Cassava use in southern Benin: Importance and perception of actors involved in the value chain

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In Benin, many families resort not only to consumption but also to the therapeutic use of cassava (Manihot esculenta). The study assessed the impact of socio-economic factors on the use of cassava, and the perception of the actors involved in the value chain in Benin. Four areas of high production and processing, with 516 producers and processors of cassava roots were surveyed. The results reveal that producers are mostly men (83.30%) over 40 years of age (53%) with a primary education (73%); while processors are mostly women (83%) over 40 years of age (65%) and uneducated (55%). BEN, RB, and Finton are the most produced varieties. Post-harvest losses are much higher in Kétou than Aplahoué and Zogbodomè. The processors carry out at least two processes per month (83%) with a quantity of less than 500 kg (93%), and an annual income of less than 150,000 African Financial Community franc (CFAF). Cassava leaves are used to treat anaemia in children, haemorrhage and headaches, while the roots are employed to treat erectile dysfunction and malaria. Cuttings are used against accidents. Cassava is important in Benin because of its nutritional, financial and therapeutic values.

Key words: Manihot esculenta, producers, processors, pathologies, Benin.

INTRODUCTION

The socio-economic importance of cassava (Manihot esculenta) is appreciated worldwide through its contribution to the food security of populations, the employment it generates, as well as the agricultural income it allows to collect. As a result, world cassava production is about 250 million tonnes (Mt), 250 billion

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kilos per year in 2020 (compared to 160 Mt in 1999) (FAO, 2018). Africa is the world’s largest producer with a total annual production of 169 million tonnes in 2018, of which 93 Mt was produced in western Africa. This represents 55% of the cassava production in Africa, and 33.5% of the world production (FAO, 2018). As a staple food of the African population, almost all of its production is consumed.

Thus, due to its energy productivity, it occupies a prominent place in Benin’s agricultural system. Its production has increased rapidly with an estimated 3.9 tonnes of fresh roots produced in 2017 (MAEP, 2017). According to the forecasts contained in the Strategic Plan for the Development of the Agricultural Sector (PSDSA), the cumulative gross value of production amounts to approximately CFAF 5,572 billion for the period 2017-2021 in Africa. The cumulative gross value of cassava alone amounts to CFAF 2,784 billion, or nearly 50% of the total, which illustrates the essential place of cassava in terms of food security and sources of income for stakeholders. The most popular varieties are BEN 86052, RB 89509 and TMS 30572 which have been adopted by produce for several decades. With a production potential of 45 t/ha, their yields at the farm level vary between 7 and 10 t/ha (Adjanohoun and Allagbé, 2011).

The aggregate value of cassava and other tubers such as yam, potato and sweet potato exceeds that of all other African food crops. It is much higher than the total value of cereal crops such as maize, wheat, and rice (with annual cereal production averaging 169 Mt compared to 108 Mt hectares of land) (Nteranya, 2015). As such, cassava is able to supplement food crops such as millet, maize and sorghum. Despite its nutritional importance, two major drawbacks limit its use in human nutrition, which include its toxicity, due to the presence of cyanogenic compounds, and a low protein content of 1-5% dry matter (Stupak et al., 2006). Cassava varieties can be divided into two groups: sweet and bitter. The sweet varieties are used artisanally for human consumption, while the bitter varieties are only used after various industrial processes (Rwamudanga, 1988). In West African countries such as Benin, Côte d’Ivoire, Togo, etc., cassava root is used mainly for human consumption in various artisanal and industrial forms, and for livestock feed. Fresh roots are consumed by both urban and rural people, and the leaves are also consumed in some regions. Several products derived from cassava are marketed in Benin, Côte d’Ivoire, Togo, including gari, attiéché, husks, starch, tapioca, fufu, lafun, raw flour, etc.

Nevertheless, cassava processing is considered a threat to the environment and human health because of the waste it generates and the pressure on forest resources to cover the energy needs for cooking food derivatives. Thus, regardless of the level of performance of the technology used, cassava processing generates large amounts of waste, which is mostly peelings and pressing juice (wastewater) (Loukou et al., 2021). Furthermore, studies on cassava in Benin have shown the presence of scopoletin in cassava pods. The latter prevents the secretion of aflatoxins (Gnonlonfin et al., 2011). Also the work of Ba et al. (2016) showed antifungal activity of scopoletin extracted from cassava roots. Apart from the latter, studies have proven the presence of amygdalin, also called Vitamin B17, in cassava roots. Cassava is entirely edible and is an excellent and inexpensive source of calories for many countries. Rich in vitamins A and C, iron, potassium and calcium, its root and leaves are used in traditional recipes in Benin. The ways in which cassava is used are diverse and vary from region to region. All organs of the plant have an economic and/or food value. Besides its nutritional importance, the leaves and roots of *M. esculenta* are also used in traditional medicine. They contain secondary metabolites such as flavonoids, saponins, steroids and glycosides (Bahekar and Kale, 2013). In addition, leaves and young shoots have a high concentration of cyanogenic glycosides. According to studies conducted in Madagascar by Andrianarison et al. (2015), pharmacological experiments have shown therapeutic activities of *M. esculenta* against several diseases such as cancer, diabetes, rheumatoid arthritis, cell aging, cardiovascular diseases including atherosclerosis (Bahekar and Kale, 2013).

In Benin, studies initiated on cassava are numerous and diversified. They have placed a strong emphasis on varietal improvement, yield increase, processing, marketing and consumption. Very little research has been done on the use of the different parts of cassava in the treatment of diseases such as cancer. The present study therefore aims to investigate the socio-economic importance of cassava varieties and the perception of cassava stakeholders in the treatment of pathologies in Benin. In a first step, the socio-economic importance of the production of cassava varieties was assessed; in a second step, the different therapeutic uses of cassava and the usefulness of the waste products regenerated by the processing of cassava roots were listed.

**MATERIALS AND METHODS**

**Study area**

The study areas were identified after a documentary study followed by consultations with the executives of the Cendre d’Action Régionale pour le Développement Rural (CARDER), which made it possible to target the major production and processing areas for cassava varieties in southern Benin. A prospective study was conducted from September 2021 to November 2021 in these areas through meetings with actors involved in the cassava value chain. This approach made it possible to select the areas to be taken into account for the surveys. Five villages (Akiza, Tovlamé, Adakplamé, Afossogbé, Edounou) in three communes (Kétéou, Zogbodomé, and
Applahoué) belonging to three departments (Plateau, Zou and Couffo) in southern Benin were surveyed. In order to better appreciate the different medicinal uses of cassava organs, the commune of Djidja was added to the three other communes (Figure 1) in southern Benin.

**Sampling**

The sample size was determined by a normal approximation of the binomial variable of Dagnelie (1998). The choice of the two groups surveyed was random. In each of the selected villages, a list of producers and processors of cassava varieties was drawn up with the help of technicians from the Research and Development sites or village chiefs and some leaders. The study population was represented by male and female producers, processors of cassava roots, traditional healers, agricultural training technicians, heads of households, women's groups and Non-Governmental Organization (NGOs). The survey included 516 cassava root producers and processors. For a survey design based on a simple random sample,
Table 1. The main variables.

| Dependent variable                                      | Independent variable                      |
|----------------------------------------------------------|-------------------------------------------|
| Traditional uses of cassava organs in the treatment of   | Production                                |
| pathologies in Benin                                     | Processing                                |
|                                                          | Waste management                          |
|                                                          | Level of education                        |
|                                                          | Gender                                    |
|                                                          | Types of varieties                        |
|                                                          | Average annual gain                       |
|                                                          | Types de conservation                     |

Source: Study

the required sample size was calculated by applying the following formula:

\[ N_i = \frac{t^2 \times p_i(1-p_i)}{d^2} \]

where \( N_i \) = required sample size (total number of women maize producers to be interviewed), \( t = 95\% \) confidence level (standard value taken from the normal distribution table of 1.96 \( \approx 2 \)), \( p_i \) = estimated proportion of cassava production in the study area (pi varies from area to area; \( \pi_i \) = agricultural population/total population), and \( d \) = margin of error at 10\% (typical value 0.1).

**RESULTS**

Socio-demographic characteristics of producers

The majority of the producers are men (83.30\%) and over 40 years old (53\%). They are all married (100\%) and belong mainly to Christian religion (70\%) and the Fon ethnic group (63\%). They are producers (90\%) with at least primary education (73\%). The results of the ANOVA and the Student Newman-Keuls test revealed that the age of producers does not vary (\( p > 0.05 \)) from one commune to another (Table 2).

Distribution of cassava actors according to selling price, average earnings and waste production

The internal selling price of cassava is similar (\( p>0.05 \)) in the communes of Aplahoué and Kétou. Its prices are higher (\( p<0.001 \)) than those in Zogbodomey. The same observations are made with regard to the quantities of cassava sold. The average daily gain in Zogbodomey is significantly higher (\( p<0.05 \)) than in Kétou and Aplahoué. The amount of waste produced (42.35 kg) is significantly higher (\( p<0.05 \)) in Zogbodomey compared to the other two communes. The number of years of experience in cassava production is significantly (\( p<0.05 \)) higher in Aplahoué and Zogbodomey compared to Kétou (Table 3).

Socio-economic characteristics of cassava processors

**Distribution of cassava processors by gender, age and education**

The majority of the processors are women (82.80\%) and over 40 years old (65.50\%) (Table 4). They are all married (83\%), and belong mainly to the Christian faith
Table 2. Socio-demographic characteristics of producers.

| Variable         | Modality     | Percentage of respondent |
|------------------|--------------|--------------------------|
|                  |              | Aplahoué | Kétou | Zogbodomey | Total |
| Gender           | Masculin     | -        | 75.00 | 95.00    | 83.30 |
|                  | Female       | 100      | 25.00 | 5.00     | 16.70 |
| Age (years)      | Age ≤ 40     | 100      | 62.50 | 35.00    | 46.70 |
|                  | Age > 40     | -        | 37.50 | 65.00    | 53.30 |
| Marital status   | Married      | 100      | 100   | 100      | 100   |
| Ethnicity        | Goun         | -        | -     | 5.00     | 3.30  |
|                  | Fon          | -        | -     | 95.00    | 63.30 |
|                  | Adja         | 100      | -     | -        | 6.70  |
|                  | Mahi         | -        | 100   | -        | 26.70 |
| Religion         | Animist      | 100      | -     | 35.00    | 30.00 |
|                  | Christianity | -        | 100   | 65.00    | 70.00 |
| Education level  | Primary      | 100      | 87.50 | 65.00    | 73.30 |
|                  | Secondary 1  | -        | 12.50 | 25.00    | 20.0  |
|                  | Secondary 2  | -        | -     | 10.00    | 6.70  |
| Profession       | Cultivator   | 100      | 87.50 | 90.00    | 90.00 |
|                  | Security guard | -    | 12.50 | 5.00     | 6.70  |
|                  | Artisan      | -        | -     | 5.00     | 3.30  |
| Informant        | Producer-processor | 100 | 12.50 | -        | 10.00 |
|                  | Producer     | -        | 87.50 | 100.00   | 90.00 |

Source: Study

Table 3. Quantitative data (mean values ± standard errors) on producers in the three production zones.

| Communes           | Age of producers (years) | Selling price of cassava internally (FCFA) | Quantity of cassava sold (kg) | Avarage gain (FCFA) | Number of year of expérience | Quantity of waste (kg) |
|--------------------|--------------------------|-------------------------------------------|-------------------------------|---------------------|-----------------------------|------------------------|
| Aplahoué           | 40.00±0.00⁹              | 12000±0.00⁹                               | 100.00±0.00⁹                 | 98000±2000⁹         | 10.00±0.00⁹                 | 13.00±1.00⁹           |
| Kétou              | 35.00±4.89⁴             | 12312.50±2995.44⁴                         | 81.25±09.15⁴                 | 35625.00±10326.69⁴ | 7.00±2.66⁴                  | 20.69±8.47⁴           |
| Zogbodomey         | 44.20±1.38⁸             | 3290.00±284.04⁸                           | 48.75±1.25⁸                  | 42125.00±6917.36⁸  | 10.05±0.56⁸                 | 42.35±3.91⁸           |
| F-Value            | 3.2                     | 13.56                                     | 15.27                         | 3.95                | 2.57                        | 5.06                   |
| Probability        | 0.06                    | 0.0001                                    | 0.0001                        | 0.03                | 0.04                        | 0.01                   |

Means followed by the same alphabetical letter are not significantly different (p > 0.05) according to the Student Newman-Keuls test.

Source: Study

(86%) and the Fon ethnic group (90%). These are female processors (62.10%), 55% of whom have no education. The results of ANOVA and the Student Newman-Keuls test revealed that the age of processors does not vary significantly (p>0.05) from one commune to another (Table 5).

Most of the women processors in each commune have more than 10 years experiences in cassava processing (76%) with an annual income of up to 150,000 CFA francs (79%). These women process at least two
Table 4. Socio-economic characteristics of cassava processors surveyed by study area.

| Variable                  | Modality                  | Aplahoué | Kétou | Zogbodomey | Total |
|---------------------------|---------------------------|----------|-------|------------|-------|
| Gender                    | Male                      |          |       | 17.20      | 17.20 |
|                           | Female                    | 100      | 100   | 82.80      | 82.80 |
| Age (years)               | Age ≤ 40                  | 100      | 100   | 34.60      | 34.50 |
|                           | Age > 40                  |          |       | 65.40      | 65.50 |
| Marital status            | Married                   | 100      | 100   | 82.80      | 82.80 |
|                           | Widows                    |          |       | 17.20      | 17.20 |
| Ethnicity                 | Fon                       |          |       | 89.70      | 89.70 |
|                           | Mahi                      | 100      | 100   | 10.30      | 10.30 |
| Religion                  | Animist                   |          |       | 24.10      | 13.80 |
|                           | Christianity              | 100      | 100   | 75.90      | 86.20 |
| Education level           | None                      | 100      | 50    | 58.60      | 55.20 |
|                           | Primaire                  |          | 50    | 41.40      | 44.80 |
| Profession                | Cultivator                |          | 100   | 72.40      | 79.30 |
|                           | Trader and farmer         |          | 100   | 17.2       | 20.70 |
|                           | artisan                   |          |       | 10.40      | -     |
| Informant                 | Producer-processor        |          |       | 34.50      | 34.50 |
|                           | Producer                  |          |       | 3.50       | 3.40  |
|                           | Transformer               | 100      | 100   | 62.00      | 62.10 |
| Quantity processed (kg)   | Q≤ 500                    | 100      | 50    | 96.20      | 93.10 |
|                           | Q > 500                   |          | 50    | 3.80       | 6.70  |
| Average gain (FCFA)       | 150 000                   | 100      | 50    | 72.40      | 79.30 |
|                           | 200 000                   |          | 50    | 17.60      | 20.70 |
| Frequency of conversions per month | 1                       |          |       | 17.20      | 17.20 |
|                           | 2                         | 100      | 100   | 72.80      | 82.80 |
| Processing experience (years) | 6                       |          |       | 11.50      | 10.30 |
|                           | 8                         |          |       | 15.40      | 13.80 |
|                           | 12                        | 100      | 100   | 73.10      | 75.90 |

Source: Study operations per month (83%) with a quantity ranging from 100 to 400 kg and less than 500 kg (93%). The results of ANOVA and the Student Newman-Keuls test revealed that the quantity of cassava processed, experience in cassava processing, earnings from processing, and the number of processing operations per month do not vary significantly (p>0.05) from one commune to another (Table 5).  

Cassava varieties grown, parts used and storage methods according to producers

The Correspondence Factor Analysis (CFA) of the
Table 5. Quantitative data (mean values ± standard errors) on transformers in the three study areas.

| Municipality  | Age of processors (years) | Quantity per year (kg) | Experience in cassava processing (year) | Quantity processed (kg) | Gain from processing (FCFA) | Number of conversions per months |
|---------------|---------------------------|------------------------|----------------------------------------|-------------------------|-----------------------------|----------------------------------|
| Aplahoué      | 40.00±0.00                | 200±0.0                | 12.00±0.0                              | 12.00±0.0               | 150 000±0.0                | 2.0±0.0                          |
| Kétou         | 60.00±0.0                 | 450.00±250.0           | 12.00±0.0                              | 7.50±2.50               | 175 000±25000              | 2.0±0.0                          |
| Zogbodomey    | 51.15±2.02                | 330.77±25.88           | 10.69±0.44                             | 6.31±0.44               | 159615.38±3941.13         | 1.81±0.08                        |
|                |                           |                        |                                        |                         |                             |                                  |
| F-Value       | 1.36                      | 1.05                   | 0.47                                   | 2.58                    | 0.63                        | 0.32                             |
| Probability   | 0.27                      | 0.37                   | 0.63                                   | 0.09                    | 0.54                        | 0.73                             |

Means followed by the same alphabetical letter are not significantly different (p > 0.05) according to the Student Newman-Keuls test.

Source: Study

Table 6. Inertia and proportion of information on the axes.

| Axis | Inertia | Proportion | Cumulative proportion |
|------|---------|------------|-----------------------|
| Axis 1 | 0.7351  | 0.6412     | 0.6412                |
| Axis 2 | 0.4113  | 0.3588     | 1                      |

Source: Study

cassava varieties grown, parts used, and the different conservation methods used by producers according to the communes showed that the first two axes explain 100% of the total information (Table 6).

The CFA analysis (Figure 2) shows that in Zogbodomey, both male and female producers, grow several varieties of cassava such as Adjakpatin, Sowé, Glo, Ahotonon, Houla, Adohoungbo, Agric, Wokpe, Adjagoun, Fingnin and Donkoui. The roots, flesh, peelings and leaves are the parts they used. Their method of conservation consists mainly of keeping them underground in the field (Figure 2). The varieties grown by producers living in the commune of Kétou are adjagoun and fingnin, followed by those introduced by extension workers in Benin, namely the BEN and RB varieties. Their method of conservation is to keep them underground in the field or to transform them into Lafoun (cassava flour). In the commune of Aplahoué, the Finton variety is the most produced type. Their method of conservation is to transform most of their production into by-products (Figure 2). Figure 3 shows that the majority of producers in each commune surveyed consume 50% of their production and the remaining 50% are destined for direct or indirect sale (that is, sale of fresh or processed roots).

Cassava shelf life and loss and waste management by producer

The results of the PCA conducted on cassava shelf life and loss and waste management allowed the relationships between these parameters to be described and their analysis refined by producers in the three communes. These results indicate that the first two axes explain 100% of the total information (Table 7).

The projection of the different variables in the system of axes reveals that in the commune of Zogbodomey, producers keep their cassava for up to 14 months without deterioration (Figure 4). This conservation allows them to record almost no production losses. However, the few losses recorded (17%) are used as cattle feed. Similarly, the waste from post-harvest losses is transformed into organic fertiliser and biogas. For producers living in the commune of Kétou, cassava roots are kept underground for three to six months and after the post-harvest period cassava root by-products are kept for two to three years. In this commune the post-harvest losses recorded are high and are thrown away. Producers in the commune of Aplahoué, on the other hand, keep their production for two to three days and the post-harvest losses are burnt (Figure 4).

Processed cassava varieties, parts used and processing products

The results of the Correspondence Factor Analysis (CFA) carried out on the data related to processed cassava varieties, parts used for processing as well as the different processing products made by the processors according to communes showed that the first two axes explain 100% of the total information (Table 8).

Figure 5 presents the results of the CFA conducted on
Figure 2. Projection of varieties, parts used and types of conservation into the factorial axis system. The words Conserv denote the types of conservation. Source: Study

Figure 3. Post-harvest use of cassava roots. Source: Study
Table 7. Eigen value of the first four principal components.

| PC axis | Eigenvalue | Proportion | Cumulative |
|---------|------------|------------|------------|
| Axis 1  | 8.8671     | 0.591      | 0.591      |
| Axis 2  | 6.1329     | 0.409      | 1          |
| Axis 3  | 0          | 0          | 1          |

Source: Study

Figure 4. Retention time and waste management by producers according to communes in the principal component analysis (PCA).
Source: Study

Table 8. Inertia and proportion of information on the axes.

| Axis   | Inertia | Proportion | Cumulative proportion |
|--------|---------|------------|-----------------------|
| Axis 1 | 0.6774  | 0.9472     | 0.9472                |
| Axis 2 | 0.0378  | 0.0528     | 1                     |

Source: Study

Women processors. Results reveal that in the communes of Zogbodomey and Aplahoué, the varieties used by women processors are Hounla, Adohoungbo, Ahotonon, Sowé, Doukoui, Wlokpe, Agric and Glo. They use the roots, peelings and flesh. These women transform the flesh into garri, roasted cassava and tapioca. The varieties used by them in Kétou are Adohoungbo and Fingnin, as well as those introduced by extension workers in Benin, namely the BEN and RB varieties. They generally transform them into agbéli (fermented cassava paste) or roasted cassava (Figure 5). Of all the varieties, Adohoungbo, Hounla and Glo are respectively the most processed (Figure 6).

Sourcing location, lean season and processing waste management

The results of the PCA conducted on procurement location, lean season and processing waste management allowed the relationships between these parameters to be described and refined by the women processors in the three communes surveyed. These results indicate that the first two axes explain 100% of the total information (Table 9).

The projection of the different variables into the system of axes defined by the principal component analysis (Figure 7) reveals that in Zogbodomey, the processors, in
addition to their own harvest, obtain their raw materials from the centre and north of Benin. Generally, they manage to obtain supplies throughout the year, but it is in the period from April to June that they experience stock shortages. The waste from processing generally amounts to 15 to 20 kg/month and is then used as animal feed or organic fertiliser, and/or sometimes it is thrown away in communal land (in the case of peelings) (Figure 8). The

Figure 5. Projection of varieties, parts used and types of transformation into the factorial axis system following a Correspondence Factor Analysis (CFA). The Transfo tags indicate the types of transformation.
Source: Study

Figure 6. Cassava varieties processed per year.
Source: Study
Table 9. Eigen value of the first four principal components

| PC Axis | Eigen value | Proportion | Cumulative |
|---------|-------------|------------|------------|
| Axis 1  | 10.912      | 0.909      | 0.909      |
| Axis 2  | 1.088       | 0.091      | 1          |
| Axis 3  | 0           | 0          | 1          |

Source: Study

Figure 7. Procurement location, lean season and waste management by processors by commune in the principal component analysis (PCA).
Source: Study

Figure 8. Quantity of post-processed cassava root waste per month [a] and its utility [b].
Source: Study
**Table 10. Pathologies and organs of cassava used in traditional recipes according to the areas surveyed in Benin.**

| Pathologies and traditional uses | Parts used | Recipes                                                                 | Communes                                      |
|----------------------------------|------------|-------------------------------------------------------------------------|-----------------------------------------------|
| Anemia in children               | Sheets     | Crushed seedlings + Peak milk and make the children drink the solution  | Zogbodomey, Aplahoué, Kétou                  |
| Protection against accidents     | Cuttings   | Keep a 20 cm cutting in your travel bag when travelling                 | Zogbodomey, Kétou, Djidja                    |
| Aphrodisiac                      | Roots      | Eat raw the root of the Sowé variety                                    | Zogbodomey, Djidja, Aplahoué, Kétou         |
| Hemorrhages                      | Sheet      | Crush the sheet to put in the machete wound and other material wounds  | Zogbodomey, Aplahoué, Kétou                  |
| Malaria                          | Roots      | Cut roots and soak in water while drinking                              | Zogbodomey, Aplahoué, Djidja                |
| Headaches                        | Sheets     | Triturate the local soap sheet (koto) and wash the head with            | Zogbodomey, Aplahoué, Djidja                |

Source: Study

processors living in Kétou and Aplahoué, on the other hand, in addition to their own harvests, mainly buy from other communes in southern Benin. The waste from processing generally amounts to 10 to 15 kg/month and is simply thrown away (Figure 8). In Aplahoué, processors experience scarcities between October and December, while those in Kétou experience shortages between January and March (Figure 7).

**Therapeutic uses of cassava parts according to respondents**

Table 10 shows that the treatment of pathologies varies according to the organs of the cassava and the people surveyed. Cassava leaves are used in these areas to treat anaemia in children (85%), haemorrhage (88%) and headaches (47%), while the roots are used to treat erectile dysfunction and malaria (93%). Cuttings are used against accidents, but only 25% of the population surveyed still uses this recipe.

**DISCUSSION**

This study revealed the level of knowledge of cassava actors (producers and processors) on the different uses of cassava organs as well as the waste products regenerated after processing cassava roots. In all the areas surveyed, cassava producers are mostly men (83.30%), while cassava processing is done by women (82.80%). The same findings were reported in the International Fund for Agricultural Development (FIDA, 2009) and state that customary laws make it virtually impossible for women to inherit land despite the fact that they constitute up to 80% of the agricultural workforce.

They are much more involved in the processing and sale of cassava products. All the actors surveyed are over 40 years old. The older farmers are generally more experienced than the younger ones, which gives them more tips on how to improve yields. It should therefore be remembered that cassava is the source of several food and marketable products in Benin, and its harvest is almost permanent throughout the year. As a result, processing, which is essentially artisanal and village-based, is carried out by women working alone or in groups. The activity is profitable overall, but profits vary considerably depending on location, season of production and other factors (Fanou, 1994).

The major constraint to cassava production and processing is the fresh storage of tuberous roots. In southern Benin, two methods of storing fresh roots are adopted. These are conservation in the ground and processing into several cassava root derivatives. In the commune of Zogbodomey, producers keep their cassava underground in the field for up to 14 months without deterioration,
while in Kétou the duration varies from three to six months for the same method of conservation, and from three at the most in Aplahoué. Post-harvest losses are much higher in the commune of Kétou than in the other two communes. This result can be explained by the quality of the soil in the communes visited. It should be noted that cassava can be stored for several months underground, but once it is uprooted, it must be processed within three days, otherwise it can cause losses of up to 100% of the harvest. The results of studies carried out in Côte d'Ivoire show that after harvesting, these roots have a maximum shelf life of three days, after which blackening and rotting occur, making them unsuitable for human consumption, which is the primary use of this product (Onwaka and OgboGU, 2007).

Moreover, as cassava is an important crop used for food, feed and industrial products, traditional processes to extend storage time have been considered and developed by cassava consuming companies (Amani, 2010). These processes concern the preservation of cassava roots in the soil either after maturity or freshly harvested, the storage of fresh cassava roots in silos-mules, crates, by soaking in water, in plastic bags, and the preservation by production of cassava pods. All these methods allow for short term preservation. Cassava processed in granular form (garri, tapioca or semolina) can be stored for more than two years at room temperature while retaining all the qualities of fresh cassava.

In general, in the areas surveyed, women processors carry out at least two operations per month (83%) with a quantity of less than 500 kg (93%) and an annual income of up to 150,000 FCFA (79%). This annual income is much lower than those of Ahoyo and Madji (2016) who report annual incomes for individual women processors ranging from over three million in the Plateau to over one million in the Collines and Couffo.

Some cassava processors in Kétou and Aplahoué (60%) are unaware of the usefulness of root waste (peelings and wastewater). As a result, cassava processing is considered a threat to the environment and human health because of the large amounts of waste it generates. However, studies by Ehouinsou et al. (2006) have shown that dried cassava peelings can be used either to supplement the diet of small ruminants or as a component in rations served to small ruminants. They also show that both sheep and goats consume cassava root peelings well without health problems, and most importantly, adding urea to the peelings and feeding them at different rates in rations improves total feed intake, allowing sheep to make good weight gains. In general, the ways in which cassava is used vary from place to place around the world. All organs of the plant have an economic and/or food value (Padonou, 2010). The leaves are used for both food and feed and are also used as packaging for some foods. The woody stems constitute vegetative propagation material sold to producers (Akoroda, 2007). The roots are the main organs for which the plant is cultivated (Ba et al., 2015).

In addition, different uses are made of cassava root organs for therapeutic purpose. Cassava leaves are used in the surveyed localities to treat anaemia in children, haemorrhage, headaches; while the roots are used in the treatment of erectile dysfunction and malaria. The cuttings are used against accidents. In Congo, for the same organs of cassava plants the following pathologies are cited (Ivan, 1999):

(1) Metrorrhagia of pregnancy, haemorrhage of childbirth: aqueous macerated tuber without bark and powdered residue of the macerate, per os.
(2) Emetic: macerated stem in fermented corn water, per os.
(3) Cutaneous dermatoses: juice of crushed leaves, applied locally.
(4) Snake bite: leaf paste, mixed with cooking salt for local application.
(5) Heart palpitation: crushed leaves with added cooking salt and palm oil for consumption.
(6) Coughs: tuber crushed with chilli, to be eaten. Wounds, abscesses, chickenpox: paste of tuber or leaves, applied locally (rubbed with the juice for chickenpox).
(7) Constipation, indigestion: grated tuber juice, per os.
(8) Diarrhea: boiled or pulverized fresh tuber, to be consumed.
(9) Toothache: macerated dry leaves, as a mouthwash.
(10) Emmenagogue: infused leaves, per os
(11) Headache: paste of crushed leaves, applied to the forehead.

Of all the diseases mentioned, the respondents (100%) had no knowledge of the use of cassava organs to treat cancer. Nowadays, several testimonies have been reported regarding the treatment of cancer by eating cassava roots. Indeed, amygdalin (D-mandelonitrile-ß-D-gentiobioside) is a popular and well-documented cyanoic disaccharide that is very abundant in the seeds of apricots, almonds, cherries, plums, peaches, apples and other rosaceous plants used in human nutrition (Viorica-Mirela et al., 2006).

Conclusion

This study shows that cassava is of great value for human and animal nutrition as well as for traditional therapies in southern Benin. In addition, there is a lack of means and systems to manage post-harvest losses and waste from the various processing operations, which leads to increased environmental pollution. The study revealed that these actors benefit from their production
and/or processing because it helps to meet the family's needs to some extent.

In view of these nutritional and therapeutic values in the traditional domain, it would therefore be interesting to identify the bioactive molecules in the different cassava organs produced in Benin.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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