2026

Target Food Product Profile

Boiled Cassava



RTB Breeding

RTB foods

Gates Foundation

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Breeding Root, Tuber, and Banana (RTB) varieties that better serve user and consumer preferences will lead to greater varietal adoption in RTB value chains. This will help to further boost RTB-linked livelihoods and food and nutrition security, and reduce drudgery.

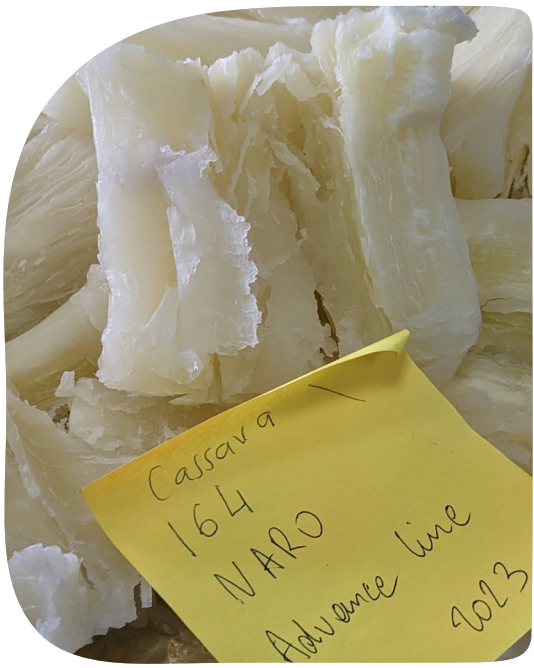
The RTB*foods* project designed and implemented a participatory gendered interdisciplinary methodology with RTB researchers and regional stakeholders. This has contributed to **identifying key traits and characteristics required for RTB food products, in terms of processing and consumption**. **New high-throughput phenotyping tools** for assessing RTB food product quality and preferences have been developed and deployed for use by breeders and food scientists. These validated new traits are already being incorporated into breeding programmes. The project has developed product profiles covering the complete range of RTB food products. Furthermore, the previously unknown and often stereotyped African gastronomy is emerging as an 'African nouvelle cuisine' which will benefit from RTB varietal quality improvements. The RTB*foods* project was supported by the Bill & Melinda Gates Foundation, and ended in 2023, and the work is now embedded within the RTB Breeding Initiative.

This Target Food Product Profile (TFPP) for **Boiled Cassava** is being translated into market-driven breeding initiatives to develop new, end-user-focused cassava varieties, which is significantly boosting their adoption.

Product Identity

Boiled Cassava is the final ready-to-eat product from boiling cassava (*Manihot esculenta* Crantz) roots grown in subtropical to tropical zones (Africa, Asia, and Latin America). Boiled cassava is widely consumed in all major cassava producing countries. Africa is the primary producer of cassava, accounting for 64% of global production, with Nigeria, Congo, and Ghana being significant producers (FAOSTAT, 2022). It has a significant market share in Central, Eastern, and Southern Africa. Once cassava roots are harvested, they are peeled and trimmed. The roots are rinsed with clean water to remove any dirt or debris and then cut or sliced. Cooking methods for cassava vary. Sliced cassava roots can be immersed in water and boiled, or wrapped in banana leaves and steamed.

Controlling the water and cassava ratio requires skilled cooking, in order to avoid the cassava absorbing too much water and becoming glutinous. Boiling cassava roots is typically done in a covered pot or saucepan for 30–45 minutes. Good boiled cassava varieties can be cooked within 15–20 minutes. Few 'quickly-cookable' varieties are available in local markets. Cooking progress can be assessed by pressing pieces with a fork or breaking by hand, by the viscosity and turbidity of cooking water, or through the cooked cassava odor. After boiling, cassava should be soft and mealy, and have a sweet taste (not bitter). Boiled cassava is served as a main dish accompanied by sauces, stews, or soups. Some consumers pound their boiled cassava slices into a dough. .



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Exploration of good quality traits for Boiled Cassava

In order to obtain the best product quality and rank traits in order of importance, a gendered map of characteristics demanded by food-chain actors was achieved through a multidisciplinary methodology. These actors included cassava farmers, processors/cooks and consumers of boiled cassava. By including boiled-cassava processors in a participatory diagnosis of processing, and consumers in rural and urban areas in consumer testing, a more appropriate gendered food-product profile for boiled cassava in Benin and Uganda have been developed. Several key end-user preferences for boiled cassava quality traits have been identified. For selecting raw cassava roots, the most preferred end-user quality traits are **smooth skin, white flesh color, and a little sweet taste (not bitter).** Root size affects transportation costs and adoption level. During processing, cassava suitable for boiling should be easy to peel and have white flesh. Ease of peeling significantly reduces women's labor during processing cassava roots. **Soft texture of boiled roots, absence of fiber and in-ground stability** are key attributes influencing varietal preference, besides **high yield, non-bitter roots, disease resistance, early maturity and drought resistance**[1]. In Cassava bitterness is mainly associate with toxic cyanogenic compounds harmful to consumer health. Soft boiled cassava is determined by the finger that can easily indent when the flesh is pressed or soft as one chews. Women consider softness (implies a short cooking time) to be an important characteristic that affects the quantity of firewood needed to boil cassava. The dominant high-quality characteristics of boiled cassava are **crumbly, soft, sweet, nice aroma** (like cassava aroma), and **white** in color. Cassava that is fibrous, bitter-tasting, hard, or has a glassy texture is undesirable.



CIRAD/IITA team interviewing a consumer in Bertoua, Cameroon, about her preference for boiled cassava.
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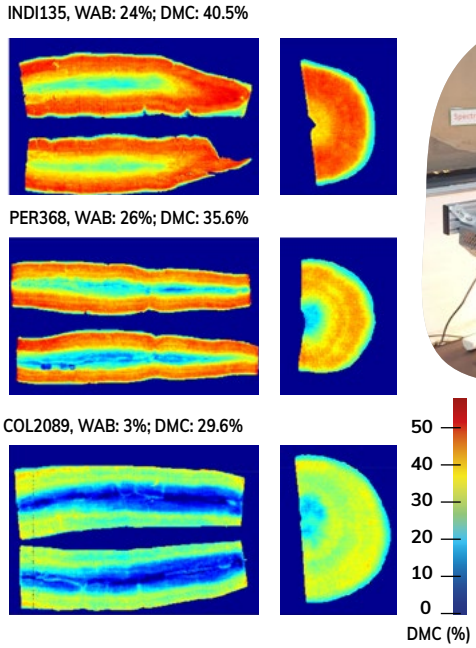
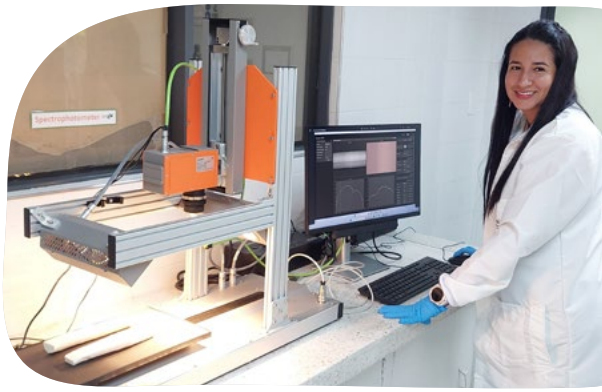
A trait evaluation toolbox to support breeding superior cassava varieties for enhanced adoption of Boiled Cassava





↑ Maria Alejandra Ospina, a research associate (CIAT, Colombia) working on hyperspectral imaging of fresh cassava roots.

← Hyperspectral images of longitudinal and transversal sections of raw cassava roots at 40.5, 35.6 and 29.6% dry matter content (DMC, wet basis). Images by Meghar et al. (2024)

For the first time, food technologists and social scientists can now assist breeders with quantifiable thresholds in terms of biophysical and sensory scores for overall preference for each measured trait. A toolbox of standard operating procedures (SOPs) for texture and sensory analyses for boiled cassava has been developed. Instrumental texture analysis methods (penetrometry, compression, and texture-extrusion) have highlighted clear textural differences between cassava varieties. Sweetness of taste indicated by sugar levels, can be quantified. Cassava flesh color can be rapidly measured with a chromameter. Overall cooking ability of boiled cassava can be assessed by water absorption (WA), as it is related to mealiness and optimum cooking time (CT). This newly developed method enables the medium-throughput sorting of cassava varieties into short-cooking (25–30 min) and long-cooking (40–60 min)[2]. Certain **elite cassava varieties exhibit outstanding cooking performance (<20 min)**. Boiled cassava dry matter does not correlate with its cooking quality, but can be an indicator for starch content. Softness and WA have been assessed in white- and yellow-fleshed breeding lines[3]. Three populations of contrasting cassava genotypes, from good-cooking to poor-cooking have been characterized in Benin, Colombia, and Uganda[4]. Key boiled-cassava quality attributes covering root preparation, visual aspects, taste, and texture, have been identified and translated into **acceptability thresholds** in terms of sensory quantitative descriptive analysis scores, and instrumental measurements (water absorption during boiling, and texture analysis). The acceptability thresholds for boiled cassava quality have identified promising genotypes in distinct Colombian and Benin populations. Genotype x Environment Interaction (GEI) effects on the end-user culinary qualities of boiled cassava varieties in Nigeria have been evaluated[5]. **Genotype had the greatest influence on mealiness and color**, while **GEI had more impact on fiber, adhesiveness, softness, taste, aroma, and firmness.**

For large cassava clone population screening, high-throughput phenotyping tools such as near infrared spectrometry (NIRS) and hyperspectral imaging have been developed. Amylose, and dry matter of cassava roots can be quantitatively measured using NIRS. A large database of NIRS fingerprints has been generated from experimental fields and from various breeding populations at CIAT, Colombia. A NIRS calibration has now been developed for screening genotypes according to low and high WA30 (water absorption capacity after 30 minutes of boiling). The acceptability threshold between low and high was set at 12% water absorption. Developing molecular markers for identifying genes of interest can be achieved through our approaches based on the preferences of boiled cassava users and consumers. Identifying and assessing candidate genes controlling desirable cassava quality traits can enhance cassava selection and efficiency through genomic-assisted breeding. **Integrating evidence-based consumer acceptability traits of boiled cassava, and high-throughput phenotyping tools, together with advanced genomics technologies in cassava selection pipelines will accelerate developing superior cassava varieties, and improve their adoption rate.** This will comprehensively address stakeholder preferences across the entire boiled cassava value chain. The work will significantly boost adoption rates of new varieties and make them more attractive in the market.

Key Publications

[1] Iragaba et al., 2021. Identification of cassava quality attributes preferred by Ugandan users along the food chain. *Int. J. Food Sci. Technol.*, 56(3), 1184–1192. https://doi.org/10.1111/ijfs.14878

[2] Tran et al., 2021. Correlation of cooking time with water absorption and changes in relative density during boiling of cassava roots. *Int. J. Food Sci. Technol.*, 56(3), 1193–1205. https://doi.org/10.1111/ijfs.14769

[3] Wembabazi et al., 2022. Consumer preferred boiled cassava cooking qualities in white and yellow fleshed advanced breeding populations in Uganda. *Afr. J. Rural Dev.*, 7(3), 315–324. https://afjrdev.org/index.php/jos/article/view/414/281

[4] Iragaba et al., 2024. Definition of sensory and instrumental thresholds of acceptability for selection of cassava genotypes with improved boiling properties. *J. Sci. Food Agric.*, 104(8), 4561–4572. https://doi.org/10.1002/jsfa.13363

[5] Uchendu et al., 2022. Genotype-by-environment interaction and stability of root mealiness and other organoleptic properties of boiled cassava roots. *Sci. Rep.*, 12, 20909. https://doi.org/10.1038/s41598-022-25172-8

Honfozo et al., 2023. Cross-approaches for advising cassava trait-preferences for boiling. *Cogent Food Agric.*, 9(1), 2253716. https://doi.org/10.1080/23311932.2023.2253716



Target Food Product Profile of Boiled Cassava

Cassava is a key RTB food security crop in African, Asian, and Latin American countries.



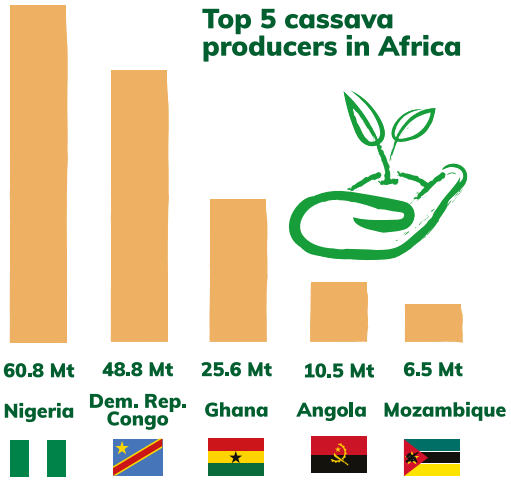
326
million tons

Global annual cassava production

- 64% Africa
- 28% Asia
- 8% Latin Ameria

Source: FAOSTAT, 2022

Top 5 cassava producers in Africa



Main consumers of Boiled Cassava

Brazil
Paraguay
Colombia
Central America
Indonesia
Uganda

Boiled Cassava preparation



As a result of our work, new traits are being integrated into the cassava breeding pipeline. Moving forwards, this will significantly boost adoption rates and performance of new cassava varieties.

Preferences of farmers, producers, processors, and consumers of boiled cassava

Raw cassava

- Cracked and clear peel
- White flesh
- Big roots/roots size
- Red/pink/dark/black peel

During processing

- White flesh
- Cracked flesh
- Easy to peel, and easy to cut
- Easy to break, and soft
- Good cassava aroma
- Sweet taste

Ready-to-eat boiled cassava

- Crumbly, easy to break, soft
- White color
- Good smell
- Not fibrous
- Sweet taste
- Mealiness
- Good cassava aroma

Key priority traits for development of cassava varieties for boiled cassava

- White flesh
- Easy to peel
- Short cooking time
- Crumbliness, easy to break, and softness
- Not fibrous
- Sweet taste
- Good cassava aroma

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For more information about Boiled Cassava, please see https://rtbfoods.cirad.fr/

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