

# Gendered Boiled Cassava Product Profile in Benin – Evidence Base Annex

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

**Abomey-Calavi, Benin, 2022**

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This report has been written in the framework of RTBfoods project.

To be cited as:

**Laurent ADINSI, Laurenda HONFOZO, Sounkoura ADETONAH, Jules BAKPE, Alexandre BOUNIOL, Imayath DJIBRIL MOUSSA, Lora FORSYTHE, Noël AKISSOE,** (2023). *Gendered Boiled Cassava Product Profile in Benin – Evidence Base Annex. Understanding the Drivers of Trait Preferences and the Development of Multi-user RTB Product Profiles, WP1.* Abomey-Calavi, Benin: RTBfoods Database Annex, 26 p, <https://doi.org/10.18167/agritrop/00751>

Url - Dataset – Cirad Dataverse: <https://doi.org/10.18167/DVN1/IPZ74N>

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.

Acknowledgments: This work was supported by the RTBfoods project <https://rtbfoods.cirad.fr>, through a grant OPP1178942: Breeding RTB products for end user preferences (RTBfoods), to the French Agricultural Research Centre for International Development (CIRAD), Montpellier, France, by the Bill & Melinda Gates Foundation (BMGF).

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06/07/2022

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# ABSTRACT

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This report details major steps taken by the UAC-FSA team in Benin to complete the boiled cassava product profile, following the methodology proposed within the work package 1 of the RTBfoods project. This document is to be considered as an annex to the gendered boiled cassava product profile in Benin, <https://doi.org/10.18167/DVN1/IPZ74N>.

**Key Words:** cassava root, processing, boiled cassava, quality characteristic, gender assessment, product profile, market value

# 1 INTRODUCTION

The current report provides a brief evidence base of key evidence to be considered for the WP1 Food Product Profile (FPP) (step 5) for boiled cassava in two areas of Benin. The report will be circulated to a multidisciplinary design team to consider in developing the WP1 FPP.

## 2 STATE OF KNOWLEDGE REVIEW (STEP 1)

Key evidence:

- Iragaba et al (2020) reported that men and women preferred high yield, not bitter, not diseased, early maturing, cook soft and drought resistant varieties.
- The literature provides some information about quality characteristics of raw cassava. The most important criteria for raw cassava are related to the types of variety, the age (maturity) of the root, the root size, the appearance of the peel, the colour of the bark of the root. Apart from these characteristics, the heaviness, the hardness and the colour (whiteness) of the peeled cassava are also important
- Adjebeng-Danquah et al. (2016) reported external colour of root, colour of root pulp, root shape as qualitative traits characterizing some cassava genotypes they studied.
- Cassava roots are consumed in Benin in several forms, including boiled in water, roasted, fried or after conversion into intermediate products, such as gari, flour (from dried chips), tapioca or starch. The boiled cassava is one of the most common form of consumption of cassava root in rural and urban areas (Padonou et al., 2005). It is consumed at all meals and as a snack. The texture, the taste and the colour are the priority traits of boiled cassava. A good boiled cassava must also have a good cassava smell.
- Concerning texture, crumbliness or mealiness is universally cited by consumers as the most important quality attribute of boiled cassava (Asaoka and Blanchard, 1991, Eggleston and Asiedu, 1994, Favaro and Beleia, 2008, Ngeve, 2003).

Some cassava varieties used in Benin

| Local name  | Other local name/ethnicity | Root characteristics |
|-------------|----------------------------|----------------------|
| Adoborou    | Olobêkpê                   | Sweet, very crumbly  |
| Ahotonon    | -                          | Sweet                |
| Ben 86052   | Ben                        | Sweet                |
| Igbèkokpan  | 92B/00068                  | Sweet                |
| Ina Premier | 92/0427                    | Sweet, very crumbly  |
| INA-H       | 92B/00061                  | Sweet                |
| Kpaki Swan  | -                          | Bitter               |
| Maniben-01  | 91/02324                   | Sweet                |
| Maniben-02  | 92/0326                    | Sweet                |
| MR-67       | 92/0067                    | Sweet                |
| Obaïlè      | 92B/0057                   | Sweet                |
| Odongbo     | -                          | Sweet                |
| Maniben-03  | Okò-Iyawo                  | Sweet, very crumbly  |
| Olichutè    | -                          | Sweet, very crumbly  |
| Olobokpo    | 91/02327                   | Sweet                |

(Source: Beninese catalog of plant species)

| Characteristic category  | High quality characteristics | Indicator of characteristic | Driver(s)  | Customer group(s)                   | Preference group(s) | Priority                | Good, high quality varieties | Evidence           |
|--|------------------------------|-----------------------------|--|-------------------------------------|---------------------|-------------------------|------------------------------|--------------------|
| <b>1. Raw material characteristics</b><br><i>(agronomic, post-harvest)</i> | Root size                    | By looking                  | Big roots give more final product and are easy to be processed   | Processors and consumers            | Processors          | Added-value trait       | Agric,                       | KII; SOK reference |
|  | Maturity of the root         | Not available               | A mature roots give a best quality product   | Processors and consumers            | Processors          | Essential trait         | Not available                | KII; SOK reference |
|  | White flesh                  | By looking                  | the colour of the flesh (white) makes the cassava more attractive and is a reason for its adoption by processors and consumers | Processors and consumers            | Consumers           | Added-value trait       | Not available                | KII; SOK reference |
|  | Root hardness                | Not available               | Hardness of the root means that it doesn't contain too much water and must be crumbly once boiled                              | Processors and consumers            | Processors          | Niche opportunity trait | Not available                | KII; SOK reference |
|  | Type of variety              | Not available               | There are specific varieties for making boiled cassava. Actually, each variety is suitable for particular end-products.        | Producers, Processors and consumers | Processors          | Essential trait         |                              | KII; SOK reference |

| Characteristic category  | High quality characteristics | Indicator of characteristic           | Driver(s)  | Customer group(s)  | Preference group(s) | Priority                | Good, high quality varieties | Evidence             |
|--|------------------------------|---------------------------------------|--|--------------------|---------------------|-------------------------|------------------------------|----------------------|
| <b>2 Processing characteristics of raw material for the product quality during processing (technological, physicochemical)</b> | Ease of peeling              | Easy removal of the peel              | Easy removal of the peel is a sign of the root crumbliness. It reduces the time of processing. | Processors (women) | Processors (women)  | Niche opportunity trait | Dossi                        | Processing diagnosis |
|  | White flesh                  | By looking                            | The white colour of the flesh is a kind of added-value to the root.                            | Processors (women) | Processors (women)  | Essential trait         | Dossi, Atinwéwé              | Processing diagnosis |
|  | Ease of cutting              | The intensity of strength used to cut | The processing is less time-consuming.   | Processors (women) | Processors (women)  | Niche opportunity trait | Dossi, Atinwéwé              | Processing diagnosis |
|  | Crumbly                      | By cutting with fingers               | It is the most important (the first) quality trait of the boiled cassava                       | Processors (women) | Processors (women)  | Winning trait           | Dossi, Atinwéwé              | Processing diagnosis |
|  | Cracked flesh after cooking  | By looking                            | If the flesh is cracked after cooking, it means that the boiled cassava piece is crumbly       | Processors (women) | Processors (women)  | Added-value trait       | Dossi                        | Processing diagnosis |
| <b>4 Characteristics of cooked/ready to eat final product (to look at, touch, smell, taste, texture in mouth)</b>              | Crumbliness                  | Flesh desintegration between fingers  | A crumbly boiled cassava piece is easily chewable  | Consumers (W+M+Y)  | Consumers (W+M+Y)   | Essential trait         | Dossi, Atinwéwé              | KII; SOK reference   |
|  | White colour                 | By looking                            | White colour is attractive and gives a market value to the boiled cassava                      | Consumers (W+M+Y)  | Consumers (W+M+Y)   | Added-value trait       | Dossi, Atinwéwé              | KII; SOK reference   |
|  | Sweet taste                  | By tasting                            | When a cassava is not sweet, it is unpleasant to eat. It is therefore necessary trait          | Consumers (W+M+Y)  | Consumers (W+M+Y)   | Essential trait         | Dossi, Atinwéwé              | KII; SOK reference   |
|  | Good cassava smell           | By smelling                           | Smell is an attractive quality trait. It stimulates the desire to eat                          | Consumers (W+M+Y)  | Consumers (W+M+Y)   | Niche opportunity trait | Dossi, Atinwéwé              | Processing diagnosis |

## Relevant gender and livelihoods information from SOK Step 1

|   | <b>Response</b>                             |
|---|---|
| agronomic, processing and sensory characteristics for the crop and product and their importance –including disaggregated by gender and region   | No data on gender aspects where identified. |
| importance of characteristics by gender, region or other social segments (e.g. ethnicity, wealth category), such as citations and rankings  |   |
| characteristics important for the quality of other food products or by products that are important for women, or another social segment   |   |
| characteristics that positively or negatively impact on women’s drudgery (e.g. branching that impacts on weeding, rettability, cooking and sieving time)  |   |
| characteristics that may impact on a major activity for production, use or marketing which women rely on for their use (e.g. a reduction in peeling time could negatively impact women’ paid to peel cassava) |   |
| characteristics that positively or negatively impact on the quality and quantity of the product that would affect women’s income from the sale of the product (e.g. taste, produce yield)                     |   |
| characteristics that would positively or negatively impact on the use of resources (e.g. firewood), particularly on inputs with access constraints for women (including time)                                 |   |
| Note any issues with the research design that may be important for interpreting the results (e.g. the coverage of region, rural/urban, producers/processors/ consumers, gender).                              |   |

## 3 GENDER FOOD MAPPING (STEP 2)

- Methods: 16 FGDs (8 men and 8 women) and 77 IIs (46 women and 31 men) with community members, 8 KII and 8 MI in DANGBO and BONOU districts in Benin.
- Wémè ethnic group dominate both districts and is followed by Goun, Toli, Fon and Yoruba in some areas of the districts. Actually, three ethnic groups predominate in Bonou (Goun, Wémè and Yoruba) while two ethnic groups (Goun and Toli).
- In both districts, men as well as women are involved in cassava production. Men are more involved in cassava sale than women while women are the most involved in processing into derived products.
- Cassava is cultivated either by monocropping (rotation with beans, groundnuts, maize, pepper and tomato) or by intercropping (association with maize or beans) in both districts.
- Men and women have separate plots for cassava growing. However, women can cultivate on their husbands’ lands.
- Cassava is grown for sale, for its high yield, its short growth cycle and its ability to be processed in a diversity of products.
- Both men and women prefer the variety Agric, whatever the region.

**Varieties grown in order of importance (II Q15.1)**

| Importance      | Gender      |                   | Region    |                   |
|-----------------|-------------|-------------------|-----------|-------------------|
|                 | Men         | Women             | Bonou     | Dangbo            |
| 1 <sup>st</sup> | Agric       | Agric             | Kpèkè     | Agric             |
| 2 <sup>nd</sup> | Dossi       | Dossi             | Attinwéwé | Dossi             |
| 3 <sup>rd</sup> | Kpèkè       | Attinwéwé         | Agoula    | Hanmadou/Gbomadou |
| 4 <sup>th</sup> | Agoula      | Kpèkè             | Agric     | Adjaha            |
| 5 <sup>th</sup> | Ahotonontin | Hanmadou/Gbomadou | Dossi     | Djègodotin        |

- The importance of other varieties depends on gender and regions. In the district of Bonou, varieties “Kpèkè” and “Attinwéwé” were the first two important whereas irrespective of the regions, these varieties were the third most important for men and women, respectively.

**Characteristics of a good cassava (II Q14) table 11 in full report**

| Importance      | Gender              |                                 | Region                          |                       |
|-----------------|---------------------|---------------------------------|---------------------------------|-----------------------|
|                 | Men                 | Women                           | Bonou                           | Dangbo                |
| 1 <sup>st</sup> | Cracked peel        | Cracked peel                    | Cracked peel                    | Cracked peel          |
| 2 <sup>nd</sup> | White flesh         | Heavy roots                     | Heavy roots                     | Big roots             |
| 3 <sup>th</sup> | Big root            | White flesh                     | Many roots                      | Dark/black/red peel   |
| 4 <sup>th</sup> | Heavy roots         | Big roots                       | White flesh                     | White flesh           |
| 5 <sup>th</sup> | Many roots          | Many roots                      | Short growth cycle (5–7 months) | Good production yield |
| 6 <sup>th</sup> | Dark/black/red peel | Short growth cycle (5–7 months) | Big roots                       | Heavy roots           |

- **Important considerations:** men are those who make the decision about the variety of cassava to grow. Women have to consult them before growing cassava. Regarding the way that cassava will be used among the different products, both men and women make the decision. Indeed, the majority of decisions about what will be consumed at home or sold is made by men alone in district of Dangbo whereas men associate women in these decisions making in the district of Bonou.
- Demand: cassava prices fall. This situation causes more domestic consumption and processing than sale which is preferably made on the whole than in details because the whole is more profitable.

## Overview of cassava roots quality characteristics raw and during processing

| Items  | Characteristics                                  | Frequency<br>(%, n = 77) | Citation<br>ranking (%) |       |
|--|--|--------------------------|-------------------------|-------|
|  |  |                          | Men                     | Women |
| A good cassava <b>VARIETY</b> for making a <b>HIGH-QUALITY</b> product? By looking at it, by touching, by smelling or by tasting it? (Q20) | Cracked peel                                     | 59                       | 34                      | 37    |
|  | Sweet/slightly sweet*                            | 31                       | 16                      | 17    |
|  | White flesh                                      | 21                       | 7                       | 11    |
|  | Crumbly peel                                     | 18                       | 8                       | 10    |
|  | Smooth/without buds/without holes peel           | 13                       | 5                       | 7     |
|  | Thick peel*                                      | 13                       | 5                       | 0     |
|  | Low humidity*                                    | 9                        | 7                       | 0     |
|  | Red/pink/dark/black peel                         | 9                        | 3                       | 7     |
|  | Middle size*                                     | 5                        | 6                       | 1     |
| Characteristics of the <b>VARIETY</b> that give a <b>POOR QUALITY</b> product so that you would not use or buy it? (Q21)                   | Clear/clean peel                                 | 5                        | 2                       | 3     |
|  | Bitter*  | 36                       | 25                      | 14    |
|  | Smooth peel                                      | 35                       | 22                      | 21    |
|  | High humidity*                                   | 23                       | 16                      | 8     |
|  | Fibrous  | 23                       | 12                      | 11    |
|  | Black/dark peel                                  | 15                       | 6                       | 11    |
|  | Yellow flesh                                     | 14                       | 9                       | 6     |
|  | Rough peel                                       | 8                        | 2                       | 5     |
|  | Sticky peel                                      | 8                        | –                       | –     |
| Characteristics that show it has good <b>PROCESSING ABILITY</b> into the <b>BOILED CASSAVA</b> (Q23)                                       | Big root   | 5                        | 4                       | 2     |
|  | Brittle fiber                                    | 5                        | 1                       | 3     |
|  | Good smell                                       | 60                       | 35                      | 30    |
|  | White flesh                                      | 34                       | 17                      | 18    |
|  | White and gluey cooking water                    | 25                       | 8                       | 9     |
|  | Presence of foam on surface of the cooking water | 23                       | 11                      | 10    |
|  | Easy to peel                                     | 21                       | 9                       | 10    |
|  | Crumbly/easy to break/soft cassava               | 20                       | 6                       | 9     |
|  | Cracked flesh*                                   | 19                       | 4                       | 10    |
| Low humidity   | 9  | 3                        | 2                       |       |
| Easy to cut*   | 5  | 6                        | 1                       |       |

Note: \* significant difference between the men and women at 5% (p-value<0.05)

## Quality characteristics of boiled cassava

| Items  | Characteristics            | Frequency (% , n = 77) | Citation ranking (%) |       |
|--|----------------------------|------------------------|----------------------|-------|
|  |                            |                        | Men                  | Women |
| Characteristics of a <b>HIGH-QUALITY BOILED CASSAVA</b> <u>PRIOR TO CONSUMPTION</u> (Q28)                | Crumbly/easy to break/soft | 98.8                   | 46                   | 51    |
|  | White flesh                | 71.3                   | 26                   | 26    |
|  | Good smell of cassava      | 32.5                   | 10                   | 11    |
|  | Attractive/clean           | 13.8                   | 10                   | 3     |
|  | Without fibers             | 11.3                   | 4                    | 3     |
| Characteristics of a <b>HIGH-QUALITY BOILED CASSAVA IN THE MOUTH</b> and how do you evaluate it? (Q28.1) | Sweet                      | 80.0                   | 41                   | 39    |
|  | Crumbly/easy to break/soft | 75.0                   | 37                   | 31    |
|  | Easy to chew               | 26.3                   | 4                    | 9     |
|  | Good smell of cassava      | 25.0                   | 8                    | 5     |
|  | No sticky                  | 17.5                   | 4                    | 6     |
| Characteristics of a <b>POOR-QUALITY BOILED CASSAVA</b> when we eat it? (Q29)                            | Good taste                 | 15.0                   | 5                    | 7     |
|  | Sticky                     | 7.5                    | –                    | –     |
|  | Bitter taste               | 72.5                   | 44.2                 | 37.1  |
|  | Hard                       | 37.5                   | 23.9                 | 18.8  |
|  | Fibrous                    | 26.3                   | 11.6                 | 11.7  |
|  | Yellow/yellowish flesh     | 20.0                   | 5.1                  | 10.3  |
|  | Difficult to chew          | 15.0                   | 1.4                  | 10.3  |
|  | Dark/red/black flesh       | 13.8                   | 5.8                  | 7.0   |

- At harvest, a part of cassava is sold fresh, another part is boiled for home consumption and the rest is processed into diverse products within the household.
- In the district of Bonou and Dangbo, boiled cassava is not sold. It is only processed for home consumption and at field except in some villages where it is sold.
- Boiled cassava is more consumed in rural areas than towns or urban areas.
- Demand segments:
  - In Bonou (village of Adido) and Dangbo (villages of Akpamè, Honmè and Zounta), a part of boiled cassava processed is sold in front of hospitals, near the road, at school, and at markets.
  - The proportion of people of villages who consume boiled cassava is higher in Dangbo contrary to Bonou.

| Characteristic category  | High quality characteristics         | Indicator of characteristic    | Driver(s)   | Customer group(s)     | Preference group(s) | Priority                | Good, high quality varieties | Evidence              |
|--|--------------------------------------|--------------------------------|---|-----------------------|---------------------|-------------------------|------------------------------|-----------------------|
| <b>1. Raw material characteristics</b><br><i>(agronomic, post-harvest)</i>   | Cracked peel                         | The removal of the peel        | It is a sign of cassava crumbliness   | Producers, Processors | Producers           | Niche opportunity trait | Not available                | Individual Interviews |
|  | White flesh                          | By looking                     | White colour is more attractive. A white flesh cassava is most of the time crumbly    | Producers, Processors | Producers           | Essential trait         | Dossi, Atinwéwé              | Individual Interviews |
|  | Heavy roots                          | By holding in hands            | If the root is heavy, it means that it has low humidity and must therefore be crumbly | Producers, Processors | Producers           | Niche opportunity trait | Not available                | Individual Interviews |
|  | Big roots                            | By looking                     | Sign of maturity  | Producers, Processors | Producers           | Added-value trait       | Not available                | Individual Interviews |
|  | Dark/black/red peel                  | By looking                     | Not available   | Producers, Processors | Producers           | Niche opportunity trait | Dossi, Atinwéwé              | Individual Interviews |
|  | Short grown cycle (5-7 months)       | Early maturing                 | the early availability of the cassava   | Producers, Processors | Producers           | Niche opportunity trait | Not available                | Individual Interviews |
| <b>2 Processing characteristics</b><br><i>of raw material for the product quality during processing (technological, physicochemical)</i> | Good smell of cassava                | By smelling                    | It is a attractive quality characteristic   | Processors            | Processors          | Added-value trait       | Dossi, Atinwéwé              | Individual Interviews |
|  | White flesh                          | By looking                     | It is a sign of cassava crumbliness   | Processors            | Processors          | Essential trait         | Dossi, Atinwéwé              | Individual Interviews |
|  | White and gluey/heavy cooking water  | By pouring the water in a bowl | Not available   | Processors            | Processors          | Niche opportunity trait | Not available                | Individual Interviews |
|  | Foam on the surface of cooking water | By looking                     | Not available   | Processors            | Processors          | Niche opportunity trait | Not available                | Individual Interviews |

| Characteristic category   | High quality characteristics       | Indicator of characteristic                          | Driver(s)   | Customer group(s) | Preference group(s) | Priority                | Good, high quality varieties | Evidence              |
|---|------------------------------------|--|---|-------------------|---------------------|-------------------------|------------------------------|-----------------------|
|   | Easy to peel                       | Easy removal of the root's peel                      | This means that the cassava will be crumbly once boiled | Processors        | Processors          | Niche opportunity trait | Dossi, Atinwéwé              | Individual Interviews |
|   | Crumbly/easy to break/soft cassava | Ease of cassava slice desintegration between fingers | The cassava slices require less effort for chewing      | Processors        | Processors          | Essential trait         | Dossi, Atinwéwé              | Individual Interviews |
|   | Cracked flesh                      | By looking   | It is related to crumbliness                            | Processors        | Processors          | Niche opportunity trait | Dossi, Atinwéwé              | Individual Interviews |
|   | Low humidity                       | Absence of water on the root during peeling          | It indicates the high quality of the cassava            | Processors        | Processors          | Essential trait         | Dossi, Atinwéwé, Agric       | Individual Interviews |
|   | Easy to cut                        | Cutting involves less strength                       | Not available   | Processors        | Processors          | Essential trait         | Dossi, Atinwéwé              | Individual Interviews |
| <b>4 Characteristics of cooked/ready to eat final product</b> (to look at, touch, smell, taste, texture in mouth) | Crumbly/easy to break/soft cassava | Ease of cassava slice desintegration between fingers | The cassava slices require less effort for chewing      | Consumers (M+W+Y) | Consumers (M+W)     | Essential trait         | Dossi, Atinwéwé              | Individual Interviews |
|   | White flesh                        | By looking   | It is a sign of cassava crumbliness                     | Consumers (M+W+Y) | Consumers (M+W)     | Niche opportunity trait | Dossi, Atinwéwé              | Individual Interviews |
|   | Good smell of cassava              | By smelling  | It is a attractive quality characteristic               | Consumers (M+W+Y) | Consumers (M+W)     | Added-value trait       | Dossi, Atinwéwé              | Individual Interviews |
|   | Attractive/clean                   | By looking   | It raises up the desire to eat                          | Consumers (M+W+Y) | Consumers (M+W)     | Essential trait         | Dossi, Atinwéwé              | Individual Interviews |

| Characteristic category | High quality characteristics | Indicator of characteristic           | Driver(s)                                       | Customer group(s) | Preference group(s) | Priority                | Good, high quality varieties | Evidence              |
|-------------------------|------------------------------|---------------------------------------|---|-------------------|---------------------|-------------------------|------------------------------|-----------------------|
|                         | Without fibres               | By looking                            | Not available                                   | Consumers (M+W+Y) | Consumers (M+W)     | Niche opportunity trait | Dossi, Atinwéwé              | Individual Interviews |
|                         | Sweet/good taste             | By tasting                            | A boiled cassava which is not sweet is rejected | Consumers (M+W+Y) | Consumers (Y)       | Added-value trait       | Dossi, Atinwéwé              | Individual Interviews |
|                         | Easy to chew                 | Duration of chewing before swallowing | Less strength is involved during eating         | Consumers (M+W+Y) | Consumers (M+W+Y)   | Essential trait         | Dossi, Atinwéwé              | Individual Interviews |
|                         | Not sticky                   | Not sticks to the teeth               | No inconvenience is caused                      | Consumers (M+W+Y) | Consumers (M+W)     | Niche opportunity trait | Dossi, Atinwéwé              | Individual Interviews |

## Relevant gender and livelihoods information from Gendered Food Mapping Step 2

|   | Response  |
|---|---|
| Characteristics important by gender, region or other social segments (e.g. ethnicity, wealth category), such as citations and rankings  | Men and women are all agree on cracked peel, heavy roots, white flesh, big roots, many roots on a cassava tree as characteristics of a good cassava. Only women mentioned short growth cycle while only men cited the darkness or the red/black colour of the peel. Regardless the region, cracked peel is the most important characteristic. It is followed by big roots in Dangbo and heavy roots at Bonou.   |
| Characteristics important for the quality of other food products or by products that are important for women, or another social segment   | Roots with high maturity are suitable for products like gari, klaklou and tapioca   |
| Characteristics that positively or negatively impact on women's drudgery (e.g. branching that impacts on weeding, rettability, cooking and sieving time)  | The varieties which peel sticks to the flesh causes a difficult peeling which is time consuming   |
| Characteristics that may impact on a major activity for production, use or marketing which women rely on for their use (e.g. a reduction in peeling time could negatively impact women' paid to peel cassava) | No information  |
| Characteristics that positively or negatively impact on the quality and quantity of the product that would affect women's income from the sale of the product (e.g. taste, produce yield)                     | Cooking step is controlled to limit the water absorption of cassava pieces because if the optimum cooking time is exceeded, the pieces may be overcooked due to water absorption and consequently the women's income decreases. When salt is added at the beginning of the cooking step, the cassava pieces may become non crumbly. The dominant high quality characteristics (crumbly, sweet and white colour) contributed to increase the market value of boiled cassava pieces and consequently the women's income |
| Characteristics that would positively or negatively impact on the use of resources (e.g. firewood), particularly on inputs with access constraints for women (including time)                                 | Hard to break is considered by the women as important characteristic that impacts the firewood required to boil cassava. Indeed, when the boiled cassava is too hard to break or cut, it means that the cooking step required more firewood for softening a little bit the boiled cassava pieces.   |

## 4 PROCESSING DEMONSTRATIONS & DIAGNOSTICS (STEP 3)

- Methods: Six cassava varieties with contrasting characteristics were processed by six skilled processors and the raw cassava characteristics, the unit operations of boiled cassava preparation and quality characteristics of cassava at each step of preparation into boiled cassava were gathered.
- Unit operations of boiled cassava processing were carried out exclusively by women.
- The root should be long with thin lines on its peel. The parenchyma should be pink and the flesh colour, white. The flesh must have a given level of moisture and firmness.
- The ease of peeling, the viscosity of cooking water, the whiteness of the cassava, the cracked flesh of cassava during cooking were the characteristics considered to select the best preferred varieties or to reject the least preferred ones.
- Dossi and Atinwéwé are considered high quality, Agric/Adjaha is considered intermediate quality while Alanmandou and Koléahonmè are considered poor quality cassava for making boiled cassava.
- The weight of cassava pieces varies from 48.7 to 116.6 gram.
- The cooking time varies between 27.8 and 37.6 minutes.
- The dry matter content varies between 18.57 to 39.97.
- The yield (% db) of cooking unit operation varies between 70.6 and 166.2.

### End-products descriptors collected after processing and evaluating by each processor

| Colour  |   | Textural   |  | Taste        |                 | Flavour       |  |
|---|---|--|--|--------------|-----------------|---------------|--|
| High quality  | Poor quality  | High quality   | Poor quality   | High quality | Poor quality    | High quality  | Poor quality   |
| White<br>Dirty white<br>Attractive<br>Light yellow on the surface | Yellowish<br>Yellow<br>Not attractive<br>Translucent/glassy<br>Viscous water on the surface | Crumbly<br>Easy to break<br>Not sticky in hand<br>No fibers<br>Tender<br>No water<br>Do not stick in mouth | Hard<br>Unbreakable<br>Sticky<br>Gluey<br>Elastic<br>Fibrous<br>Watery<br>No tender<br>Stick to the teeth<br>Not crumbly | Sweet        | Bitter<br>Bland | Cassava odour | Unpleasant smell of boiled cassava<br>No cassava odour |

The length of the root, the presence of lines on the root's peel, the pink colour of the parenchyma, the white flesh of the root, the humidity and the firmness of the root were the characteristics considered by processors for selection of the best cassava varieties.

## Synthesis of main quantitative data collected

| Varieties         | Weight_raw cassava (g) | Length_raw cassava (cm) | Dry matter_raw cassava (%) | Peeling Productivity (kg/h/op) | Cooking time (min) | Cooking Yield (% d.b) | Processing Yield (% w.b) |
|-------------------|------------------------|-------------------------|----------------------------|--------------------------------|--------------------|-----------------------|--------------------------|
| Alanmandou        | 464.5 <sup>b</sup>     | 35.5 <sup>a</sup>       | 37.91 <sup>a</sup>         | 15.8 <sup>b</sup>              | 27.8 <sup>a</sup>  | 91.4 <sup>e</sup>     | 79.5 <sup>a</sup>        |
| Adjaha            | 277.9 <sup>c</sup>     | 29.6 <sup>a, b</sup>    | 21.17 <sup>c, d</sup>      | 9.3 <sup>b</sup>               | 30.6 <sup>a</sup>  | 155.8 <sup>b</sup>    | 71.4 <sup>b, c</sup>     |
| Agric             | 279.3 <sup>c</sup>     | 27.2 <sup>b</sup>       | 18.57 <sup>d</sup>         | 11.7 <sup>b</sup>              | 37.6 <sup>a</sup>  | 166.2 <sup>a</sup>    | 66.6 <sup>c</sup>        |
| Koleahome         | 1245.1 <sup>a</sup>    | 31.8 <sup>a, b</sup>    | 30.08 <sup>b</sup>         | 27.5 <sup>a</sup>              | 35.8 <sup>a</sup>  | 106.2 <sup>d</sup>    | 77.5 <sup>a, b</sup>     |
| Atinwewe          | 601.1 <sup>b</sup>     | 30.6 <sup>a, b</sup>    | 24.05 <sup>c</sup>         | 15.6 <sup>b</sup>              | 31.6 <sup>a</sup>  | 119.8 <sup>c</sup>    | 82.0 <sup>a</sup>        |
| Dossi             | 170.3 <sup>c</sup>     | 25.1 <sup>b</sup>       | 39.97 <sup>a</sup>         | 13.4 <sup>b</sup>              | 28.6 <sup>a</sup>  | 70.6 <sup>f</sup>     | 78.5 <sup>a</sup>        |
| <i>Mean Value</i> | <i>506.4</i>           | <i>30.0</i>             | <i>28.63</i>               | <i>15.5</i>                    | <i>32.0</i>        | <i>118.3</i>          | <i>75.9</i>              |

| Characteristic category   | High quality characteristics | Indicator of characteristic                           | Driver(s)  | Customer group(s)  | Preference group(s) | Priority          | Good, high quality varieties   | Evidence                    |
|---|------------------------------|---|--|--------------------|---------------------|-------------------|--------------------------------|-----------------------------|
| <b>1. Raw material characteristics</b><br>(agronomic, post-harvest)   | Long root                    | By looking  | Not available  | Processors         | Women               | Essential         | Dossi, Atinwéwé                | Processing diagnosis Step 3 |
|   | Thin lines on the peel       | By looking  | It is a trait of high quality cassava  | Processors         | Women               | Essential         | Dossi, Atinwéwé                | Processing diagnosis Step 3 |
|   | Pink parenchyma              | By looking after skinning the first layer of the peel | It is a trait of high quality cassava  | Processors         | Women               | Essential         | Dossi, Atinwéwé                | Processing diagnosis Step 3 |
|   | White flesh                  | By looking  | White flesh cassava is a crumbly cassava   | Processors         | Women               | Added-value       | Dossi, Atinwéwé                | Processing diagnosis Step 3 |
|   | Humid root                   | By appreciating the quantity of water on the knife    | Not available  | Processors         | Women               | Niche opportunity | Dossi, Atinwéwé                | Processing diagnosis Step 3 |
|   | Firm root                    |   | Not available  | Processors         | Women               | Niche opportunity | Dossi, Atinwéwé                | Processing diagnosis Step 3 |
| <b>2 Processing characteristics</b><br>of raw material for the product quality during processing (technological, physicochemical) | Ease of peeling              | Easy removal of the peel                              | Easy removal of the peel is a sign of the root crumbliness. It reduces the time of processing. | Processors (women) | Processors (women)  | Niche opportunity | Dossi, Atinwéwé, Agric         | Processing diagnosis Step 3 |
|   | White flesh                  | By looking  | The white colour of the flesh is a kind of added-value to the root.                            | Processors (women) | Processors (women)  | Essential         | Dossi, Atinwéwé                | Processing diagnosis Step 3 |
|   | Ease of cutting              | The intensity of strength used to cut                 | The cutting is less time-consuming.  | Processors (women) | Processors (women)  | Niche opportunity | Dossi, Atinwéwé, Agric/ Adjaha | Processing diagnosis Step 3 |
|   | Crumbly                      | By cutting with fingers                               | It is the most important (the first) quality trait of the boiled cassava                       | Processors (women) | Processors (women)  | Winning           | Dossi, Atinwéwé                | Processing diagnosis Step 3 |

| Characteristic category   | High quality characteristics | Indicator of characteristic                          | Driver(s)  | Customer group(s)  | Preference group(s) | Priority          | Good, high quality varieties        | Evidence                    |
|---|------------------------------|--|--|--------------------|---------------------|-------------------|-------------------------------------|-----------------------------|
|   | Cracked flesh after cooking  | By looking   | If the flesh is cracked after cooking, it means that the boiled cassava piece is crumbly | Processors (women) | Processors (women)  | Added-value       | Dossi                               | Processing diagnosis Step 3 |
| <b>4 Characteristics of cooked/ready to eat final product</b> (to look at, touch, smell, taste, texture in mouth) | Crumbly                      | Ease of cassava slice desintegration between fingers | The cassava slices require less effort for chewing                                       | Consumers          | Women               | Winning           | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |
|   | Attractive                   | By looking   | It raises up the desire to eat   | Consumers          | Women               | Essential         | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |
|   | White flesh                  | By looking   | It is a sign of cassava crumbliness  | Consumers          | Women               | Added-value       | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |
|   | Sweet taste                  | By tasting   | A boiled cassava which is not sweet is rejected  | Consumers          | Youth               | Added-value       | Dossi, Atinwéwé, Adjaha, Alanmandou | Processing diagnosis Step 3 |
|   | Good cassava smell           | By smelling  | It is a attractive quality characteristic  | Consumers          | Men, Women          | Essential         | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |
|   | Easy to break                | By cutting with fingers                              | Less strength is required  | Consumers          | Youth               | Niche opportunity | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |
|   | No fibres                    | By looking   | Not available  | Consumers          | Men, Women, Youth   | Niche opportunity | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |
|   | Not sticky in hands          | By holding in hands                                  | No inconvenience is caused   | Consumers          | Men, Women          | Niche opportunity | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |
|   | Not sticky in mouth          | Not stick to teeth                                   | No inconvenience is caused   | Consumers          | Men, Women          | Niche opportunity | Dossi, Atinwéwé                     | Processing diagnosis Step 3 |

### Relevant gender and livelihoods information from Processing diagnosis 3

|  | <b>Response</b>  |
|--|--|
| agronomic, processing and sensory characteristics for the crop and product and their importance –including disaggregated by gender and region  | The study was carried out in one region and Gender was unspecified. All processors are women   |
| importance of characteristics by gender, region or other social segments (e.g. ethnicity, wealth category), such as citations and rankings   | Social segment was not considered in this study  |
| characteristics important for the quality of other food products or by products that are important for women, or another social segment  | No information   |
| characteristics that positively or negatively impact on women's drudgery (e.g. branching that impacts on weeding, retrainability, cooking and sieving time)  | The ease of peeling and cutting increase the boiled cassava productivity. If salt is added at the beginning of the cooking, the boiled cassava doesn't cook well (it is not soft enough) |
| characteristics that may impact on a major activity for production, use or marketing which women rely on for their use (e.g. a reduction in peeling time could negatively impact women's paid to peel cassava) | No information   |
| characteristics that positively or negatively impact on the quality and quantity of the product that would affect women's income from the sale of the product (e.g. taste, produce yield)                      | Crumbliness and sweet taste increase women's income for boiled cassava. Inversely, bitter taste is considered as source of rejection.  |
| characteristics that would positively or negatively impact on the use of resources (e.g. firewood), particularly on inputs with access constraints for women (including time)                                  | No-crumbliness varieties require a lot of wood fire while collecting wood is tiresome for the women. The scarcity of drinking water is considered as drudgery for women processors       |
| Note any issues with the research design that may be important for interpreting the results (e.g. the coverage of region, rural/urban, producers/processors/ consumers, gender).                               | The research design was focused on the women, they are the actors of boiled cassava processing.  |

## 5 CONSUMER TESTING IN RURAL AND URBAN AREAS (STEP 4)

- The high quality characteristics of boiled cassava are in order of importance: crumbly/ easy to break/soft, white colour, sweet taste, good cassava smell.
- The Low quality characteristics of boiled cassava are in order of importance: hard in mouth, yellow colour, bitter taste.

### Quality characteristics from CATA

| Quality characteristics from CATA | Gender       | Location (Rural, Urban) |
|-----------------------------------|--------------|-------------------------|
| Bitter taste (P)                  | 0,052        | 0,998                   |
| Crumbly/easy to break/soft (H)    | 0,000        | 1,588                   |
| sweet taste* (H)                  | <b>5,719</b> | <b>4,261</b>            |
| Hard in mouth (P)                 | 1,858        | 0,609                   |
| white colour (H)                  | 0,564        | 0,244                   |
| Good cassava smell (H)            | 0,002        | 0,262                   |
| yellow colour (P)                 | 0,265        | 0,013                   |

P-value in bold highlighted the quality characteristic which is significant

Asterix (\*) indicate that the quality characteristics was highly and significantly cited by men

P: Poor quality characteristics; H: High quality characteristics

| Characteristic category   | High quality characteristics | Indicator of characteristic                          | Driver(s)  | Customer group(s) | Preference group(s) | Priority          | Good, high quality varieties | Evidence                 |
|---|------------------------------|--|--|-------------------|---------------------|-------------------|------------------------------|--------------------------|
| <b>4 Characteristics of cooked/ready to eat final product</b> (to look at, touch, smell, taste, texture in mouth) | Crumbly in hands             | Ease of cassava slice desintegration between fingers | The cassava slices require less effort for chewing | Consumers         | Women               | Winning           | Dossi, Atinwéwé              | Consumer testing, step 4 |
|   | Attractive                   | By looking   | It raises up the desire to eat                     | Consumers         | Women               | Essential         | Dossi, Atinwéwé              | Consumer testing, step 4 |
|   | White flesh                  | By looking   | It is a sign of cassava crumbliness                | Consumers         | Women               | Added-value       | Dossi, Atinwéwé              | Consumer testing, step 6 |
|   | Sweet taste                  | By tasting   | A boiled cassava which is not sweet is rejected    | Consumers         | Youth               | Added-value       | Dossi, Atinwéwé              | Consumer testing, step 4 |
|   | Good cassava smell           | By smelling  | It is a attractive quality characteristic          | Consumers         | Men, Women          | Essential         | Dossi, Atinwéwé, Alanmandou  | Consumer testing, step 4 |
|   | Easy to break with hand      | By cutting with fingers                              | Less strength is required                          | Consumers         | Youth               | Niche opportunity | Dossi, Atinwéwé              | Consumer testing, step 4 |
|   | Sticky between fingers       | By pressing between fingers                          | Not available                                      | Consumers         | Men, Women          | Niche opportunity | Dossi, Atinwéwé              | Consumer testing, step 4 |
|   | White outside, yellow inside | By looking   | It's an attractive characteristic                  | Consumers         | Men, Women          | Essential         | Dossi, Atinwéwé              | Consumer testing, step 4 |
|   | Crumbly in mouth             | Ease of cassava slice desintegration in mouth        | The cassava slices require less effort for chewing | Consumers         | Women               | Winning           | Dossi, Atinwéwé              | Consumer testing, step 4 |
|   | No fibres                    | By looking   | Not available                                      | Consumers         | Men, Women, Youth   | Niche opportunity | Dossi, Atinwéwé              | Consumer testing, step 4 |

## 6 SECTION 5: TRIANGULATION AND SUMMARY TABLE

For this triangulation, the quality traits gathered from four previous steps were considered by UAC-FSA team (Benin) involved in WP1 and WP2 activities. **Product State**

| Quality traits        | Indicator of characteristics    | Priority   | Rank              | Gender impact scores (G+ tools) |              |                             |                                     | Good high quality variety |
|-----------------------|---------------------------------|--|-------------------|---------------------------------|--------------|-----------------------------|-------------------------------------|---------------------------|
|                       |                                 |  |                   | <u>Do</u>                       |              | <u>no</u>                   |                                     |                           |
|                       |                                 |  |                   | <u>harm</u><br><u>Score</u>     | <u>Score</u> | <u>harm</u><br><u>Score</u> | <u>Score</u>                        |                           |
| <b>Raw cassava</b>    | Cracked and clear peel          | By looking   | Essential         | 2                               | 0            | 2                           | Dossi                               |                           |
|                       | White flesh                     | By looking   | Added value       | 1                               | 0            | 2                           | Dossi, Atinwéwé                     |                           |
|                       | Big roots/ roots size           | By looking   | Essential         | 4                               | 1            | 0                           | Atinwéwé                            |                           |
|                       | Red/pink/dark/black peel        | By looking   | Essential         | 3                               | 0            | 1                           | Dossi                               |                           |
| <b>Processing</b>     | Good smell                      | By smelling  | Added value       | 5                               | 0            | 2                           | Dossi, Atinwéwé                     |                           |
|                       | White flesh                     | By looking   | Essential         | 1                               | 0            | 2                           | Dossi, Atinwéwé                     |                           |
|                       | Easy to peel                    | Easy removal of the peel                                 | Niche opportunity | 2                               | 0            | 2                           | Dossi, Atinwéwé, Agric              |                           |
|                       | Crumbly/easy break/soft cassava | to By cutting/breaking with fingers                      | Winning           | 6                               | 0            | 2                           | Dossi                               |                           |
|                       | Easy to cut                     | The intensity of strength used to cut                    | Niche opportunity | 3                               | 1            | 3                           | Dossi, Adjaha, Atinwéwé, Agric      |                           |
|                       | Cracked flesh                   | By looking   | Added value       | 4                               | 0            | 2                           | Dossi, Atinwéwé                     |                           |
| <b>Boiled cassava</b> | Crumbly/easy break/soft         | to Ease of cassava slices desintegration between fingers | winning           | 3                               | 0            | 2                           | Dossi, Atinwéwé                     |                           |
|                       | White flesh                     | By looking   | Essential         | 1                               | 0            | 2                           | Dossi                               |                           |
|                       | Good smell of cassava           | By smelling  | Essential         | 6                               | 0            | 2                           | Dossi, Atinwéwé, Alanmandou         |                           |
|                       | Attractive                      | By looking   | Essential         | 2                               | 0            | 2                           | Dossi                               |                           |
|                       | Without fibers                  | By looking   | Niche opportunity | 4                               | 0            | 2                           | Dossi, Atinwéwé                     |                           |
|                       | Sweet                           | By tasting   | Added value       | 3                               | 0            | 2                           | Dossi, Alanmandou, Adjaha, Atinwéwé |                           |

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