pair** | **Difference** | **SE** | **Q** | **Lower CI** | **Upper CI** | **Critical Mean** | **p-value** |
| x2-x3 | 1.6887 | 2.5582 | 0.6601 | -8.204 | 11.5815 | 9.8928 | 0.9903 |
| x2-x4 | 1.1391 | 2.5582 | 0.4453 | -8.7537 | 11.0319 | 9.8928 | 0.9979 |
| x2-x5 | 2.8212 | 2.5582 | 1.1028 | -7.0716 | 12.714 | 9.8928 | 0.9364 |
| x3-x4 | 0.5497 | 2.5582 | 0.2149 | -9.3431 | 10.4425 | 9.8928 | 0.9999 |
| x3-x5 | 1.1325 | 2.5582 | 0.4427 | -8.7603 | 11.0252 | 9.8928 | 0.9979 |
| x4-x5 | 1.6821 | 2.5582 | 0.6575 | -8.2107 | 11.5749 | 9.8928 | 0.9904 |

| Group | x2 | x3 | x4 | x5 |
|---|---|---|---|---|
| x1 | 0.23 | 1.91 | 1.36 | 3.05 |
| x2 | 0 | 1.69 | 1.14 | 2.82 |
| x3 | 1.69 | 0 | 0.55 | 1.13 |
| x4 | 1.14 | 0.55 | 0 | 1.68 |

| Abia | | | | | | | |
|---|---|---|---|---|---|---|---|
| x1-x2 | 0.3444 | 2.5599 | 0.1345 | -9.5548 | 10.2436 | 9.8992 | 1 |
| x1-x3 | 2.0993 | 2.5599 | 0.8201 | -7.7999 | 11.9985 | 9.8992 | 0.978 |
| x1-x4 | 1.0728 | 2.5599 | 0.4191 | -8.8264 | 10.9721 | 9.8992 | 0.9983 |
| x1-x5 | 3.4503 | 2.5599 | 1.3478 | -6.4489 | 13.3495 | 9.8992 | 0.8758 |
| x2-x3 | 1.755 | 2.5599 | 0.6856 | -8.1442 | 11.6542 | 9.8992 | 0.9888 |
| x2-x4 | 0.7285 | 2.5599 | 0.2846 | -9.1707 | 10.6277 | 9.8992 | 0.9996 |
| x2-x5 | 3.106 | 2.5599 | 1.2133 | -6.7932 | 13.0052 | 9.8992 | 0.912 |
| x3-x4 | 1.0265 | 2.5599 | 0.401 | -8.8727 | 10.9257 | 9.8992 | 0.9986 |
| x3-x5 | 1.351 | 2.5599 | 0.5278 | -8.5482 | 11.2502 | 9.8992 | 0.9959 |
| x4-x5 | 2.3775 | 2.5599 | 0.9287 | -7.5217 | 12.2767 | 9.8992 | 0.9654 |

| Group | x2 | x3 | x4 | x5 |
|---|---|---|---|---|
| x1 | 0.34 | 2.1 | 1.07 | 3.45 |
| x2 | 0 | 1.75 | 0.73 | 3.11 |
| x3 | 1.75 | 0 | 1.03 | 1.35 |
| x4 | 0.73 | 1.03 | 0 | 2.38 |

The difference between the averages of all groups is not big enough to be statistically significant. Therefore, there is no significant difference between the overall liking of the clones given that p-value equals 0.877729, [p( x ≤ F ) = 0.122271]. The test statistic F equals 0.300401, which is in the 95% region of acceptance: [-∞ : 2.3838]. This implies that there is no significant difference between the means of any pair.

### 5.3.2 Investigating the influence of the Demographic data of the consumers interviewed

Three (300) consumers were interviewed in the two (2) locations, Among the 150 consumers interviewed in Abia, 99 consumers were females and 51 were males, while in Benue, 98 consumers were females and 52 were males indicating no significant difference in gender (Chi-square-Table 8). All (100%) the consumers are Nigerians, 150 comprise the Ibo ethnic group, while 150 are Idoma (10%). In Abia, 46 consumers were within the age range of 18-25 years old, 31 were aged between 26-35, 21 between 36-45, 46-55 (21), while 31 consumers were aged above 56years old, while in Benue, 40 consumers were between 18-25 years old, 28 were aged between 26-35, 26persons between 36-45, 24 were between 46-55 (5%). About 32 consumers (13%), unemployed (30%), while majority (83%) were farmers (Table 7). In terms of age, 51 consumers were single in Abia, 55 in Benue, 82 married in Abia and 84 in Benue, in both Abia and Benue, 11 are widowed. The frequency of consumption also showed significant variation (1%).

**Table 8: Demographic differences of the consumers with respect to cluster division for Abia and Benue States**

| | Abia (n=150) | | | | Benue (n=150) | | | |
|---|---|---|---|---|---|---|---|---|
| **Consumer** | **Urban** | **Rural** | **Pooled** | **Chi-square test (P)** | **Urban** | **Rural** | **Pooled** | **Chi-square test (P)** |
| **Sex** | 75 | 75 | 150 | 0.2674 | 75 | 75 | 150 | |
| Female | 48 | 51 | 99 | | 50 | 48 | 98 | 0.524672 |
| Male | 27 | 24 | 51 | | 25 | 27 | 52 | |
| **Nationality** | | | | | | | | |
| Nigerian | 75 | 75 | 150 | | 75 | 75 | 150 | |
| **Ethnic group** | | | | | | | | |
| Idoma | 0 | 0 | 0 | <0.0001* | 75 | 75 | 150 | <0.0001* |
| Igala | 0 | 0 | 0 | | 0 | 0 | 0 | |
| Tiv | 0 | 0 | 0 | | 0 | 0 | 0 | |
| Ibo | 75 | 75 | 150 | | 0 | 0 | 0 | |
| Hausa | 0 | 0 | 0 | | 0 | 0 | 0 | |
| Yoruba | 0 | 0 | 0 | | 0 | 0 | 0 | |
| **Age** | | | | | | | | |
| 18-25 | 19 | 27 | 46 | | 19 | 21 | 40 | |
| 26-35 | 9 | 22 | 31 | | 8 | 20 | 28 | 0. 004676 |
| 36-45 | 12 | 9 | 21 | 0.004789 | 12 | 15 | 26 | |
| 46-55 | 12 | 9 | 21 | | 12 | 12 | 24 | |
| 56 and above | 23 | 8 | 31 | | 24 | 7 | 31 | |
| **Occupational status** | | | | | | | | |
| Student | 10 | 12 | 22 | | 16 | 13 | 29 | |
| Artisan | 13 | 8 | 21 | | 13 | 11 | 24 | |
| civil servant | 6 | 6 | 12 | 5.080728 | 11 | 6 | 15 | |
| trade/business | 7 | 18 | 25 | | 5 | 19 | 24 | 1.334307 |
| employed | 4 | 1 | 5 | | 7 | 1 | 8 | |
| unemployed | 16 | 5 | 21 | | 4 | 5 | 9 | |
| Farmer | 19 | 25 | 44 | | 19 | 20 | 39 | |
| **Marital status** | | | | | | | | |
| Single | 26 | 31 | 51 | | 27 | 28 | 55 | |
| Married | 42 | 40 | 82 | | 41 | 43 | 84 | 0. .488522 |
| Widowed | 7 | 4 | 11 | 0.0520597 | 7 | 4 | 11 | |
| **Frequency of consumption** | | | | | | | | |
| Every day | 30 | | 8 | | 30 | 14 | 44 | |
| Several times a week | 42 | | 28 | | 42 | 21 | 63 | *p* < 0.00001** |
| Once a week | 1 | | 33 | P< 0.00001 | 1 | 29 | 30 | |
| Several times a month | 1 | | 3 | | 1 | 6 | 7 | |
| Once a month | 1 | | 3 | | 1 | 5 | 6 | |

### 5.3.3 Consumer attitudes

Out of 300 consumers interviewed in Abia and Benue, 27.3% (38 and 44 respectively) consume *eba* every day. About 44.3% (70 and 63) consume *eba* several times a week both in Abia and Benue, while 21.3% (34 and 30) consume *eba* once in a week in both Abia and Benue. Only 3.7% (4 and 7) consume *eba* only several times a month in both states, and 3.4% (4 and 6) consumers consume *eba* once in a month also in that order.

### 5.3.4 Just About Right test (JAR)

Just-about-right (JAR) scale was used to determine the optimum level of intensity as perceived by the consumers for some important sensory quality characteristics of the *eba* samples. Such "descriptor diagnostic" may help understand why consumers like or dislike this *eba* sample. Consumers were asked to give their perception of traits like " Colour, Stretchability, Smoothness and Stickiness of each Product sample, by using a 9-point Hedonic scale (9 = "extremely like" ,8="like very much", 7="moderately", 6=like slightly", 5="neither like, nor dislike" 4= "dislike slightly", 3= " dislike moderately", 2=dislike very much" and 1 = "extremely dislike" respectively). Majority of the consumers in Abia State ranked TMEB419 as the most preferred *eba* in colour, smoothness, stretchability and stickiness, followed by Nwaocha in all the traits, while the least preferred in all the traits assessed were F9P002 and F1053P0010. In Benue, majority of the consumers selected TMEB419 as their most preferred *eba* in colour, smoothness, stretchability, followed by F1053P0010, while the sample with the least preferred score in all the traits assessed is Ichenke.

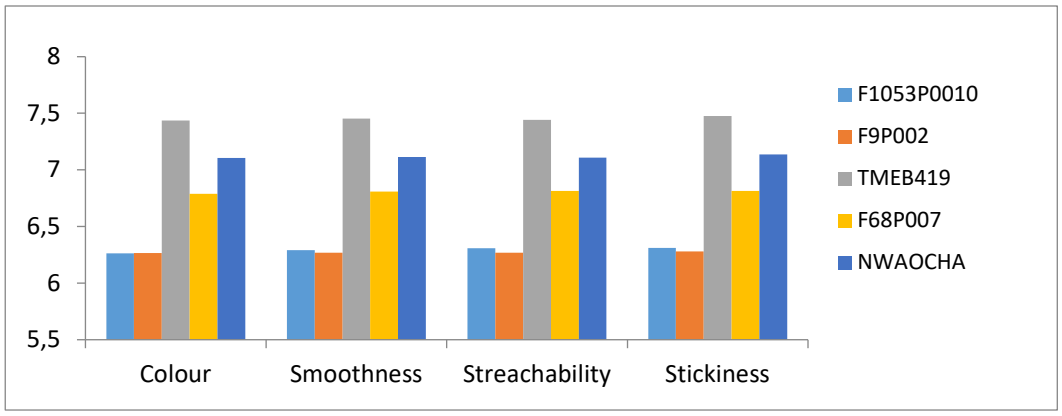


**Figure 8: Just about right for traits (eba) (Abia)**

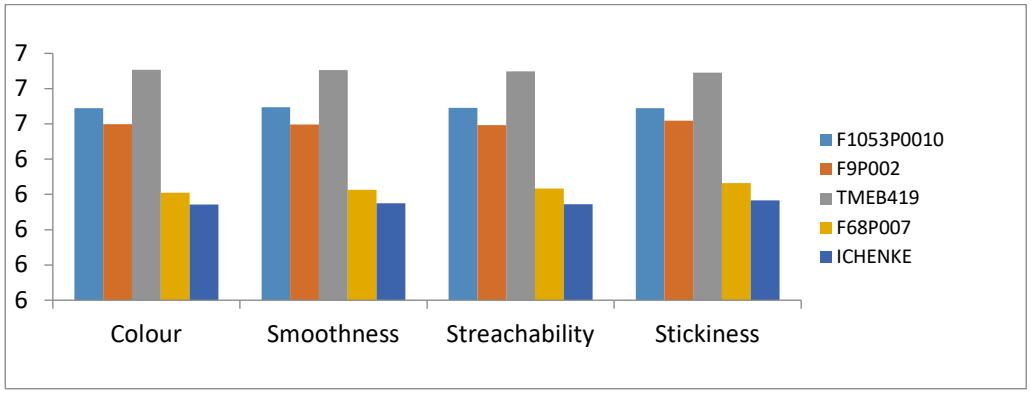


**Figure 9: Just about right for traits (eba) (Benue)**

### 5.3.5 Check all that apply (CATA)

The objective of the CATA test is to show the relationships between hedonic Overall liking scores for each Product sample and the frequencies of citation of each CATA sensory characteristic by all the consumers. After scoring the Overall liking and the perception of some specific sensory characteristics, consumers were invited to choose the most appropriate terms among 23 sensory characteristics that better describe each Product sample. The frequency of citations given by consumers to describe each Product sample were calculated (Table 10). The sensory characteristics most frequently cited by the consumers that were considered the best for describing the products. In Abia, the best characteristics were the following: "Mouldable, Neat, No lumps, Sweet, Moderately soft, Less lumps, Butter/cream colour, Good taste, Good aroma, Smooth, Stretchy" with a frequency of citation range of 200-650 for all the sample products. Also a negative quality characteristic within this range is "Sour" (220 citations) among the 5 samples). In Benue, the sensory characteristics most frequently cited by the consumers that were considered the best for describing the products are: ""Mouldable, Neat, No lumps, Sweet, Moderately soft, Less lumps, Butter/cream colour, Good taste, Good aroma, Smooth, Stretchy" with frequency citation range of 200-650% for all the sample products. Among negative quality characteristics that ranked high were "Sour (211 citations), Fibre/dirty particles (235 citations)" among the 5 samples.

**Table 9: CATA frequency table**

| | Abia | | | | | | Benue | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Characteristics** | **F1053P0010** | **F9P002** | **TMEB419** | **F68P007** | **NWAOCHA** | **Sum** | **F1053P0010** | **F9P002** | **TMEB419** | **F68P007** | **ICHENKE** | **Sum** |
| Mouldable | 144 | 119 | 131 | 127 | 125 | 646 | 144 | 121 | 134 | 119 | 127 | 645 |
| Neat | 122 | 74 | 96 | 71 | 107 | 470 | 119 | 69 | 103 | 63 | 111 | 465 |
| Too sticky | 39 | 48 | 37 | 40 | 31 | 195 | 44 | 55 | 39 | 47 | 37 | 222 |
| Offensive odour | 2 | 14 | 18 | 18 | 18 | 70 | 7 | 17 | 31 | 29 | 15 | 99 |
| No lumps | 34 | 40 | 57 | 37 | 44 | 212 | 41 | 48 | 74 | 37 | 57 | 257 |
| Sour | 41 | 58 | 38 | 43 | 40 | 220 | 40 | 57 | 37 | 44 | 33 | 211 |
| Sweet | 71 | 38 | 53 | 46 | 64 | 272 | 76 | 42 | 61 | 46 | 80 | 305 |
| Not stretchy | 12 | 14 | 15 | 16 | 12 | 69 | 14 | 23 | 18 | 21 | 16 | 92 |
| Moderately soft | 101 | 97 | 108 | 69 | 80 | 455 | 102 | 96 | 111 | 64 | 94 | 467 |
| Less lump | 58 | 59 | 46 | 49 | 51 | 263 | 64 | 60 | 47 | 62 | 52 | 285 |
| No taste | 8 | 13 | 20 | 26 | 9 | 76 | 10 | 16 | 19 | 30 | 11 | 86 |
| Butter/cream colour | 98 | 47 | 89 | 31 | 80 | 345 | 19 | 40 | 90 | 25 | 81 | 255 |
| Good taste | 122 | 104 | 108 | 103 | 112 | 549 | 120 | 95 | 107 | 96 | 118 | 536 |
| Good aroma | 140 | 113 | 112 | 114 | 120 | 599 | 136 | 107 | 33 | 104 | 126 | 506 |
| Not sour | 30 | 23 | 31 | 21 | 23 | 128 | 30 | 22 | 9 | 22 | 21 | 104 |
| Too soft | 6 | 7 | 9 | 7 | 16 | 45 | 6 | 8 | 93 | 6 | 13 | 126 |
| Smooth | 99 | 76 | 90 | 101 | 89 | 455 | 98 | 72 | 98 | 94 | 97 | 459 |
| Stretchy | 82 | 69 | 96 | 77 | 80 | 322 | 86 | 69 | 22 | 78 | 86 | 341 |
| Too hard | 11 | 19 | 24 | 43 | 18 | 115 | 15 | 26 | 23 | 57 | 16 | 137 |
| Dull/dark/brown | 30 | 43 | 23 | 55 | 26 | 177 | 30 | 55 | 15 | 67 | 21 | 188 |
| Not mouldable | 20 | 19 | 17 | 56 | 18 | 130 | 19 | 20 | 3 | 31 | 18 | 91 |
| Yellow | 9 | 52 | 3 | 54 | 7 | 125 | 9 | 59 | 28 | 58 | 7 | 161 |
| Fibre/dirty particles | 44 | 55 | 23 | 54 | 21 | 197 | 47 | 66 | 28 | 69 | 25 | 235 |

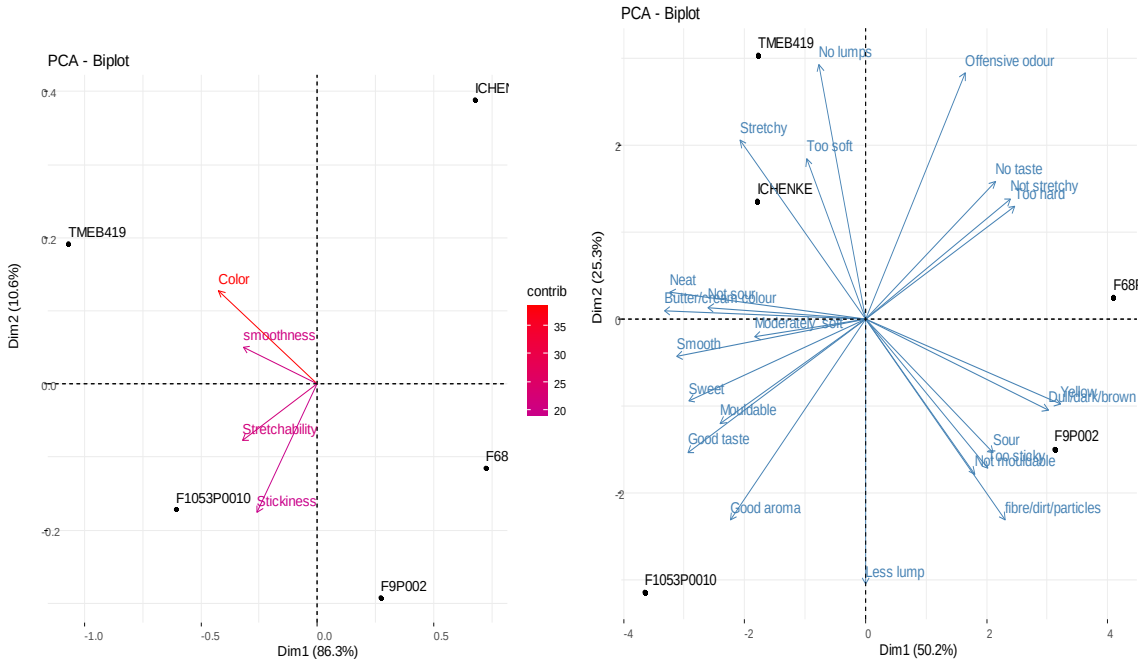


**Figure 10: Principle component analysis showing the characteristics and overall liking to identify the main characteristics and emotional descriptors that determine the overall liking**

**Table 10: Correlation Matrix Abia and Benue**

| **Abia** | | | | | |
|---|---|---|---|---|---|
| **Traits** | **Overall-liking** | **Colour** | **Smoothness** | **Stretchability** | **Stickiness** |
| Overall | 1.00 | 0.96 | 0.90 | 0.81 | 0.52 |
| Colour | 0.96 | 1.00 | 0.96 | 0.84 | 0.62 |
| Smoothness | 0.90 | 0.96 | 1.00 | 0.82 | 0.73 |
| Stretchability | 0.81 | 0.84 | 0.82 | 1.00 | 0.85 |
| Stickiness | 0.52 | 0.62 | 0.73 | 0.85 | 1.00 |
| **Benue** | | | | | |
| Overall | 1.00 | 0.90 | 0.98 | 0.85 | 0.64 |
| Colour | 0.90 | 1.00 | 0.96 | 0.93 | 0.71 |
| Smoothness | 0.98 | 0.96 | 1.00 | 0.92 | 0.75 |
| Stretchability | 0.85 | 0.93 | 0.92 | 1.00 | 0.87 |
| Stickiness | 0.64 | 0.71 | 0.75 | 0.87 | 1.00 |

# 6 DISCUSSION AND CONCLUSION

The study evaluated Suitability of New Cassava Genotypes to RTB Users' Needs and Preferences regarding *Gari*/*Eba* at in Abia (South-East region) and Benue (North-Central region) of Nigeria. The wide variations for some of the agronomic traits indicate the increasing acceptability of the improved materials among farmers. Asrat *et al*. (2010), noted that although improved crop varieties may be high yielding, farmers may not like them unless they have some traits that farmers consider important. Edmeades (2008), also indicated that crop variety traits or attributes are the performance characteristics of the plant varieties that include both the production capacity of the plant and the consumption attributes of the product.

Generally, some of the improved clones performed better than the local checks in terms of root shape, root skin colour, root colour, skin texture and ease of peel. This was also same with the intermediate product (*eba*) at both locations. The improved clones either compared favourably with the improve clones or out performed in most cases.

The study shows that gari/*eba* is mainly consumed by women compared to their male counterparts. CARE (2022), indicated that between 2018-2021, the number of hungry women versus men grew by 8.4 times, despite being responsible for 90% of preparing and buying food, they are eating last and least. Gari/*eba* is also consumed by youths more than their aged counterparts. This might be as a result of more energy demand among this group. Cook (2005), noted that cassava is a basic energy source for human food and "gari" being one of its product is a well-known west Africa food (Nigeria). Gari is mainly consumed daily or several time in a week, because it's one of the staple foods, easy to prepare and eaten in a variety of forms.

For JAR and CATA, some of the improved varieties either compete favourably or were better than the local checks, most especially F1053P0010 followed by TMEB419 for mouldability, neat, moderately soft, good aroma and good taste.

# 7 ARCHIVING RAW DATA (UPLOADING TO CIRAD WEBSITE)

Please arrange the data of each type in excel and upload to the Cirad website and fill the table below. Per category (see table 9 below) try as much as you can to put the data in single excel files using different sheets if necessary.

https://collaboratif.cirad.fr/share/page/site/RTBfoods/documentlibrary#filter=path%7C%2FWP5%7C&page=1

**Table 11: Overview of WP5 raw data uploaded**

| N° | Type of raw data | Nr of files and names of the files | Uploaded? (Y/N) |
|---|---|---|---|
| 1 | Trial agronomic data | a. Regional UYT Agronmic data (Umudike and Otobi) 2021<br>b. Agronomic data Regional UYT 2021<br>c. UYT Harvest and Processing Data | n |
| 2 | Evaluation with champion processors of roots, intermediate products and final food products | Food Processing and diagnostics data | n |
| 4 | Laboratory data physiochemical and functional properties on fresh harvest and final and (if applicable) intermediate products | | |
| 5 | Laboratory QDA | RTB copy of sensory data using 5 genotypes | n |
| 6 | Consumer testing data (classical consumer testing using JAR or Tricot with or without JAR) | Consumer Testing (Abia and Benue) | n |

# APPENDIX 1

| s/n | Variety/Clone harvested Umudike | Skin colour | Root colour | Skin texture | Ease of peal | Peeling time (min) | REMARKS | Grating time | Sieving time (min) | Mash colour | Mash texture | Toasting time | Taste | Aroma | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | F2201(P007) | 12 (1st) | | 10 (1st ) | 9 (1st) | 14 (1st ) | BEST | 3 (1st) | 9 (4th) | 4(4th) | 10(1st) | 49(5th) | 7(3rd) | 7(2nd) | POOR |
| 2 | R22(P001) | 1 (5th) | | 4 (5th ) | 1(5th) | 35 (5th) | POOR | 4 (2nd) | 9 (4th) | 5(3rd) | 1(5th) | 34(2nd) | 9(1st) | 8(1st) | BETTER |
| 3 | IBA 000070 | 7 (2nd ) | | 5 (3rd ) | 4 (4th) | 29 (3rd ) | GOOD | 4 (2nd) | 7 (1st) | 2(5th) | 7(3rd) | 35(3rd) | 5(4th) | 5(4th) | GOOD |
| 4 | F1053(P0010) | 7 (2nd) | | 5 (3rd ) | 7 (2nd) | 26 (2nd ) | BETTER | 5 (4th) | 8 (3rd) | 7(2nd) | 10(1st) | 41(4th) | 4(5th) | 6(3rd) | FAIR |
| 5 | F25(P001) | 3 (3rd) | | 6 (2nd) | 6 (3rd) | 33 (4th ) | FAIR | 5 (4th) | 7 (1st) | 11(1st) | 2(4th) | 30(1st) | 8(2nd) | 4(5th) | BEST |
| 6 | F9 (P002) | 5 (2nd) | | 5 (2nd) | 6(2nd) | 15 (1st) | BETTER | 4 (1st) | 9 (3rd) | 5(2nd ) | 5(3rd) | 18(1st ) | 5(2nd) | 6(1st ) | BETTER |
| 7 | F1306 (P0015) | 9 (1st) | | 9 (1st) | 7(1st) | 23 (2nd) | BEST | 5 (3rd) | 6 (1st) | 4 (3rd ) | 8(1st ) | 29(3rd) | 5 (2nd) | 6(1st) | GOOD |
| 8 | F44 (P002) | 3 (3rd) | | 3 (4th) | 4(4th) | 39 (4th) | POOR | 4 (1st) | 6 (1st) | 7(1st) | 8(1st ) | 18(1st) | 7 (1st) | 6 (1st) | BEST |
| 9 | F68 (P007) | 1 (4th) | | 5 (2nd) | 5(3rd) | 31(3rd) | FAIR | 7 (4th) | 11(4t) | 2(4th) | 1(4th) | 30(4th) | 1(4th) | 1(4th) | POOR |
| 10 | F116(P001) | 4(1st) | 3(3rd) | 8(1st) | 8(1st) | 31(2nd) | BEST | 4(3rd) | 5(1st) | 8(1st) | 6(2nd) | 31(1st ) | 2(3rd) | 3(4th) | Better |
| 11 | **TMEB419** | 4(1st) | 5(2nd) | 5(3rd) | 4(3rd) | 22(1st) | BETTER | 3(1st) | 7(3rd) | 4(2nd) | 9(1st) | 33(2nd) | 2(3rd) | 4(3rd) | Good |
| 12 | **F1304(p0003)** | 4(1st) | 7(1st) | 6(2nd) | 6(2nd) | 37(4th) | GOOD | 4(3rd ) | 5(1st) | 4(2nd) | 0(5th) | 65(3rd) | 5(2nd) | 5(2nd) | Poor |
| 13 | **F3P017** | 0(4th) | 3(3rd) | 0(4th) | 0(4th) | 33(3rd) | POOR | 3(1st) | 9(4th) | 2(4th) | 3(4th) | 31(1st) | 7(1st) | 6(1st ) | Best |
| 14 | **F1301(P0013)** | 6(3rd) | 6(4th) | 4(3rd) | 4(4th) | 16(1st) | GOOD | 5(2nd) | 6(2nd) | 5(3rd) | 6(2nd) | 37(2nd) | 2(5th) | 3(4th) | Good |
| 15 | F23 (P003) | 3(4th) | 3(3rd) | 4(3rd) | 6(3rd) | 32(5th) | FAIR | 5(2nd) | 6(2nd) | 10(1st) | 6(2nd) | 45(4th) | 4(4th) | 7(2nd) | Better |
| 16 | F24(P001) | 0(5th) | 0(5th) | 4(3rd) | 3(5th) | 18(2nd) | POOR | 6(4th) | 6(2nd) | 8(2nd) | 7(1st) | 46(5th) | 6(2nd) | 3(4th) | Fair |
| 17 | F1160 (P0004) | 10(2nd) | 10(1st) | 9(2nd) | 7(2nd) | 24(4th) | BETTER | 7(5th) | 5(1st ) | 2(5th) | 6(2nd) | 39(3rd) | 9(1st) | 9(1st) | Best |
| 18 | NWAOCHA (local check | 11(1st) | 10(1st) | 11(1st) | 13(1st) | 20(3rd) | BEST | 4(1st) | 8(5th) | 5(3rd) | 5(5th) | 29(1st) | 5(3rd) | 6(3rd) | Poor |
| | **Otobi** | | | | | | | | | | | | | | |
| 1 | F1160 (P004) | 5(3rd) | 7(2nd) | 6(2nd) | 8(2nd) | 11(3rd) | BETTER | 2(1st) | 13(1st) | 10(2nd) | 10(2nd) | 85(5th) | 11(1st) | 9(1st) | BEST |
| 2 | 1053 (P0010) | 12(1st) | 12(1st) | 11(1st) | 10(1st) | 14(5th) | BEST | 3(3rd) | 18(2nd) | 11(1st) | 11(1st) | 57(2nd) | 10(2n) | 8(2nd) | BETTER |
| 3 | 04 (P003) | 5(3rd) | 5(4th) | 6(3rd) | 8(2nd) | 9(1st) | GOOD | 2(1st) | 29(5th) | 6(3rd) | 6(3rd) | 58(3rd) | 3(3rd) | 7(3rd) | GOOD |
| 4 | F9 (P002) | 8(2nd) | 6(3rd) | 5(4th) | 1(5th) | 11(3rd) | FAIR | 4(4th) | 24(3rd) | 3(4th) | 1(5th) | 53(1st) | 3(3rd) | 3(4th) | FAIR |
| 5 | R22 (P001) | 2(5th) | 0(5th) | 2(5th) | 5(4th) | 10(2nd) | POOR | 4(4th) | 25()4th | 0(5th) | 2(4th) | 70(4th) | 3(3rd) | 3(4th) | POOR |
| 6 | F24 (POO 1) | 2(5th) | 2(5th) | 4(4th) | 2(4th) | 19(4th) | POOR | 4(3rd) | 19(4th) | 5(3rd) | 8(2nd) | 80(4th) | 8(2nd) | 8(3rd) | GOOD |
| 7 | F25 (POO 1) | 7(2nd) | 8(3rd) | 8(2nd) | 5(3rd) | 19(4th) | GOOD | 3(2nd) | 21(5th) | 4(4th) | 3(4th) | 73(3rd) | 5(4th) | 2(5th) | FAIR |
| 8 | 1301 (POO 13) | 10(1st) | 12(1st) | 11(1st) | 12(1st) | 9(1st) | BEST | 2(1st) | 9(1st) | 11(1st) | 11(1st) | 63(1st) | 7(3rd) | 10(1st) | BEST |
| 9 | F23 (POO 3) | 5(4th) | 3(4th) | 2(5th) | 2(4th) | 14(2nd) | FAIR | 4(3rd) | 17(3rd) | 0(5th) | 0(5th ) | 71(2nd) | 1(5th) | 3(4th) | POOR |
| 10 | TMEB 419 | 6(3rd) | 9(2nd) | 7(3rd) | 9(2nd) | 16(3rd) | BETTER | 4(3rd) | 11(2ndt) | 10(2nd) | 8(2nd) | 84(5th) | 9(1st) | 9(2nd) | BETTER |
| 11 | 1306 (POO 15) | 8(2nd) | 6(3rd) | 11(1st) | 9(1st) | 11(1st) | BEST | 6(4th) | 15(1st) | 4(3rd) | 5(3rd) | 45(3rd) | 5(4th) | 4(4th) | FAIR |
| 12 | 2207(POO07) | 9(1st) | 8(2nd) | 10(2nd) | 7(2nd) | 14(2nd) | BETTER | 4(2nd) | 20(3rd) | 7(2nd) | 7(2nd) | 47(5th) | 6(2nd) | 6(3rd) | BETTER |
| 13 | F68 (POOO7) | 4(4th) | 1(5th) | 4(4th) | 5(3rd) | 11(1st) | POOR | 5(3rd) | 26(5th ) | 3(5th) | 3(4th) | 41(2nd) | 6(2nd) | 7(2nd) | GOOD |
| 14 | F116 (POO1 | 1(5th) | 5(4th) | 6(3rd) | 5(3rd) | 11(1st) | GOOD | 6(4th) | 24(4th) | 4(3rd) | 3(4th) | 46(4th) | 3(5th) | 1(5th) | POOR |
| 15 | Wonono | 8(2nd) | 12(1st) | 0(5th) | 4(5th) | 17(5th) | FAIR | 3(1st) | 16(2nd) | 12(1st) | 12(1st) | 40(1st) | 12(1st) | 8(1st) | BEST |
| 16 | F44 (POO2) | 1(4th) | 0(4th) | 0(4th) | 0(4th) | 9(1st) | POOR | 3(1st) | 11(1st) | 3(3rd) | 3(3rd) | 50(3rd) | 3(3rd) | 3(3rd) | GOOD |
| 17 | F3(PO17) | 4(2nd) | 3(3rd) | 4(3rd) | 2(3rd) | 11(2nd) | GOOD | 4(2nd) | 15(3rd ) | 0(4th) | 0(4th) | 38(1st) | 1(4th) | 0(4th) | POOR |
| 18 | IBA 00070 | 4(2nd) | 5(2nd) | 6(2nd) | 5(2nd) | 14(3rd) | BETTER | 4(2nd) | 17(4th ) | 6(2nd) | 6(2nd) | 44(2nd) | 7(1st) | 7(1st) | BETTER |
| 19 | Ichenke | 9(1st) | 9(1st) | 8(1st) | 9(1st) | 15(4th) | BEST | 4(2nd) | 12(2nd) | 9(1st) | 9(1st) | 51(4th) | 7(1st) | 7(1st) | BEST |

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