2026

Target Food Product Profile

Fufu



RTB Breeding

RTB foods

Gates Foundation

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Transforming African Agriculture

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 cassava-derived **Fufu** is being translated into market-driven breeding initiatives to develop new, end-user-focused cassava varieties, which is significantly boosting their adoption.

Product Identity

Fufu or Foo-Foo is a traditional food product that is made from cassava (*Manihot esculenta* Crantz) by fermenting and transforming it into a wet paste. Fufu is popular among people in southern, western, and eastern Nigeria, as well as some parts of West and Central Africa. It is also known as "Akpu" or "Utaraakpu" in some parts of Nigeria. The processing of cassava roots to make fufu involves retting (softening) by soaking or steeping whole or cut peeled cassava roots in water and fermenting them for three to four days. Alternatively, after two days of fermentation, the soaked roots can be washed and grated, followed by another round of steeping the grated roots. **Retting is a crucial step as it will influence the quality of fufu.** The fermentation time is contingent on the ambient temperature. Fermented, grated mash, or whole roots are sieved with water into a container and allowed to sediment for about an hour. The fermented product is dewatered to about 50% of initial moisture content. Dewatered mash is an intermediate form of fufu that is stored and sold as wet cake or dried flour. Making cooked fufu dough involves reconstituted paste being molded, pounded, or stirred with a wooden ladle to create a thick and smooth dough. The texture of fufu dough is similar to that of pounded yam, a traditional staple food before cassava became important in West Africa. Cooked fufu has a slightly sour taste and is better accompanied with soups and stews, fish, or meat.



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Exploration of good quality traits for Fufu

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 fufu. A gendered food product profile for fufu in Nigeria has been generated. Several key end-user preferences for fufu quality traits have been identified[1], but these have not been traditionally included in breeding pipelines. Fufu is usually prepared by households and rural processors. Key characteristics that shape gender-specific consumer preferences are related to appearance, texture, and aroma. The gender and livelihood assessments emphasize the importance of specific attributes: **white color, ease of peeling, good retting ability, high yield of fufu mash, absence of fibers, and stretchiness** of the final product. At the raw material level, important quality characteristics of cassava that appeal to all users are smooth skin, heavy weight, and white color. Important processing characteristics are ease of fermentation, ease of peeling, high yield of mash, and white or cream color. The dough-like product should be moldable (hold shape), not stick to the hands (cohesive), and retain its firmness without becoming overly soft or watery. While bright and attractive color are preferred, a chalky white appearance is typically indicative of inadequately cooked fufu. At the ready-to-eat stage, important characteristics of the fufu product are **white or cream color, ease of forming dough, smoothness and stretchability**. Ideal fufu should possess a **moderately soft texture, be easy to swallow, can be cut with fingers, and have a mild fufu aroma.**





Pounding fufu flour with hot water to make fufu dough
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A new traits evaluation toolbox to support breeding superior cassava varieties for enhanced adoption of Fufu



Sensory evaluation of fufu quality traits © Dominique Dufour - CIRAD

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. **Cassava retting ability, textural qualities, color, smoothness, and stretchability** are among the most liked characteristics of fufu[1]. A toolbox of standard operating procedures (SOPs) for sampling, textural, and sensorial analyses for fufu has been developed. Instrumental texture profile analysis (ITPA) has been deployed for measurement of fufu texture attributes such as hardness, adhesiveness, cohesiveness, springiness, gumminess, chewiness and resilience using a texture analyzer. Sensory texture profile analysis (STPA) has been designed for evaluation of sensory attributes of the cooked fufu dough such as color, smoothness, moldability, stickiness, hardness, stretchability and odor. Quantitative descriptive analysis (QDA) and consumer acceptance assessments have been conducted with sensorial panels. Different protocols have been developed to discriminate or characterize cassava genotypes based on retting ability, physical, sensorial and textural qualities[2-5]. Determination of biophysical attributes such as bulk density, swelling power, solubility index, water absorption capacity (WAC), dispersibility, starch, sugar and amylose content, have been applied to fufu flour and dough[2]. WAC had a significant effect on the moldability of the cooked dough, but not on its stickiness, after analyzing correlations between biophysical and textural attributes.

Cassava retting is a key fufu processing step. Retting ability or retting index of cassava has been standardized with a penetrometer which measures the firmness (hardness) of cassava roots. The protocol had a high ability to discriminate the cassava genotypes[1,3]. **The best parameters for predicting cassava retting ability include pH, foaming ability, and dry matter content (DMC)**[3]. Fermentation time can be influenced by DMC. Fresh cassava roots with a high DMC tend to require a longer time to soften during retting but will likely result in higher fufu yield. The smoothness and stretchability of fufu can be predicted by measuring its cohesiveness with a texture analyzer[3]. The biophysical and textural characteristics have been used as selection criteria for improved cassava genotypes that are likely to produce consumer-favored fufu[4]. At IITA, Nigeria, the released cassava varieties performed well on fufu quality next to the landraces that performed best evaluated by the champion processors[5]. At NRCRI, Nigeria, the improved cassava clones are competitive with the local varieties due to their good performance in smoothness, low stickiness, and stretchability. The correlations between instrumental and sensory fufu textural attributes demonstrated the feasibility of developing mid- or high-throughput protocols for screening fufu quality attributes.

Developing molecular markers for identifying genes of interest can be achieved through our approaches based on the preferences of fufu users and consumers. Identifying and assessing candidate genes controlling desirable cassava quality traits can enhance cassava selection and efficiency through marker-assisted selection (MAS). **Integrating evidence-based consumer acceptability traits of fufu, 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 fufu value chain. The work will significantly boost new varieties' adoption rates and make them more attractive in the market.

Key Publications

[1] Chijioke et al., 2021. Quality attributes of Fufu in South-East Nigeria: guide for cassava breeders. *Int. J. Food Sci. Technol.*, 56(3), 1247–1257. https://doi.org/10.1111/ijfs.14875

[2] Awoyale et al., 2022. Correlation of the quality attributes of Fufu flour and the sensory and instrumental texture profiles of the cooked dough produced from different cassava varieties. *Int. J. Food Prop.*, 25, 326–343. https://doi.org/10.1080/10942912.2022.2026955

[3] Chijioke et al., 2024. Cassava retting ability and textural attributes of Fufu for demand-driven cassava breeding. *J. Sci. Food Agric.*, 104(8), 4586–4595. https://doi.org/10.1002/jsfa.13400

[4] Awoyale et al., 2023. Biophysical and textural attributes as selection indices for replacing the adopted cassava variety with the improved genotype to produce Fufu. *Front. Sustain. Food Syst.*, 7, 1272724. https://doi.org/10.3389/fsufs.2023.1272724

[5] Teeken et al., 2021. Understanding cassava varietal preferences through pairwise ranking of gari-eba and Fufu prepared by local farmer–processors. *Int. J. Food Sci. Technol.*, 56(3), 1258–1277. https://doi.org/10.1111/ijfs.14862

Wakem et al., 2024. Histological and biophysical changes of cassava roots during retting, a key step of Fufu processing. *J. Sci. Food Agric.*, 104(8), 4689–4699. https://doi.org/10.1002/jsfa.13130



Target Food Product Profile of Fufu

Cassava is a key Root, Tuber and Banana (RTB) food security crop in African, Asian, and Latin American countries.



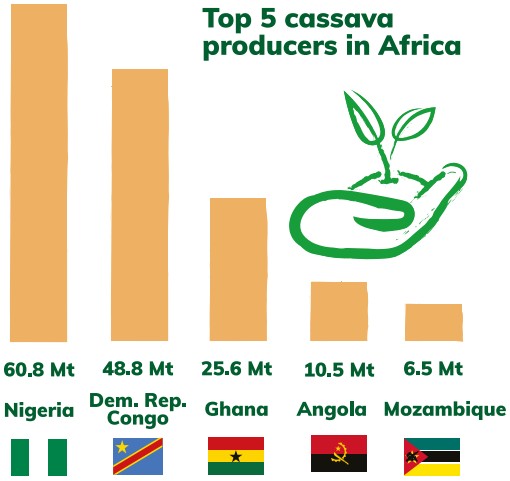
326
million tons

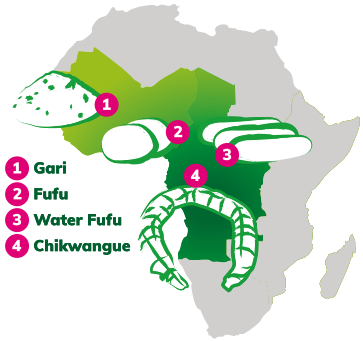
Global annual cassava production

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

Source: FAOSTAT, 2022

Top 5 cassava producers in Africa

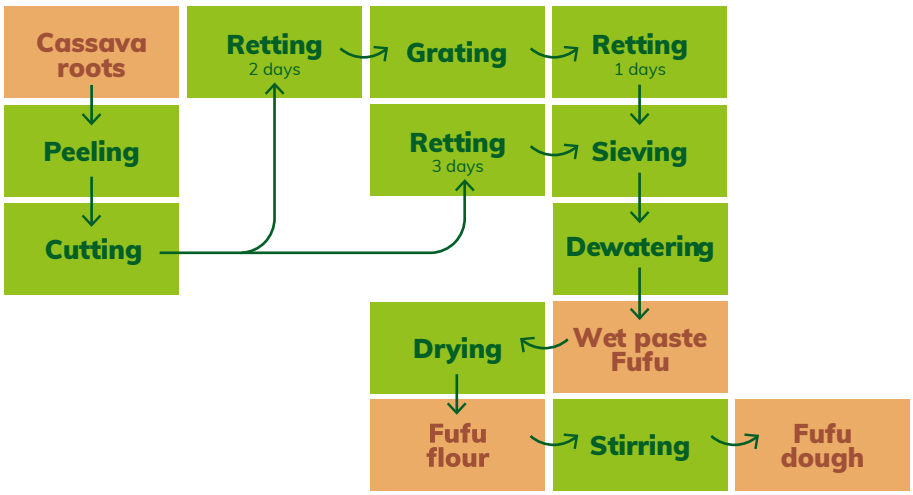




Importance of soaking technologies



Fufu preparation



Preferences of farmers, producers, processors, and consumers of fufu

Raw cassava
- Smooth skin
- Heavy weight
- White color flesh

During processing
- Easy to ferment
- Easy to peel
- High mash yield
- White or cream color

Ready-to-eat Fufu
- White or cream color
- Easy to form dough
- Stretchability
- Moderately soft
- Easy to swallow
- Cut with the fingers
- Mild fufu aroma

Key priority traits for development of cassava varieties for Fufu:

- Good retting ability/ easy to ferment
- Easy to form dough
- White or cream color
- Smoothness, not sticky
- Stretchability
- Easy to swallow
- Mild fufu aroma

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.

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

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This article is available at: https://doi.org/10.18167/agritrop/00906