

# When knowledge is not enough: barriers to recommended cassava processing in resource-constrained Kwango, Democratic Republic of Congo

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## Abstract

**Background.** Despite interventions to provide knowledge and improve bitter cassava processing in the Democratic Republic of Congo (DRC), cassava processing is sub-optimal. Consumption of insufficiently processed bitter cassava is associated with konzo, a neurological paralytic disease.

**Objective.** This study aimed to explore barriers to appropriate cassava processing carried out by women in one deep rural, economically deprived area of DRC.

**Methods.** A qualitative design used focus group discussions (FGDs) and participant observation to collect data among purposively selected women aged 15-61 years in Kwango, DRC. Data were analyzed using thematic analysis.

**Results.** 15 FGDs with 131 women and 12 observations of cassava processing were undertaken. Observations indicated women did not follow recommended cassava processing methods. Although women were knowledgeable about cassava processing, two main barriers emerged: access to water and lack of money. Accessing water from the river to process cassava was burdensome, and the cassava was at risk of being stolen by soaking it in the river; therefore, women shortened the processing time. Cassava was not only used as a staple food but also as a cash crop, which led to households shortening the processing time to reach the market quickly.

**Conclusion.** Knowledge about the risks of insufficient cassava processing and about safe processing methods alone is insufficient to change practices in a context of severe resource constraints. When planning nutrition interventions, it is critical to view the intervention in light of the socio-economic context in which the intervention will take place to improve its outcomes.

## Introduction

Poor nutrition is an important reason for high morbidity and mortality globally, particularly in low-income countries in Africa. Lack of nutrition knowledge and inappropriate dietary practices are among the main determinants of nutritional problems and diseases.<sup>1</sup> Nutritional interventions play a significant role in preventing disease and malnutrition.<sup>2</sup> Interventions to improve communities' nutritional knowledge through nutrition education messages and the development of skills have been widely used to optimize dietary practices and have been shown to be effective in changing practices and improving nutrition.<sup>2</sup> Nevertheless, decisions about dietary intake and practices are complex and are influenced by several social and personal factors such as knowledge, attitudes, beliefs, food taboos, income,

socioeconomic status, and food availability.<sup>3,4</sup> It is, therefore, vital to contextualize nutrition messages taking into account all these factors.

Nutrition messages should cover what and how much food should be consumed and also food safety and how crops should be processed before consumption.

One such crop is cassava, an important staple food in African countries such as Nigeria, Benin, Ghana, Uganda, Kenya, Zambia, Zimbabwe, and the Democratic Republic of Congo (DRC). Cassava is also grown in tropical areas of South America and South East Asia. In some areas of Africa, cassava provides up to 50% of the daily diet.<sup>5</sup> Although cassava is widely used as a food staple in sub-Saharan Africa, there are inherent dangers with cassava consumption, namely the presence of cyanogens which can be toxic if consumed in large amounts. There are different varieties, namely sweet cassava and bitter cassava, depending on the level of cyanogen. However, adequate household processing methods such as soaking, wetting, and grinding with drying can improve this quality and make it safe for consumption. Furthermore, cassava is deficient in the protein needed to minimize the cyanogen effect in the body.

Intake of inadequately processed cassava causes cyanogen side effects like headaches, nausea, and long-term exposure can lead to irreversible paralysis, known as konzo.<sup>6</sup> Messages and interventions to address the safe consumption of cassava have focused on providing information about processing cassava to achieve the World Health Organization-recommended cyanogen safe levels of <10 mg HCN eq/kg.<sup>7</sup> Processing cassava is achieved through a fermentation process using either dry solid-state fermentation or submerged fermentation, such as soaking or wetting.<sup>8</sup> Simultaneous intake of micronutrient-rich food and cassava is known to detoxify cyanogens in the body, thus limiting the effect of toxic cyanogens. In resource-constrained communities, inadequate food intake leads to a lack of protein to detoxify cyanogens in the body. Therefore, good processing is vital to improve cassava quality. As cassava is such an important component of the diet in many African settings, communicating messages about the safe processing of cassava and the importance of simultaneous intake of micronutrient foods is paramount.

This paper presents findings from a study that explored knowledge and practices concerning the safe consumption of cassava as a staple food among women in a deep rural, resource-constrained, community in the DRC. Kwango province was identified by the DRC National Ministry of Health Nutrition Program (PRONANUT) as one of the priority sites in which nutritional interventions should be undertaken to provide communities with knowledge and skills to safely process cassava.

### **Cassava processing intervention provided by the Democratic Republic of Congo Ministry of Health through the National Nutrition Program**

Given the importance of cassava in providing the nutritional needs in Kwango, an intervention to teach the safe processing of cassava using the soaking and wetting methods was introduced. PRONANUT trained Kwango residents, mostly women, in the safe processing of cassava for consumption using the soaking and wetting method between 2011 and 2015.<sup>9</sup>

The soaking method transforms cassava by leaving its roots in the water. It induces lactic fermentation, which is the essential element of soaking. The microbes disrupt the cell structure and allow contact between the enzyme and the cyanogen glycosides, making the final product safe for consumption. The longer the cassava roots are left in the water, the more time the enzyme has to break

down cells. The optimal soaking time is three nights, after which less than 3% of hydrocyanic acid remains in the roots.

The wetting method is used if cassava roots have been soaked for shorter periods causing the roots to contain more hydrocyanic acid. When the short-soaked cassava roots are ground into flour it is possible to reduce the cyanogen content of the flour by mixing the flour with a small quantity of water to humidify it, and then keeping the mixture in an open vessel for about 2 hours under the sun or 5 hours in the shade to allow the escape of cyanogen gas.

Most processing steps are carried out manually using simple, inexpensive tools and equipment that are available to small-scale farmers. The harvest and transportation of roots from fields to home and the subsequent processing are mainly done by women.

The first intervention to introduce wetting methods started in 2010 and training continued over 4 years. All women in the villages were invited to participate. The training was undertaken outdoors in an accessible location. During the intervention, women were trained to process their own cassava. Men and village leaders were also trained separately from women.

## **Materials and Methods**

### **Study site**

The DRC is a large country in central Africa with a population above 84 million (UIS 2018) which has been exposed to years of war and political unrest. The economy is driven by agriculture with cassava, plantain, groundnuts, and rice being the most important crops; mining, fishing, and forestry are other important economic sectors. The DRC has high levels of malnutrition in children and, in 2017, more than 7 million people reported household food insecurity.<sup>10</sup>

The study was undertaken in 6 villages: Ipesi, Mutombo, Tsakala-Mbewa, TsakalKenya, Manzanzi, and Mangungo dominated by the Yaka ethnic group, in the deep rural area of Kwango province, DRC. The socio-economic status is characterized by extreme poverty, high rates of malnutrition, and the highest prevalence of konzo worldwide. Kwango consists of 90 thousand km<sup>2</sup> in which cassava is grown and there is a high consumption of cassava among inhabitants. Kwango province is divided into 14 health zones, 12 of which have reported cases of Konzo. Popokabaka health zone has the highest number of cases of konzo in Kwango province. The bitter variety of cassava which is grown in Kwango needs an efficient processing method to avoid the consequences of chronic cyanide exposure.<sup>6</sup>

### **Study design**

This study used a qualitative design consisting of focus group discussions (FGDs) and participant observation (PO) to gain a comprehensive understanding of how cassava processing methods are implemented among women, and of which barriers prevent them to use the recommended methods. All FGDs and PO were conducted in the community where the participants lived.

### **Sampling strategy and process**

Non-probability purposive sampling was used to identify participants. Women were recruited from those who participated in the training intervention in wetting methods of cassava processing and were knowledgeable about soaking methods.

Local leaders of the 6 selected villages were approached to explain the purpose and process of the study thus ensuring local leadership support. This was followed by a meeting where participants indicated their willingness to participate in the study, which

established a reciprocal relationship with the participants. Eligibility criteria to participate in the PRONANUT intervention and this study included being female and over the age of 15 years, undertaking the cassava processing in the family or having a household of her own, and residing in the health area for at least 2 years.

### Data collection

Data were collected by the principal investigator of the study (GB) using FGDs and PO.

The purpose of PO was to systematically observe women in their natural settings undertaking cassava processing, from digging up the cassava roots to the completion of cassava processing and use as a food source. In each village, the researcher followed women into the fields for a period of 6 hours or more during their cassava processing activities, from early morning until they finished working with the cassava for the day. Every step of harvesting the cassava roots to the final processing of the cassava roots was meticulously recorded in fieldnotes by the researcher who conducted observations until saturation was reached.

FGDs were conducted in the community at a central location close to where the participants lived. A FGD guide was developed based on exploring participants' knowledge about DRC Ministry of Health recommendations for processing cassava for safe consumption, current cassava processing methods and reasons for these, challenges faced when processing cassava, and barriers to the implementation of recommended cassava processing practices. FGDs were conducted with participants until data saturation was reached. FGDs were conducted in the participants' language of preference, either Yaka or Lingala and were audio recorded. Detailed notes were taken during the FGDs. FGDs were conducted by research assistants who were mother-tongue speakers of Yaka or Lingala with the researcher present.

### Data management

Digital recordings were transcribed *verbatim* in the local language and then translated into French by a translator and research assistants. The transcripts were further translated into English by the researcher and an English-speaking professor at the University of Kinshasa. The transcripts were back-translated into Yaka by two translators working independently to ensure accuracy and consistency before analysis. The fieldnotes were written in French and translated into English.

### Data analysis

All data generated from the FGD transcripts, notes taken during FGDs, and observation fieldnotes were analyzed using an inductive thematic approach. This included reading the transcripts and observation fieldnotes, identifying themes, developing codes, synthesizing information, and interpreting patterns. Codes from the FGDs were compared to the notes taken during the FGDs, resulting in some revision of individually-generated categories and determination of the final coding categories. The final collation of categories, themes, and patterns was undertaken and arranged into a narrative passage so that the findings would occur logically.

### Ethical considerations

This study was approved and ethical clearance was obtained from the ethics committee of the Kinshasa School of Public Health (ESP/CE/035B/2017). Authorization was also obtained from political and administrative authorities and local leaders in Kwango Province.

All participants provided written informed consent and codes were assigned to each participant to ensure anonymity. All data is kept on a password-protected computer.

## Results

The study was conducted over a period of 3 months. A total of 15 FGDs were conducted and comprised between 8 to 10 participants in FGDs and 12 observations of cassava processing were undertaken. The age of participants ranged from 15 to 61 years of age. All participants were female and most were farmers (Table 1).

### Observations

Observations revealed that women often go to the fields in groups mostly around 6 am. Processing starts by uprooting the cassava and the roots are put into 1-2 baskets that are then transported on the women's head or back. Women walk with this load to the bottom of the valley where the rivers and ponds are located. Walking time was 45 minutes to 1 hour. At the river, women put their cassava roots into the ponds for soaking.

The period of soaking of the cassava roots for most women was shorter than recommended (two nights), with only a few women soaking for three nights. After soaking, women fetched their cassava from the ponds, put it into the baskets, and carried them back up the hill to the village. In the village, the soaked cassava roots were placed onto racks made of wood outside their homes, for sun drying for 4 to 5 days, depending on the weather. Observations revealed that when cassava roots were soaked for 3 nights they were very soft and disintegrated more easily than cassava soaked for 1-2 nights, causing women to complain about its quality and how this affects their ability to sell it in the markets.

### Knowledge about recommended cassava processing practices

FGDs were undertaken after POs, and results suggested women had good knowledge about recommendations for cassava processing. Women from different villages reported that to achieve safe levels of cyanogen in cassava roots, good processing requires 3 nights of soaking which protects their household (including children) from getting the disease (konzo).

*"We soak our cassava roots in water so that the substance that gives headaches may go with water, and we know that it requires 3 nights for good health. The 3 nights make all poison go out the root." (FGD1, Tsakala Mbewa village)*

### Barriers to recommended cassava processing practices

Despite women knowing about the benefits of soaking the cassava for three days, they explained the reasons why they only

**Table 1. Demographic characteristics of participants.**

Variables	n=131
Age	
15-49 years	97
50 years and older	34
Schooling	
No schooling	8
1-5 years	25
6-12 years	96
University	2
Occupation	
Nurse	5
Teacher of primary school	12
Teacher of secondary school	8
Farming	106

soaked it for 2 days. These included the need for money at home, lack of food reserves, poverty, shortage of water in the vicinity of the homes, and long distances to the rivers and ponds. One woman explained:

*“Most of the time we are called to do ‘kamwanga pressé’, a porridge obtained from rapidly short soaked roots for economic reasons. With the method of water [2 days], it is better for selling and getting money rapidly to cover [monetary] needs of households at the same time the family is eating.” (FGD7 Manzanzi village)*

The majority of women reported that roots from shorter processing of cassava have a good market value because they do not disintegrate and they will not become dark. The reasons for the shortcut process were explained by a woman:

*“Roots from the shortcut process will not disintegrate, therefore they will not lose any cassava when selling. If they disintegrate you will not have money because no trader like disintegrated roots and the pieces of roots which are sold at low prices that is why most of the time I do Kamuanga pressé.” (FGD10 Mangungo village)*

Another woman spoke of the lack of money as one of the barriers to the recommended cassava processing:

*“It is good to do the recommended processing, but we are abandoned by the government; how can we access money if we don’t sell our cassava in the entire shape without them being disintegrated roots? You see?” (FGD5, Mangungo village)*

Women also described poverty as a barrier to complying with the recommended processing times and suggested the government should improve their living conditions first before making any recommendations.

*“The government tells us to make the 3 night processing but they don’t care about us? For health issue? Healthcare is expensive here and if you don’t have money, how will you live? Where could I afford money for buying things for family living?” (FGD12, Mutombo village)*

Water was another barrier to the recommended processing practices. When it rains women can undertake the wetting/soaking process at home. They complained that walking long distances with heavy baskets of fresh cassava roots, to and from the rivers and ponds, causes fatigue. Roots left in the ponds for long periods could also be stolen.

*“Water should not be far from the village to allow us to do good processing. The fact that water is far makes us in the condition of doing the rapid form [of processing] called kamuanga pressé to avoid the roots being stolen. Putting them in some containers and basins at home [could] help a lot. You see yourself [the] mountains we have here. To cross the river you have to climb the mountain just for water.” (FGD8, Manzanzi village)*

Women reported that one of the recommended methods called the wetting method was good but it requires utensils they do not have because of lack of money. They added that if they had the money, they would buy the utensils needed which includes a bassinet to mix the flour with some water and mats to dry the mixture in the sun. As they lacked these items they couldn’t use the

wetting method, one of the Government recommended methods.

*“Yintombo ya patte nge bien, the method that was shown was good but we don’t have enough money to buy other materials than what was given by the project.” (FGD9, Ipesi village)*

Women said their commonly used and preferred method of cassava processing was short soaking for 2 days in the river. Short soaking can be done in a bassinet at home in times of water shortages or drought and they will have acceptable roots for market purposes thus enabling the household to get quick food.

*“With shortcut process, the children and the men will get food so rapidly. It enables us to never run out food at home. As you know, children and men don’t support (being) hungry for a long time.” (FGD4, Tsakala Kenya village)*

Some women also favored the shortcut processing at home because it would mean they do not have to walk long distances to the river, which added to their heavy workloads. Other women needed the cassava roots as a cash crop to provide for their household needs.

*“Cassava roots are our cash crop, if your cassava roots become dark because of more time in water, children couldn’t go to school because of poor condition we are living in and you cannot have money to cover other needs at home. There are many things to do with money not only eating. If you just plan for eating, what about others’ needs at home?” (FGD2, Tsakala Mbewa village)*

## Discussion

These findings show that even in this deep rural area women knew they had to process the bitter cassava roots before eating them and understood the consequences of poor processing on their own and their family’s health. Women were aware that the unprocessed bitter cassava contained a poison that caused headaches and could lead to konzo. In addition, they knew both methods of cassava processing but because of the harsh environment and their lack of other forms of income, they chose the short-cut process to ensure their family does not go hungry. Rapid cassava processing not only provides meals for their family but is also able to preserve the appearance of the cassava to get a good price for their crop in the market. Once sold at the market, women have money to provide for other needs of the family.

Many health interventions have been implemented worldwide in an attempt to improve health outcomes with mixed results. It is also important to acknowledge that health is not confined to individuals but occurs at a social level and the social context in which the intervention is nested needs to be taken into consideration.<sup>11</sup> The social context in which this intervention was undertaken is the resource-deprived deep rural villages of Kwango in the DRC. While the intervention consisted of teaching women simple methods of cassava processing, this was not enough to overcome the basic survival needs of women and their families. This harsh environment and limited water resources meant women had to walk long distances to the rivers. If they left their cassava crops in the river too long the roots deteriorated and reduced their income. Their behaviors were governed by day-to-day survival and not any long-term problem they were trying to address. In some households, women were not able to replace basinettes that were provided during the intervention. For the women in this study, there was

no hierarchy of needs, there was one need: provide for today and survive.

It is well-known that knowledge is not enough to achieve behavior changes.<sup>12-14</sup> The gap between knowledge and practice has been identified in many settings and has led to a variety of behavior changes in models relating to health.<sup>15</sup> One reason for the lack of behavior changes is the lack of understanding of the context in which the behavior occurs. Behavior occurs within social, political, and economic environments,<sup>11,16</sup> and these environments have an important role in determining particular behaviors. Within a complex social climate, behavior is regulated by habit, conscious choice, and automatic responses to the environment.<sup>11</sup> It is clear, giving people information and knowledge without taking into consideration the context in which this information is given, does not ensure behavior change.<sup>16</sup>

As a result of these findings, alternative interventions should be considered. This could include pumping water from the rivers so women could have water close to their homes. Future studies could include testing new methods of rapid cassava processing so women do not have to make choices between feeding their family partially processed cassava and not feeding them at all. In addition, agricultural agencies could work in communities where bitter cassava is the staple food and introduce viable crops to increase protein in the diet, thus preventing the effects of cassava cyanogens.

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## Conclusions

Knowledge alone is not enough to sustain proper cassava processing in resource-constrained areas of DRC. Economic factors and water availability in the area in which interventions take place should be taken into consideration. Women struggle in their everyday lives through seasons of growing and processing cassava to sustain life and alleviate hunger in their families. Piping water from rivers and research into better agricultural practices and cassava processing could improve the nutrition outcomes in areas where bitter cassava is the staple food.

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