

## Ethnobotanical study of edible plants sold in three markets and implications for food security in the town of Daloa (Central-West Côte d'Ivoire)

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### Abstract

An ethnobotanical study of edible plants was carried out in three markets in the town of Daloa. The ethnobotanical approach chosen consisted of visiting the tables of the women interviewed in order to send them a questionnaire. Only 5% of edible plant traders are men. Most of the women traders had not been to school. These investigations revealed that parts of 41 species, divided into 31 genera and 21 families, are sold. The Solonaceae family is the most widely sold on the three markets. Seven parts of edible plants are sold. Whithout, fruits, with a proportion of 38.30%, are the most widely sold. Some parts are eaten dry. Others are used fresh. The different parts of the plants are consumed in ten modes, according to the informants. Several leaves and seeds are eaten in sauce.

**Keywords:** Ethnobotany; Edible plants; Daloa; Côte d'Ivoire

### 1. Introduction

The rich and diverse tropical flora offers a multitude of spontaneous or cultivated plants that can help guarantee food and health security for populations (Kassi, 2013; Kouakou, 2019 a; Harouna Diète *et al.*, 2023). Edible plants play a fundamental role in human societies and have been an important source of food for humans throughout history and continue to be an essential component of the diets of many communities (Aschalew *et al.*, 2022; Caballero-Roque *et al.*, 2024). However, the food situation in sub-Saharan Africa in general and in Côte d'Ivoire in particular is very worrying (Bédiakon, 2020). Moreover, according to a study by FAO-CI (2018), around 20.5% of the population of Côte d'Ivoire has not reached the minimum level of calorie intake and the diet of this population has remained undiversified in all age groups.

According to Kouakou (2019 b), the study of local knowledge about plants, from an ethnobotanical perspective, is essential to enhance and preserve traditional knowledge while supporting the sustainable management of natural resources. Furthermore, according to Vanié Bi *et al.* (2021), the development of wild edible plants, integrating the socio-economic and environmental heritage of farmers, appears to be an alternative strategy for sustainably increasing incomes and improving meals for poor households in rural areas.

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In Côte d'Ivoire, as in other African countries, it is crucial to gain a better understanding of the diversity of food plants and their role in the social and economic dynamics of local markets. This study, carried out in three markets in the town of Daloa, is part of this drive to enhance the value of local food plants. It aims to identify the plants sold at the markets, document their food uses and analyse their economic role for traders and consumers. The central problem can be formulated as follows: what is the diversity of food plants present in the markets of Daloa, and what are their uses and their socio-economic importance?

The general aim of this work is to highlight the crucial role of food plants sold on local markets in enhancing biodiversity and economic development. Three specific objectives follow on from this general objective. The first specific objective is to draw up an inventory of the various food species sold in three markets in Daloa. The second objective is to identify the different parts of plants that are marketed. The third objective was to identify the shape and mode of consumption of different parts of edible plants.

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## 2. Materials and methods

### 2.1. Study site

This study took place in three markets in the town of Daloa. The town of Daloa is located in central western Côte d'Ivoire, 141 km from Yamoussoukro, the political capital, and 383 km from Abidjan, the economic capital (Yéboué, 2020). The town lies at 6°53 North latitude and 6°27 west longitude (Ahoussi *et al.*, 2019). It is bordered to the North by the departments of Vavoua and Zuénoula, to the South by the department of Issia, to the East by the department of Bouaflé and to the west by the department of Zoukougbeu (Gouaméné *et al.*, 2019). It is the capital of the Haut Sassandra department and region, occupying 28% of the surface area, and is the economic hub of the region (Kouassi *et al.*, 2019). It has an area of 15,200 Km<sup>2</sup> for an estimated population of 591633 inhabitants (INS, 2014). The results of the recent census published by the INS (2021) estimated the population at around 421,879, making it the 4th most populous city in the country. The population is made up mainly of natives (Bété, Niaboua and Gouro), non-natives (Baoulé, Sénoufo, Malinké) and ECOWAS populations, as well as a Lebanese community (Kouakou, 2019 a).

In Côte d'Ivoire, the Centre-West region has a humid tropical climate (Yéboué, 2020). This part is thus characterised by two seasons (Kouakou, 2019 a) of unequal length, somewhat disrupted by current climate change. There is a rainy season from March to October. During this period, the amount of rainfall varies from month to month. Rainfall peaks in September (168.22 mm). After the rainy season, there is a dry season which begins in November and ends in February. The average annual temperature recorded at the Daloa station is 25.8°C. Monthly temperatures during this dry period vary slightly, as they are generally below 5°C. The lowest temperature was recorded in July (24.93°C). The hottest month of the year is February, with a temperature of 28.06°C (Figure 1).

### 2.2. Equipment

#### 2.2.1. Plant material

The plant material consists of the various parts of plant species consumed and sold by traders in the three markets selected for this study.

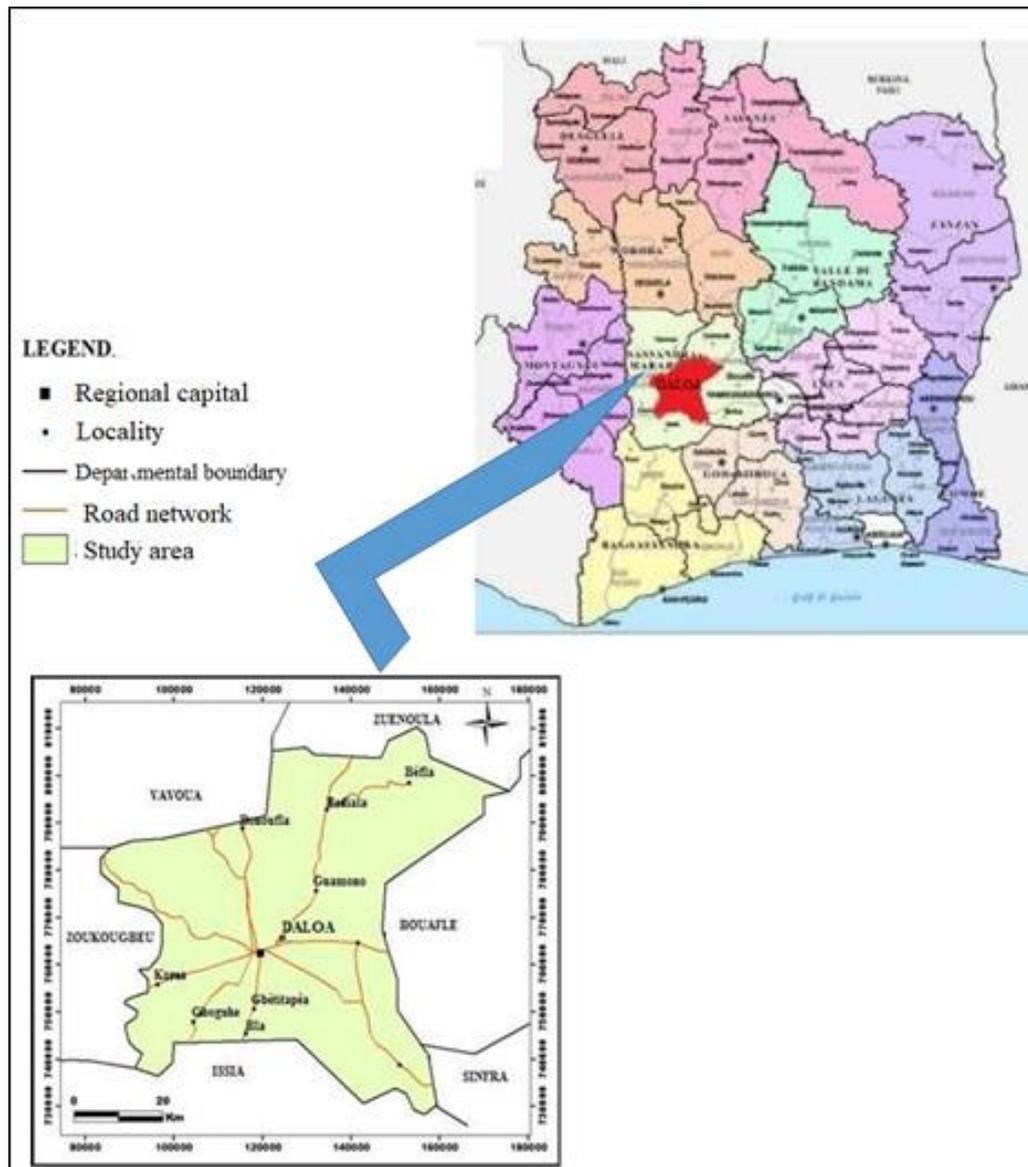
#### 2.2.2. Technical equipment

The technical equipment used during the study consisted of: a digital camera for taking photographs; a notepad for collecting specific information; a plastic bag for transporting the species and newspaper for making herbariums.

### 2.3. Data collection

#### 2.3.1. Survey periods

These surveys took place over half a year (from December 2024 to May 2025). We chose three months: December, January and February, when rainfall is rare, and three months (March, April and May) during the rainy season. The aim is to collect as many food plants as possible for sale during both periods of the calendar year.



**Figure 1** Geographical location of the town of Daloa (Kouakou et al., 2024)

### 2.3.2. Choice of interpreters and guides

The ethnobotanical surveys were preceded by a scoping visit. The information gathered was used to compile a database on the dietary use of commercialised plant organs. Ethnobotanical data was collected through semi-structured interviews. This technique has been used by several authors, including Abera and Belay (2022) ; Wassie, (2024), to collect information on edible plants in various studies. During the interviews, we were assisted by interpreters and guides taken from each market. These guides were chosen according to two criteria. Firstly, on the basis of their knowledge of plants in their local language. Secondly, they had to be fluent in the local language and understand and be able to express themselves in French (Kouakou, 2019 b; Bédiakon, 2020). The interviews were conducted in local languages (Malinké, Bété or Baoulé) and in French. The presence of interpreters facilitated communication between us and the food plant traders.

### 2.3.3. Ethnobotanical approach used

The approach chosen consisted of visiting the tables of the women interviewed in order to send them a questionnaire. The information collected concerned the socio-demographic status of the respondent, the vernacular name of all the spontaneous plants found on their table, the organ consumed, the place of supply, the state of consumption, the method of harvesting, the method of culinary use, the taste, the abundance and the periods of availability.

## 2.4. Data Analysis

### 2.4.1. Identification of samples

Some plant samples were collected and identified with the help of local informants. Other samples collected (fruits, seeds, tubers, flowering or fruiting branches), on the other hand, were identified using the following works: Aké-Assi (2001), Aké-Assi (2002). The classification of families follows the fourth version of the Angiosperm Phylogeny Group (APG IV, 2016) and the scientific names have been updated using the APD database (African Plants Database version 3.4.0).

### 2.4.2. Socio-demographic data Analysis

The proportion of people involved in the marketing of edible plants is given by the following formula :

$$P (\%) = \frac{n}{N} \times 100$$

Where:

*n* is number of informants of one sex;

*N* is total number of respondents interviewed during the survey

### 2.4.3. Informants level of education

The informants level of education is expressed by the proportion of each level. The proportion with which level is cited *P* (%) and calculated using following formula :

$$P (\%) = \frac{n}{N} \times 100$$

Where:

*n* is the number of respondents a level;

*N* is the total number of respondents interviewed during the survey.

### 2.4.4. Frequency of each part consumed

The frequency of each part consumed (FPC) was calculated. This frequency was used to identify the most and least used parts. The formula used is as follows:

$$FPC (\%) = \frac{npc}{N} \times 100$$

Where :

*npc* is number of informants using the part consumed

*N* is the total number of informants who sold the species

### 2.4.5. Mode of Consumption Frequency of Wild Edible Plants sold

Frequency of consumption mode of edible plants sold (FC) represents the frequency of informants who have previously consumed the plant. The FC was calculated as:

$$FC = \frac{ncm}{N}$$

Where :

ncm is number of informants who have previously used the consumption mode

N is the total number of informants who sold the species

### 2.5. Ethical considerations

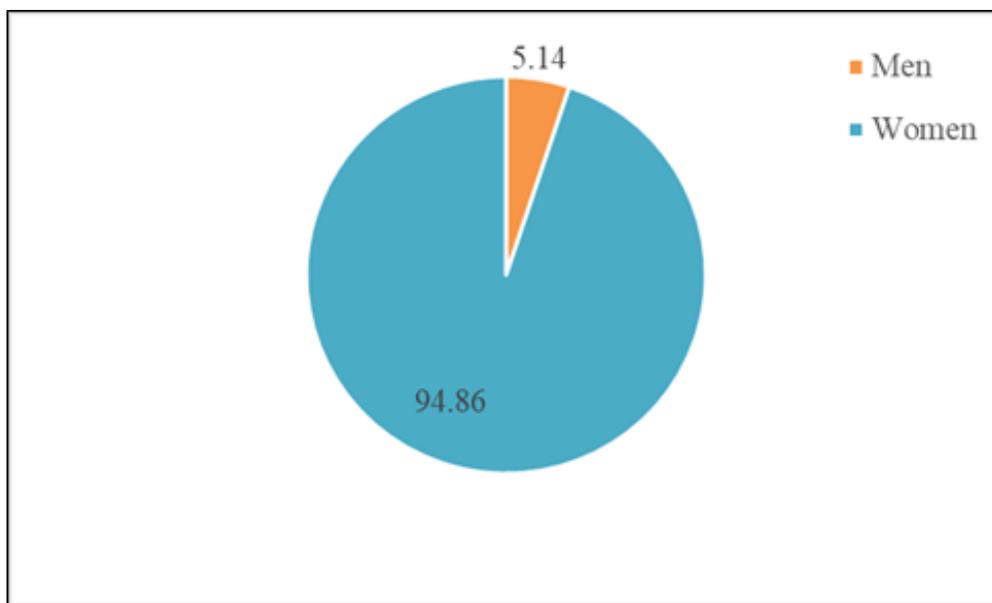
Before the study, edible plant traders of each surveyed market were informed of the research project and prior consent was required in accordance with the recommendations of the Ethnobiology International Ethics Code for this research. Data collection was carried out with special care to the cultural views of the local communities of the study area.

## 3. Results

### 3.1. Information on informants

#### 3.1.1. Gender of people involved in selling edible plants

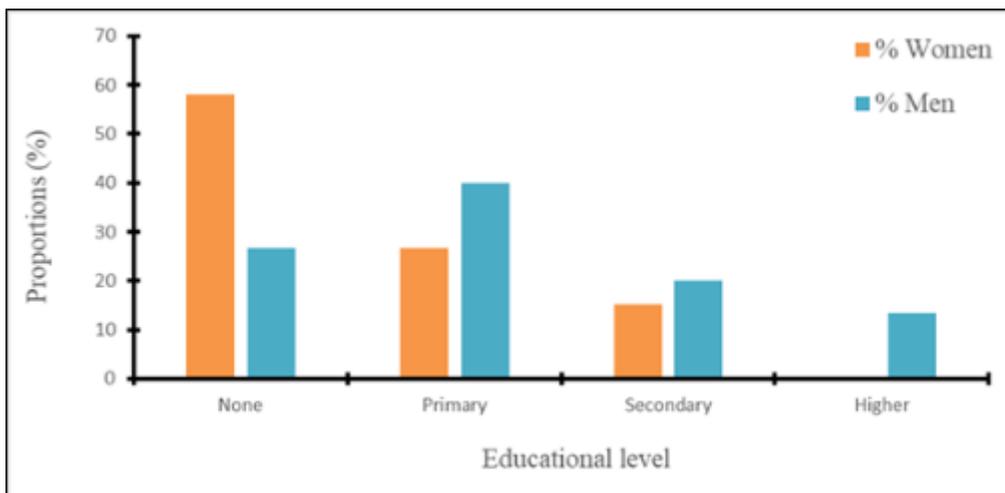
Our investigations revealed that both men and women sell edible plants. However, with a proportion of 95%, women account for the majority of those selling edible plant species (Figure 2). These women market several parts of the plants sought for consumption. In contrast, at 5%, men are very poorly represented in the sale of edible plants. These men sell only yam tubers. Results from a *t-test* showed a difference at the limit of statistical significance ( $p = 0.05$ ) between men and women involved in selling edible plants.



**Figure 2** Breakdown of food plant traders by gender

#### 3.1.2. Informants level of education

Our research shows that some edible plant traders are illiterate, while others are well educated. With a proportion of 58.12%, illiterate women are the most numerous. It should be noted that none of the female food plant traders had completed higher education. Among men, 40% had attended primary school. This proportion is highest among men, followed by those who are illiterate, with a proportion of 25% (Figure 3).



**Figure 3** Educational level of food plant traders

### 3.2. Edible plants sold in markets in the town of Daloa

There are 41 food plants listed in markets in the town of Daloa. They belong to 31 genera and 23 families. The Solanaceae family, with seven species, is the most represented in the various markets. It is followed by the Malvaceae family, with four species. Apart from these families, which are well represented in the markets, other families are very poorly represented. This is the case for Bromeliaceae, Poaceae and Arecaceae, which each have one species sold in the markets (Table).

#### 3.2.1. Proportions of edible parts of plants sold

People in the town of Daloa look for seven parts of plants. These are: bulbs, leaves, flowers, fruit, seeds, roots and tubers. Our investigations revealed that fruit, with a proportion of 30.95%, is the most commonly sold part. These fruits are followed by leaves and seeds with a proportion of 23.81% for each part. In contrast, the bulb of *Allium cepa* L. (onion) and the flower of *Hibiscus sabdariffa* L. (Bissap) with a proportion of 2.38% are the parts of plants consumed least sold in the three markets in the town of Daloa (Figure 4).



**Figure 4** Different parts of food plants sold in Daloa markets

### 3.2.2. Condition of the edible and sold parts

The various parts are consumed both fresh and dry. From these investigations, it appears that the parts consumed fresh are the leaves of several plants. This is the case for *Corchorus olitorius* L. (Figure 5 A) and *Allium cepa* L. (Figure 5 B). A part from the leaves, the seeds of edible plants are eaten fresh. *Elaeis guineensis* (Figure 6 A) and *Arachis hypogaea* L. (Figure 6 B) are among the plant species whose seeds are eaten fresh and are highly prized. Unlike the parts that are eaten fresh, other parts are eaten after drying. This is the case with the leaves of *Bombax costatum* L., *Ceiba pentandra* L., etc.



A: Fresh *Corchorus olitorius* leaves; B: Fresh *Allium cepa* leaves.

**Figure 5** Some leaves eaten fresh



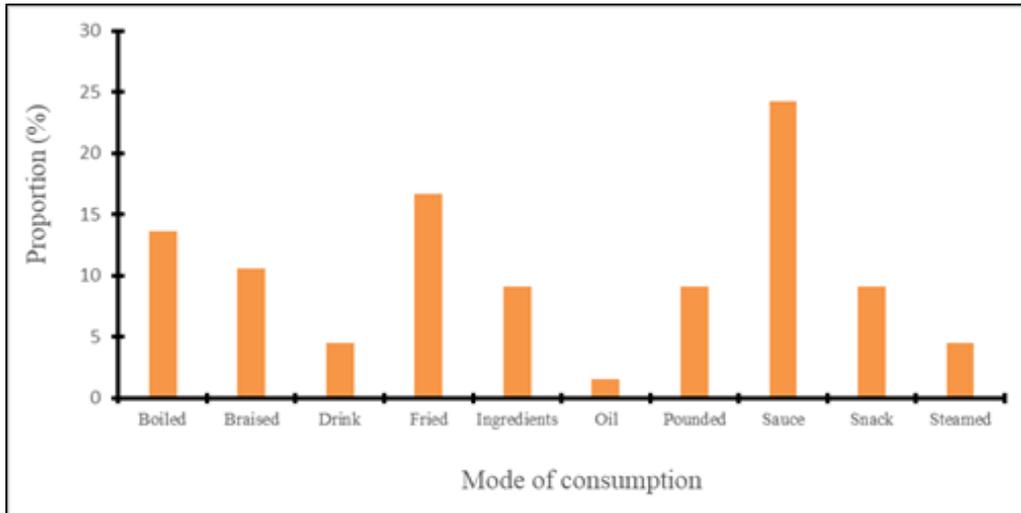
A: *Elaeis guineensis* seeds in a bowl; B: *Arachis hypogaea* seeds in a bowl.

**Figure 6** Some fruit and seeds eaten fresh

### 3.2.3. Mode of consumption of edible plants sold in markets in the town of Daloa

The different parts of the plants are consumed in ten ways. With a proportion of 24.24%, sauce is the most commonly used method (Figure 7). The parts used to make sauces are: leaves, fruit and seeds. Snacks, with a proportion of 16.67%, are the second most common use of edible plant parts sold in the three markets visited. Only one part of the plants, the fruit, is eaten directly as a snack. These foods generally do not go through the fire. Some fruits, such as those of *Mangifera indica* (Figure 8 A), are eaten directly after a simple washing with water. Other fruits such as *Persea americana* (Figure 8 B) can be eaten in the same way. However, these fruits can be eaten with a little seasoning (onion, salt and oil) with bread or yam porridge.

Many parts of edible plants undergo processing before being eaten. This is the case for tubers and certain roots. Among these tubers, the most widely consumed are those of *Dioscorea spp.* (Figure 9 A). These yam tubers can be boiled, braised, steamed, fried or mashed. These many ways of eating *Dioscorea spp.* (yam) make it an important food source for the people of Daloa. In addition to the different varieties of yam that are consumed after processing, *Manihot esculenta* Crantz (Figure 9 B) can be consumed in several ways. This species is widely consumed in Daloa in various ways, including steamed (Attiéké, Attoukpou and placali), boiled, braised and mashed.



**Figure 7** Mode of consumption for different food plants



A: some ripe *Mangifera indica* fruit; B: some *Persea americana* fruit

**Figure 8** Some foods eaten as snacks



A: Some *Dioscorea sp.* tubers; B: Some *Maniokt esculenta* roots

**Figure 9** Some parts of plants consumed after processing

#### 4. Discussion

Very few men are involved in the marketing of edible plants in the markets visited. These results are not limited to the Daloa markets. Indeed, in Cameroon, according to Betti *et al.* (2016), women with a proportion of 88.24%, represent the majority of the traders interviewed involved in the marketing of edible plants in the Yaoundé markets. The low proportion of men in the sale of edible plants could be justified by various reasons. According to our informants, men grow several edible plants and women are responsible for marketing them. Similar results were obtained by N'dri *et al.* (2008). According to these authors, activities requiring a great deal of physical effort are reserved for men, while those requiring a fair amount of time, such as trading, are reserved for women. Furthermore, for other informants, trading is not a major activity for men in the Central (Baoulé) and Central West (Bété).

In terms of level of education, the majority of traders have not been to school. This high proportion of people who have not been to school involved in plant marketing could be justified by the fact that these people find trading a main income activity. This result differs from those of Bédiakon *et al.* (2018). In fact, according to work carried out in the department of Agboville, the secondary level is the most represented with 45.5% of respondents.

Our investigations revealed that several edible plants such as *Discorea alata*, *Elaeis guinensis*, *Capcicum frusyescens*, etc. are sold. This finding is not an isolated one. Indeed, the work of Kouamé *et al.* (2015) mentions that *Dioscorea alata* tubers, *Elaeis guinensis* seeds, *Capcicum frusyescens* fruits, are consumed in Daloa. Kouadio *et al.* (2017) also reported the consumption of *Mangifera indica* and *Persea american* fruits in Daloa. These plants are consumed because they contain several chemical components that are useful for human health. These chemical components include vitamin C, flavonoids and alkaloids found in the fruits of *Capsicum frutescens* and *Elaeis guinensis* respectively (Kouamé, 2015).

Various parts of the plants that are consumed are sold in the three markets visited. However, flowers, bulbs and roots are used less. In another study, flowers, seeds and stems are used less and resin was rarely used. (Kaoutar *et al.*, 2022). This study shows that different parts of an edible plant are sometimes used. Similar results were obtained by Sina and Degu (2015). According to these authors, fruits, shoot, flower/nectar and tubers roots and barks are edible

The research revealed that some plants are sought after for their leaves, which are sold. This is the case for *Corchorus olitorius* and *Allium cepa*. The marketing of the leaves of these plants is an activity that takes place in several markets in Côte d'Ivoire (Atchibri *et al.*, 2012). From this work, we note that among the seeds that are sold, those of *Arachis hypogaea* and *Elaeis guinensis* are the most abundant and most sought-after. Studies by Kouamé *et al.* (2015) and Ngoma *et al.* (2017) have shown that the seeds of these plants are widely consumed and sold elsewhere in the country's various markets.

Ten mode of consumption were recorded, of which the majority (24.24%) were consumed as Sauce. This variability in edible plant mode of consumption reveals the cultural diversity and importance of edible plants in people's lives. In addition, Mahklouf (2019) obtained 12 mode of consumption of edible plants.

This research reveals that household diets are generally not very diversified. People eat mainly yam, taro and cassava roots for long periods. These tubers are supplemented by plantain and rice for the rest of the year. Similar results were obtained by MSLS *et al.* (2013). According to these authors, the diet of several families in Côte d'Ivoire is essentially based on tubers, roots and cereals, which contribute more than 65% of daily energy intake. Yam tubers are one of the most widely consumed and sold foods in the markets visited. This result could be justified by the nutritional potential of these tubers, which meet consumers' needs.

According to N'Goran *et al.* (2024), yam tubers contain total carbohydrates (87.89±2.24%) composed mainly of starch (78.44 ± 2.06%), proteins (4.95 ± 0.93%) and lipids (1.22 ± 0.85%). In addition to yam, cassava is also highly sought after. Several food products (raw flour, gari, etc.) are derived from the cassava root. Similar results were obtained by Diallo *et al.* (2013). According to these authors, in Africa, the products derived from processing are varied and differ depending on the area: cossettes, raw flour, gari, tapioca, etc. In addition, these roots are used to make three dishes, attiéké, attoukpou and placali, which are highly prized in Côte d'Ivoire. According to Yéboué *et al.* (2017), the preference for these foods is due to the fact that they contain high levels of carbohydrates (96.10 ± 0.22, 95.68 ± 0.19 and 95.90 ± 0.28 respectively). In addition, these three foods contain magnesium (Mg) (4.38±0.14; 5.14±0.11; 5.08±1.21; respectively), iron (Fe) (0.21±0.08; 0.26±0.07; 0.21±0.03; respectively) and several other minerals such as sodium (Na), potassium (K), calcium (Ca) and phosphorus (P).

This work shows that some parts of plants are eaten fresh. In contrast, other edible parts are dried before being used. This practice is not exclusive to the three markets and to the peoples of the Central-West. Indeed, Kouakou (2019 b)

found some plant parts such as the calyxes of *Bombax costatum* Pellegr. & Perr which are dried before being consumed by the Koulango and Lobi. This practice could be justified by the fact that traditional beliefs and values influence decisions. Thus, certain dietary preferences regarding the use of plants remain deeply embedded in the culture (Sêmihinva *et al.*, 2013; Kouakou *et al.*, 2019).

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## 5. Conclusion

This ethnobotanical study was carried out in three markets in the town of Daloa. It revealed that 41 edible plants are sold. These edible plants are an essential resource for food. Their diversity reflects the rich plant heritage of the town of Daloa and the know-how of its communities. The investigations carried out shed light on the parts consumed, the state in which the plant is consumed and the method of consumption. This study provides information on the edible plant species sold in Daloa's markets. It is therefore recommended that ethnobotanical research be encouraged and that local initiatives to conserve plant biodiversity be supported.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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