Standard Operating Procedure

Farmer-based Assessment of End-User Root Quality Traits for "Boiled" and "Flour-Based" Cassava Food Products in Uganda

Root Crops Program

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1.0 Introduction

Ultimate users of a product and/or technology have a final veto. Thus, this manual is intended to guide actions undertaken during harvesting, processing and assessing end-user root quality of cassava clones under evaluation in farmers' fields. For this purpose, we employed the triadic comparison of technologies (TRICOT) methods that optimally embraces opinions of critical stakeholders in technology approval.

Farmers were purposively selected from six districts of Uganda namely: Mityana (central region), Luweero (central region), Arua (west Nile region), Dokolo (eastern region), Serere (eastern region) and Kaberamaido (eastern region). These regions represent major cassava production areas where the two target product profiles ("*boiled cassava roots*" and "*flour-based cassava meal"*) are predominant.

In each of these districts, 40 farmers were selected to participate in the TRICOT, making a total of 240 farmers. Altogether, these farmers established 12 best-bet clones on their farms, each farmer having a maximum of three clones, each represented by 18 plants.
It is these clones that are due for harvest. Thus, the aim of this manual is to highlight and guide procedures to be undertaken at harvesting, processing and assessing the end-user root qualities.

For simplicity, the manual is divided into two sections: section one exclusively focusses on farmers whose primary target product is "*boiled cassava roots*", while section two focusses on farmers whose target is both "*boiled cassava roots*" and "*flour-based cassava meal*" food products. Because each product involves varied processing methods, only key attributes (or traits) of raw, processed and final product are considered herein.

2.0   Critical Attributes of Raw, Processed and Final Products

Preparing each of the target products "*boiled cassava roots*" or "*flour-based cassava meal*" involves distinct actions. Consequently, there are different set desired attributes (or traits) by end-users. Table 1 highlights a list of traits that will be considered for each of cassava product profiles.

Table 1:   Critical attributes to be assessed for raw, processed and final cassava products from TRICOT trials[1]

Boiled cassava roots		Flour-based cassava meal	
At harvest (Raw form)	Root shape	At harvest (Raw form)	Root shape
	Root size		Root size
	Root yield		Root yield
	Disease resistance		Disease resistance
	Quality of stems		Quality of stems
	Cortex color		Cortex color
	Overall liking		Overall liking
Processing (Processed form)	Ease of peeling	Processing (Processed form)	Ease of peeling
			Ease of drying
			Ease of mingling
			Stickiness
Final product (Boiled roots)	Cooking time	Final product (Four-based cassava meal)	Taste
	Mealiness		Colour
	Taste		Texture
	Softness		Overall liking
	Fibrousness		
	Overall liking		

[1]**Stickiness** refers to holding together while mixing and/or mingling;
Cooking time refers to how well it cooks within a specified time;
Mealiness (*akukumuka*) refers to by being dry and crumbly like boiled egg york;
Softness refers to the amount of force used to bite the cooked roots (how hard or soft the cassava is while biting the boiled roots);
Fibrousness refers to feeling of threads/fibres as you chew;
Texture refers to overall feeling when being consumed.

Cortex color

"Boiled cassava roots" will be assessed in all six districts, while "flour-based cassava meal" will be assessed in Arua, Kaberamaido and Serere districts.

2.1 Requirements

a) Harvesting

- Ribbons (Yellow, orange and purple) for ease of labelling
- Hand hoe
- Labelled bags (preferably of three different colors)

b) Processing

- Knife
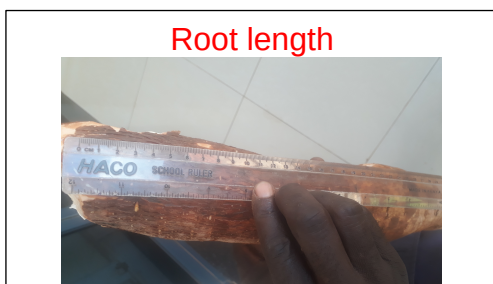- Labelled bags (preferably of three different colors)

c) Preparing "boiled roots" or "flour-based meal"

- Saucepans
- Source of fire
- Water
- Labelled plates (preferably of three different colors)
- Moisture meters for flour-based teams

2.3 Assessing boiled cassava roots

2.3.1 Procedure for harvesting

a) Ensure all plots are properly labelled with their respective letter codes and ribbon colors.

b) Uproot 2-5 plants from plot A to ensure there are at least 5 marketable roots (i.e., roots >16 cm in length or diameter > 3 cm). All harvested roots should be placed at the label "Plot A"

c) Uproot 2-5 cassava plants from plot B; this should provide you with at least 5 marketable roots (i.e., roots >16 cm in length or diameter > 3 cm). All harvested roots should be placed at the label "Plot B"

d) Uproot 2-5 cassava plants from plot C this should provide you with at least 5 marketable roots (i.e., roots >16 cm in length or diameter > 3 cm). All harvested roots should be placed at the label "Plot C"

Root length

Root diameter

4
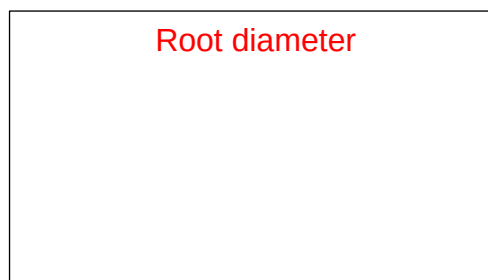
The host farmer will provide answers to the following questions, in reference to harvested plants (we anticipate that this should take ~ eight minutes)

1. Which clone has the best root shape?

2. Which clone has the worst root shape?

3. Which clone has the best root size?

4. Which clone has the worst root size?

5. Which clone has the best fresh root yield?

6. Which clone has the worst fresh root yield?

7. Which clone has the best disease resistance?

8. Which clone has the worst disease resistance?

9. Which clone has the best stem quality?

10. Which clone has the worst stem quality?

11. Which clone has the best cortex color?

12. Which clone has the worst cortex color?

13. Overall, which is the best clone at harvest?

14. Overall, which is the worst clone at harvest?

2.3.2 Procedure for preparing roots in for boiling/steaming

All roots harvested from each plot should be placed in respective bags labelled "Plot A", "Plot B" and "Plot C" and safely carried to your home to prepare them for boiling or

steaming (the farmer will cook using the local preferred method). Roots from each clone should be cooked in a different saucepan or pot, all labelled appropriately (please consistently use labels to avoid mixing up the samples when handling samples). Thus, try to avoid mixing up labels at any stage. Cooking should be done concurrently to allow for fair comparison of clones.

Please undertake the following steps:

a) Peel and wash the best 3 roots from "Plot A" and place them in a well-marked saucepan or pot. Repeat this activity using roots from "Plot B" and "Plot C".

15. Which clone is best to peel (easiest to peel) during processing (peeling)?

16. Which clone is worst to peel (hardest to peel) during processing (peeling)?

> **Note**: Preparation of the boiled product should be done according to the common practice for the respective households

b) Set three sources of fire of equal strength (amount of firewood or charcoal used).

c) Place each of the pots on a separate source of fire and allow the roots cook by steaming or boiling for 45 minutes (the farmer should cook using the preferred local method).

After 45 minutes, serve and eat the boiled roots when ready, then answer the following questions regarding the quality of boiled cooked roots.

| Cooked roots from Plot A | Cooked roots from Plot B | Cooked roots from Plot C |

17. Which clone cooks best?

18. Which clone cooks worst?

19. Which clone is best in terms of mealiness?

20. Which clone is worst in terms of mealiness?

21. Which clone has the best taste?

22. Which clone has the worst taste?

23. Which clone has the best softness while eating?

24. Which clone has the worst softness while eating?

25. Which clone is the best regarding being fibrous?

26. Which clone is the worst regarding being fibrous?

27. Overall, which clone makes the best boiled cassava food?

28. Overall, which clone makes the worst boiled cassava food?

2.4   Assessing flour-based cassava food product

2.4.1 Procedure for harvesting

a) Uproot at least 5 cassava plants from "Plot A"; this should provide you with at least 10-15 marketable roots (i.e., roots >16 cm in length or diameter > 3 cm). Harvest enough roots that can make at least two kilograms of flour; all harvested roots should be placed at the label "Plot A"

b) Uproot at least 5 cassava plants from "plot B"; this should provide you with at least 10-15 marketable roots (i.e., roots >16 cm in length or diameter > 3 cm). Harvest enough roots that can make at least two kilograms of flour; all harvested roots should be placed at the label "Plot B"

c) Uproot at least 5 cassava plants from "plot C"; this should provide you with at least 10-15 marketable roots (i.e., roots >16 cm in length or diameter > 3 cm). Harvest enough roots that can make at least two kilograms of flour; all harvested roots should be placed at the label "Plot C"

The host farmer will provide answers to the following questions (we anticipate that this should take ~ eight minutes)

1. Which clone has the best root shape?

2. Which clone has the worst root shape?

3. Which clone has the best root size?

4. Which clone has the worst root size?

5. Which clone has the best fresh root yield?

6. Which clone has the worst fresh root yield?

7. Overall, which is the best clone at harvest?

8. Overall, which is the worst clone at harvest?

2.4.2 Procedure for processing roots to flour and assessing the quality of "flour-based meal / food product"

All roots harvested from each plot should be placed in respective bags labelled "Plot A", "Plot B" and "Plot C" and safely carried to your home to process them into flour. At home the roots should be separately peeled, washed, sliced into chips and sun-dried. Three different labelled bags ("Plot A", "Plot B", and "Plot C") should be used for drying and/or keeping chips. It may take up to three days to fully dry chips generated from 10-15 roots. Thereafter, please answer the following questions based on your observations


9. Which clone is best regarding drying faster (amount of time required to dry)?
10. Which clone is worst regarding drying faster (amount of time required to dry)?

Once the drying process has been completed, the flour-based meal should be prepared as follows;

a) Mill the dry chips from each of the plots "Plot A", "Plot B" and "Plot C" into flour, using a common method preferred by the farmer.

b) Boil enough water to make three 'flour-based meals".

c) Once the water is boiled, take turns to make a meal (or paste) from each clone, ensuring that similar quantity (~1 kg) of flour is used in each case. Reserve about half a kilogram of flour from each clone, which will be picked by NARO research team for laboratory analysis.

d) Place each of the "flour-based meal" on a clean plate bearing the respective label "Plot A", "Plot B" or "Plot C".

| Paste of flour from Plot A | Paste of flour from Plot B | Paste of flour from Plot C |
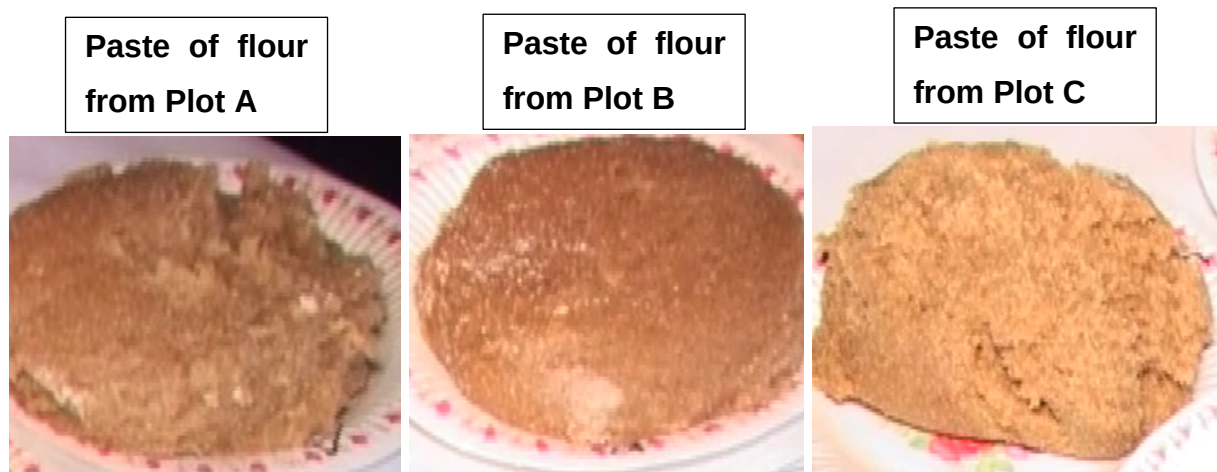
Once the "flour-based meal" is ready, eat some, the farmer may eat with some sauce if available, thereafter, please answer the following questions on the ease of making food product and the quality of the flour-based meal.

11. Which clone is best regarding ease of mingling and/or mixing?

12. Which clone is worst regarding ease of mingling and/or mixing?

13. Which clone is the best regarding stickiness i.e., how it easily holds together while mixing and/or mingling?

14. Which clone is the worst regarding stickiness i.e., how it easily holds together while mixing and/or mingling?

15. Which clone has the best "flour-based meal" taste?

16. Which clone has the worst flour-based meal" taste?

17. Which clone has the best texture of the flour-based meal"?

18. Which clone has the best texture of the flour-based meal"?

19. Overall, which clone makes the best flour-based meal" food?

20. Overall, which clone makes the worst flour-based meal" food?