Ethnobotanical Knowledge and culinary Uses of *Garcinia afzelii* Fruits in Vavoua, Haut-Sassandra Region, Ivory Coast

ABSTRACT

|  |
| --- |
| **Background:** Many edible plants are consumed in Côte d’Ivoire. However, some species produce fruits that are of little interest, such as the fruits of *Garcinia afzelii*. These fruits are largely unknown to the population and often fall from trees, where they rot. Aim: The present study aimed to conduct an ethnobotanical study to gain a better understanding of the *Garcinia afzelii* tree and its organs.**Study Design:** The survey was conducted in five localities in the Vavoua department (Seïtifla, Bonoufla, Gatifla, Bahoulifla, and Gnamienkro), targeting a sample of 600 individuals with diverse profiles. Data were collected through questionnaires and analyzed using the Chi-square test to identify potential dependencies between the studied variables. The study aims to specify the level of knowledge about *Garcinia afzelii* fruit trees and fruits, their use, and consumption.**Results:** The Chi-square independence test showed that the variables locality, age, education level, and ethnic group significantly influence (P < 0.05) the level of knowledge and use of *Garcinia afzelii* fruits. Regarding knowledge of the fruits, awareness rates vary between 33.33% in Bonoufla and 81.66% in Gatifla. Concerning education level, illiterate individuals and those with a primary education level show the highest awareness rates (84.21% and 71.14%, respectively), while secondary and higher education levels display lower percentages. Age plays a determining role. Individuals aged 60 and above know the fruits 100%, compared to 91.05% for those aged 41-59 and only 34.78% for those under 30. Results also revealed that indigenous people have the highest awareness rate (78.08%) compared to 55.69% for Ivorian migrants (*χ²obs=13.04 > χ²théo=5.99; p < 0.05*). Finally, fruit utilization varies significantly by locality, reaching 93.68% in Gnamienkro compared to 68.11% in Bahoulifla (*χ²obs=21.05 > χ²théo=5.99; p < 0.05*). Depending on education level, utilization rates range between 77.50% and 83.17%, with a predominance among individuals with a primary education level.**Conclusion:** This study highlights disparities in the knowledge and use of *Garcinia afzelii* fruits based on sociodemographic characteristics. These findings suggest the need to promote awareness and enhance the value of this resource among less-informed populations, encouraging its sustainable exploitation. |

***Keywords:*** *Garcinia afzelii, fruits, food uses, knowledge, ethnobotany*

1. INTRODUCTION

In recent years, a rapid decline in the traditional knowledge of important plants has been recognized by researchers worldwide for various reasons, such as massive industrialization and tourism. The conservation and sustainability of ethnobotanical knowledge have become a global concern, which indicates the importance of ethnobotanical records of knowledge before its disappearance (Lin et al., 2021; Murmu et al., 2016). Spontaneous edible plants play an essential role in the traditional food systems of rural populations in sub-Saharan Africa. They constitute an important source of nutrients and are often integrated into the local pharmacopoeia due to their medicinal properties (Shiundu, 2002; Mawunu et al., 2020). However, these plant species are increasingly threatened by deforestation, demographic pressure, and changing dietary habits, leading to a gradual loss of associated ethnobotanical knowledge (Kouamé et al., 2008; Ravi et al., 2006). Among these plants, species of the *Garcinia* genus are widely used in traditional medicine and as food in various intertropical regions (Piba et al., 2018). However, some species remain little known and underutilized despite their multiple potential uses. Such is the case of *Garcinia afzelii*, a shrub whose vegetative parts are commonly used in Côte d'Ivoire, particularly for making toothpicks and treating certain ailments (CNRA, 2014). In contrast, its fruits are largely neglected, although they are consumed in some Central African communities (Guedje et al., 2001). Ethnobotanical studies serve as a crucial tool for preserving and enhancing traditional knowledge related to plants. They help document local knowledge, usage patterns, and community perceptions of plant resources (Ambé, 2001). In the case of *Garcinia afzelii*, there is limited scientific data on the knowledge and use of its fruits in Côte d'Ivoire. This gap restricts the potential for valorizing the species and its contribution to food and nutritional security.

Thus, this study aims to assess the level of knowledge and use of *Garcinia afzelii* fruits in five (05) localities of the Vavoua department. It will help identify the factors influencing the consumption of these fruits and provide a better understanding of their role in local dietary and medicinal traditions.

2. materialS and method

## ****2.1 Plant material****

The study focused on the mature and ripe fruits of *Garcinia afzelii* (Fig. 1) collected from the forests of Bonoufla, Bahoulifla, Gnamienkro, Gatifla, and Seïtifla in the Vavoua region, Côte d'Ivoire.

**Fig. 1. Ripe fruits (a) and cross-section of the fruits (b) of *G. afzelii***

## ****2.2 Methods****

### ****2.2.1 Study site****

The ethnobotanical study was conducted in the Haut-Sassandra region, specifically in Vavoua, in localities such as Bonoufla, Bahoulifla, Gnamienkro, Gatifla, and Seïtifla (Fig. 2). The city of Vavoua is located in the Haut-Sassandra region, within the Autonomous District of Sassandra–Marahoué. It is situated 431 km from Abidjan and 50 km north of Daloa, at a latitude of 7°28’54’’ North and a longitude of 6°28’40’’ West.



**Fig. 2. Geographical location of the study area (Haut-Sassandra region, Central-West (Ivory Coast)**

**Legend:** In red, study areas (Haut-Sassandra); in green, departmental capital; in black, village; in white, department limit

### ****2.2.2 Sample size****

The random sampling method was used. The sample size was calculated using Dagnelie's formula (1998):

**N=**$ \frac{z^{2}×P(1-P)}{m^{2}}$

 **(1)**

Where:

*n* = required sample size,

*t* = 1.96 at a 95% confidence level,

*m* = margin of error (set at 4.01%),

*p* = estimated proportion of the population aware of *Garcinia afzelii* fruit (since *p* is unknown, *p* = 0.5 was used).

The minimum sample size obtained for the survey was 597.25, rounded up to 600 individuals. This total was evenly distributed, with 120 respondents per locality.

### ****2.2.3 Survey procedure****

A preliminary survey was conducted in the town of Vavoua to determine the study site selection. As a result, five localities (Bonoufla, Bahoulifla, Gnamienkro, Gatifla, and Seitifla) were chosen based on the population’s knowledge and use of *Garcinia afzelii* fruits. The ethnobotanical survey was then carried out using a questionnaire from August 15 to September 30, 2021. The selection of survey areas was based on the availability of the resource. In each selected locality, the questionnaires were administered individually and completed by the respondents. The data collection method involved individual interviews, where the investigator asked questions directly to a participant. The respondents were randomly selected. During the interviews, a sample of the fruit was presented to them. Participants were approached in various locations (markets, households, streets, bus stations, etc.) and were randomly selected among men and women of all age groups. The main aspects of the interview covered information regarding the knowledge of *G. afzelii* fruits, their use, harvesting and consumption methods, commercialization, and preservation. Sociodemographic characteristics were also considered in the survey.

### ****2.2.4 Analysis of Survey Data****

#### ****2.2.4.1 Determination of Knowledge Level (KL)****

The level of knowledge was determined by the ratio of the number of individuals familiar with the fruits (*N*) to the total number of respondents (*Nt*) using the following mathematical formula:

**KL (%) =**$\frac{N}{Nt} ×100$

 **(2)**

#### ****2.2.4.2 Determination of usage rate (UR)****

The utilization rate was determined by the ratio of the number of individuals who had used *Garcinia afzelii* fruits at least once (*U*) to the total number of respondents (*Nt*), expressed as follows:

**UR (%) =**$\frac{U}{Nt} ×100$

 **(3)**

#### ****2.2.4.3**** Determination of the consumption rate (CR)

The consumption percentage was calculated by the ratio of the number of people consuming the fruit (*n*) to the total number of respondents (*Nt*), using the following formula:

**CR (%) =**$\frac{n}{Nt} ×100$

 **(4)**

#### ****2.2.4.4 Statistical analyses****

The software Sphinx Plus2(V5) and SPSS 22.0 were used respectively for data entry and analysis of the survey. The Chi-square test (χ²) was applied to examine the relationship between categorical variables (Department, Age Group, Gender, Education Level, and Ethnicity) and each of the dichotomous variables (Knowledge Level, Utilization Level, and Consumption Level). Furthermore, the comparison of knowledge, utilization, and consumption levels across each categorical variable was performed using the Chi-square test, followed by Marascuilo's procedure using XLSTAT version 2014. The significance level for all statistical tests was set at p ≤ 0.05.

**3. RESULTS**

**3.1 Socio-demographic characteristics of respondents**

The socio-demographic characteristics of the respondents focused on education level, age group, ethnicity, occupation, and gender (Table 1) The majority of respondents had a secondary education level, with a total of 284 individuals, representing 47.33% of the surveyed population The highest numbers were recorded in Seïtifla and Bonoufla, with 65 and 62 people, respectively Regarding age, the results showed that the largest proportion of respondents belonged to the 18-29 age group, followed by the 30-40 age group, regardless of the department In terms of ethnicity, there was a predominance of Ivorian non-native populations across all departments Concerning gender, women were always more numerous than men, regardless of the locality From a socio-economic perspective, informal sector workers, salaried employees, and students were the most represented groups in the surveyed sample, followed by traders.

**Table 1. Socio-demographic characteristics of the respondents**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Study areas (locality)** |  |  |  |
|  | **Bahoulifla**  | **Bonoufla** | **Gatifla** | **Gnamienkro** | **Seïtifla** | **Total** | **%\*** |
| **Gender**MaleFemale | 4773 | 6456 | 5169 | 5169 | 4575 | 258342 | 43.0057.00 |
| **Age group** |  |  |  |  |  |  |  |
| [18-30[ [30-41[ [41-60[ ≥60 | 44352516 | 5546172 | 3940338 | 41382813 | 5141208 | 23020012347 | 38.3333.3320.57.83 |
| **Ethnic group** |  |  |  |  |  |  |  |
| AutochthonousIvorian AllochthonousNon-Ivorian Allochthonous | 158916 | 119613 | 327513 | 71058 | 810012 | 7346562 | 12.1677.510.33 |
| **Level of Education** |  |  |  |  |  |  |  |
| IlliteratePrimarySecondaryHigher | 34333914 | 10276221 | 1933617 | 2332578 | 9246522 | 9514928472 | 15.8324.8347.3312.00 |
| **Profession**TraderBreederStudentInformal workerHousewifeFarmerSalaried worker | 1941920123214 | 28126259328 | 1321428201825 | 173252510337 | 19219413729 | 96121031395493103 | 16.002.0017.1623.169.0015.5017.16 |

\*Percentage

## 3.2 Knowledge of *Garcinia afzelii* fruits

### 3.2.1 Distribution of the Knowledge Level of *Garcinia afzelii* fruits by locality

The level of knowledge of the fruit is relatively high in the five (05) localities (Table 2) and ranges from 33.33% to 81.66%. The highest level of knowledge is observed in Gatifla, while the lowest level is recorded in Bonoufla. Furthermore, the statistical analysis related to the Chi-square test showed that the observed Chi-square value (χ2obs=90.07) is greater than the theoretical Chi-square value (χ2theo=9.48). There is therefore a dependence between the knowledge level of the fruit and locality. Additionally, the Chi-square homogeneity test revealed that at least two levels of knowledge from the localities differ significantly (p ≤ 0.05). Indeed, the Marascuilo procedure revealed that the knowledge levels of Bahoulifla and Bonoufla differ significantly (p ≤ 0.05) from those of Gatifla and Gnamienkro.

**Table 2. Distribution of knowledge level of *Garcinia afzelii* fruits by department**

|  |  |  |
| --- | --- | --- |
|  | **Level of knowledge (%\*\*)** | **Chi-square parameter** |
| **Localities** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **p** | **χ2theo** | **Marascuilo** |
| **Bahoulifla** | 57.50 | 42.50 | 4 | 90.07 | *<*0.05 | 9.48 | b\* |
| **Bonoufla** | 33.33 | 66.66 |  |  |  |  | a |
| **Gatifla** | 81.66 | 18.33 |  |  |  |  | c |
| **Gnamienkro** | 78.33 | 21.66 |  |  |  |  | c |
| **Seïtifla** | 42.50 | 57.50 |  |  |  |  | ab |

\*[Different letters in each line indicate significant differences (p<0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degree of freedom

### 3.2.2 Distribution of the knowledge level of *Garcinia afzelii* fruits by education level

The knowledge of *Garcinia afzelii* fruits among the surveyed populations varies by education level (Table 3). Illiterate people and those with primary education have the highest levels of knowledge of *Garcinia afzelii* fruits, with rates of 84.21% and 71.14%, respectively. Moreover, the Chi-square independence test revealed that the observed Chi-square value (χ2obs=69.62) is greater than the theoretical Chi-square value (χ2theo=7.81). Therefore, there is a relationship between the fruit knowledge level and education level. Additionally, the Chi-square homogeneity test showed that at least two education levels differ significantly (p < 0.05). The Marascuilo procedure indicated that there are significant differences (p < 0.05) between the knowledge levels of people with secondary education and those with higher education, as well as between primary and illiterate individuals.

**Table 3. Distribution of the knowledge level of G*arcinia afzelii* fruits by education level**

|  |  |  |
| --- | --- | --- |
|   | **Level of knowledge (%\*\*)** | **Chi-square parameter** |
| **Education level** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **p** | **χ2theo** | **Marascuilo** |
| **Illiterate** | 84.21 | 15.78 | 3 | 69.62 | *<*0.05 | 7.81 | c\* |
| **Primary** | 71.14 | 28.85 |  |  |  |  | c |
| **Secondary** | 51.40 | 48.59 |  |  |  |  | b |
| **Higher** | 27.77 | 72.22 |  |  |  |  | a |

\*[Different letters in each line indicate significant differences (p<0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degree of freedom

### 3.2.3 Distribution of the knowledge level of *Garcinia afzelii* fruits by age group

The level of knowledge of *Garcinia afzelii* fruits varies by age group (Table 4). It increases with age. Individuals aged 60 and above have the highest level of knowledge (100%), followed by those aged 41 to 59 years with a rate of 91.05%, while individuals under 30 years old have the lowest level (34.78%). The Chi-square independence test indicated that the observed Chi-square value (χ2obs=140.82) is greater than the theoretical Chi-square value (χ2theo=7.81). Therefore, there is a relationship between the fruit knowledge level and age group. Furthermore, the Chi-square homogeneity test showed that at least one significant difference (p < 0.05) exists between the knowledge levels of fruits recorded in the different age groups. The Marascuilo procedure revealed that all fruit knowledge levels differ significantly (p < 0.05) between the age groups.

**Table 4. Distribution of the knowledge level of *Garcinia afzelii* fruits by age group**

|  |  |  |
| --- | --- | --- |
|  | **Level of knowledge (%\*\*)** | **Chi-square parameter** |
| **Age Group** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **P** | **χ2theo** | **Marascuilo** |
| **[18-30[**  | 34.78 | 65.21 | 3 | 140.82 | *<*0.05 | 7.81 | a\* |
| **[30-41[**  | 56.50 | 43.50 |  |  |  |  | b |
| **[41-60[**  | 91.05 | 8.94 |  |  |  |  | c |
| **≥60** | 100.00 | 0.00 |  |  |  |  | d |

\*[Different letters in each line indicate significant differences (p<0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degree of freedom

### 3.2.4 Distribution of the knowledge level of *Garcinia afzelii* fruits by ethnic group

The level of knowledge of *Garcinia afzelii* fruits varies between ethnic groups (Table 5). In fact, Indigenous people have the highest levels of knowledge with a rate of 78.08%, while non-Ivorian allochthons have the lowest level with a rate of 55.69%. Moreover, the Chi-square independence test showed that the observed Chi-square value (χ2obs=13.04) is greater than the theoretical Chi-square value (χ2theo=5.99). Therefore, there is a relationship between the fruit knowledge level and ethnic group. Furthermore, the Chi-square homogeneity test showed that at least one significant difference (p ≤ 0.05) exists between the knowledge levels of different ethnic groups. The Marascuilo procedure revealed significant differences (p ≤ 0.05) between the knowledge levels of Indigenous people and those of Ivorian and non-Ivorian allochthons.

**Table 5. Distribution of the knowledge level of *Garcinia afzelii* fruits by ethnic group**

|  |  |  |
| --- | --- | --- |
|  | **Level of knowledge (%\*\*)** | **Chi-square parameter** |
| **Ethnic Group** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **p** | **χ2theo** | **Marascuilo** |
| **Ivorian allochthons** | 55.69 | 44.30 | 2 | 13.04 | *<*0.05 | 5.99 | a\* |
| **Non-Ivorian allochthons** | 58.06 | 41.93 |  |  |  |  | a |
| **Indigenous** | 78.08 | 21.91 |  |  |  |  | b |

\*[Different letters in each line indicate significant differences (p<0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degree of freedom

### 3.2.5 Distribution of the knowledge level of *Garcinia afzelii* fruits by gender

The level of knowledge of *Garcinia afzelii* fruits differs by gender (Table 6). Men have a higher level of knowledge (59.64%) compared to women (57.36%). Furthermore, the Chi-square independence test showed that the observed Chi-square value (χ2obs=0.31) is less than the theoretical Chi-square value (χ2theo=3.84). Therefore, there is no dependence between the fruit knowledge level and gender. Additionally, the Chi-square homogeneity test indicated no significant differences (p > 0.05) in the knowledge levels of *Garcinia afzelii* fruits between genders.

**Table 6. Distribution of the knowledge level of G*arcinia afzelii* fruits by gender**

|  |  |  |
| --- | --- | --- |
|   | **Level of knowledge (%\*)** | **Chi-square parameter** |
| **Gender** | **Yes** | **No** | **dl\*\*** | **χ2obs** | **p** | **χ2theo** |
| **Female** | 57.36 | 42.63 | 1 | 0.31 | 0.57 | 3.84 |
| **Male** | 59.64 | 40.35 |  |  |  |  |

\*Percentage

\*\*Degree of freedom

## ****3.3**** Use of *Garcinia afzelii* fruits

### ****3.3.1**** Distribution of *Garcinia afzelii* fruit use by locality

The use rate of G*arcinia afzelii* fruits varies from one locality to another (Table 7). The highest level of use is observed in Gnamienkro (93.68%), while the lowest level is recorded in Bahoulifla (68.11%). Additionally, the Chi-square independence test showed that the theoretical Chi-square value (χ2theo=5.99) is lower than the observed Chi-square value (χ2obs=21.05). Therefore, there is a dependency between the use level and locality. Furthermore, the Chi-square homogeneity test indicated at least one significant difference (p ≤ 0.05) between the knowledge levels of *Garcinia afzelii* fruit use across different localities. In fact, the Marascuilo procedure revealed significant differences (p < 0.05) between the use levels of Gnamienkro and those of Bahoulifla and Gatifla.

**Table 7. Distribution of *Garcinia afzelii* fruit use by department**

|  |  |  |
| --- | --- | --- |
|  | **Usage level (%\*\*)** | **Chi-square parameter** |
| **Localities** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **P** | **χ2theo** | **Marascuilo** |
| **Bahoulifla** | 68.11 | 31.88 | 4 | 21.05 | *<*0.05 | 9.48 | a\* |
| **Bonoufla** | 78.04 | 21.95 |  |  |  |  | ab |
| **Gatifla** | 74.00 | 26.00 |  |  |  |  | a |
| **Gnamienkro** | 93.68 | 6.31 |  |  |  |  | b |
| **Seïtifla** | 86.27 | 13.72 |  |  |  |  | ab |

\*[Different letters in each row indicate significant differences (p < 0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degrees of freedom

### ****3.3.2**** Distribution of *Garcinia afzelii* fruit use by education level

The use level of G*arcinia afzelii* fruits among the surveyed populations is relatively high across different education levels (Table 8). It ranges from 77.50% to 83.17%. In fact, individuals with primary education have the highest use level of *Garcinia afzelii* fruits (83.17%). On the other hand, the lowest use level is recorded among illiterate individuals (77.50%). Moreover, the Chi-square independence test showed that the observed Chi-square value (χ2obs=0.97) is lower than the theoretical Chi-square value (χ2theo=7.81), indicating no correlation between the fruit use level and education level. Additionally, the Chi-square homogeneity test revealed no significant differences (p > 0.05) between the fruit use levels across different education levels.

**Table 8. Distribution of G*arcinia afzelii* fruit use by education level**

|  |  |  |
| --- | --- | --- |
|  | **Usage level (%\*\*)** | **Chi-square parameter** |
| **Education Level** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **p** | **χ2theo** | **Marascuilo** |
| **Illiterate** | 77.50 | 22.50 | 3 | 0.97 | 0.80 | 7.81 | a\* |
| **Primary** | 83.17 | 16.82 |  |  |  |  | a |
| **Secondary** | 79.86 | 20.13 |  |  |  |  | a |
| **Higher Education** | 80.00 | 20.00 |  |  |  |  | a |

\*[Common letters in each row indicate no significant differences (p > 0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degrees of freedom

### ****3.3.3**** Distribution of *Garcinia afzelii* fruit use by age group

The use level of G*arcinia afzelii* fruits varies by age group (Table 9). It increases with age. Indeed, individuals aged between 18 and 29 have the lowest use level (60.49%), while older individuals aged between 41 and 59 have the highest use level (91.15%), followed by those aged 60 or older (89.36%). Moreover, the Chi-square independence test revealed that the observed Chi-square value (χ2obs=30.98) is higher than the theoretical Chi-square value (χ2theo=7.81), indicating a relationship between the fruit use level and age group. The Chi-square homogeneity test also indicated at least one significant difference (p ≤ 0.05) between the use levels across different age groups. The Marascuilo procedure revealed that the use level of individuals in the 18-29 age group significantly differs (p ≤ 0.05) from the other age groups.

**Table 9. Distribution of *Garcinia afzelii* fruit use by age group**

|  |  |  |
| --- | --- | --- |
|   | **Usage level (%\*\*)** | **Chi-square parameter** |
| **Age group** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **P** | **χ2theo** | **Marascuilo** |
| **[18-30[**  | 60.49 | 39.50 | 3 | 30.98 | *<*0.05 | 7.81 | a\* |
| **[30-41[**  | 80.00 | 20.00 |  |  |  |  | B |
| **[41-60[**  | 91.15 | 8.84 |  |  |  |  | B |
| **≥60** | 89.36 | 10.63 |  |  |  |  | B |

\*[Different letters in each row indicate significant differences (p < 0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degrees of freedom

### ****3.3.4**** Distribution of *Garcinia afzelii* fruit use by ethnic group

The use level of *Garcinia afzelii* fruits varies somewhat between ethnic groups (Table 10). The highest use levels are found among Ivorian allochthones, followed by the indigenous Ivorian ethnic group, with rates of 82.44% and 78.94%, respectively. In contrast, the lowest use levels are recorded among non-Ivorian allochthones (67.56%). Moreover, the Chi-square independence test revealed that the theoretical Chi-square value (χ2theo=5.99) is higher than the observed Chi-square value (χ2obs=4.62), indicating no dependence between the fruit use level and ethnic group. Additionally, the Chi-square homogeneity test showed no significant differences (p > 0.05) between the use levels of different ethnic groups.

**Table 10. Distribution of *Garcinia afzelii* fruit use by ethnic group**

|  |  |  |
| --- | --- | --- |
|  | **Usage level (%\*\*)** | **Chi-square parameter** |
| **Ethnic group** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **P** | **χ2theo** | **Marascuilo** |
| **Ivorian allochthones** | 82.44 | 17.55 | 2 | 4.62 | 0.09 | 5.99 | a\* |
| **Non-Ivorian allochthones** | 67.56 | 32.43 |  |  |  |  | a |
| **Indigenous ivoirians** | 78.94 | 21.05 |  |  |  |  | a |

\*[Common letters in each row indicate no significant differences (p > 0.05) according to the Marascuilo procedure]

\*\*Percentage
\*\*\*Degrees of freedom

### ****3.3.5**** Distribution of *Garcinia afzelii* fruit use by gender

The use level of *Garcinia afzelii* fruits varies by gender (Table 11). Women have a higher use level of *Garcinia afzelii* fruits (84.00%) than men (77.66%). Moreover, the Chi-square independence test showed that the theoretical Chi-square value (χ2theo=3.84) is higher than the observed Chi-square value (χ2obs=2.20), indicating no dependence between the fruit use level and gender. The Chi-square homogeneity test also showed no significant differences (p > 0.05) between the use levels across genders.

**Table 11. Distribution of G*arcinia afzelii* fruit use by gender**

|  |  |  |
| --- | --- | --- |
|  | **Usage level (%\*)** | **Chi-square parameter** |
| **Gender** | **Yes** | **No** | **dl\*\*** | **χ2obs** | **p** | **χ2theo** |
| **Female** | 84.00 | 16.00 | 1 | 2.20 | 0.13 | 3.84 |
| **Male** | 77.66 | 22.33 |  |  |  |  |

\*Percentage

\*\*Degree of freedom

## ****3.4**** Types of uses of the fruits

The study revealed various uses of G*arcinia afzelii* fruits, including culinary, medicinal, hygienic, and appetite-suppressing uses (Table 12). Hygienic use is the most widespread, followed by medicinal use, with rates of 53.68% and 37.65%, respectively.

**Table 12. Use of the fruits by localities**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Study areas (Departments)** |  |  |  |
| **Types of Use** | **Bahoulifla**  | **Bonoufla** | **Gatifla** | **Gnamienkro** | **Seïtifla** | **Total** | **%\*** |
| **Culinary** | 4 | 0 | 4 | 5 | 0 | 13 | 3.30 |
| **Medicinal** | 24 | 33 | 46 | 27 | 18 | 148 | 37.65 |
| **Hygienic** | 39 | 56 | 70 | 27 | 19 | 211 | 68.00 |
| **Appetite suppressant** | 4 | 10 | 4 | 3 | 0 | 21 | 5.34 |

\*Percentage

## ****3.5**** Vernacular names, methods, and periods of harvest

Regarding the names in the study area, the fruits of G*arcinia afzelii* are identified by the plant itself. Depending on the population and local dialect, G*arcinia afzelii* is known by different names (Table 13). For example, the plant is called "Vando", "Vrissikpa", "Weda" by non-Ivorian allochthons; "Gloyiriploh", "Gnougouboue", "Koblicanyiriplo", "Popocici" by the Indigenous people; and finally "Allakpadjoma", "Djanganayiride", "Finzade", "Gbninni Gbenon", "Kangolikanma", "Kidjanbroude", "Sourafinzande", "Yorokougbahi" by the Ivorian Allochthons. Additionally, most of the respondents from the five localities stated that they primarily obtain fruits by collecting them. The proportions were 88% for Séïtifla, 94% for Gnamienkro and Bahoulifla, and 100% for Bonoufla and Gatifla (Fig. 3). Moreover, the periods from February to June and from November to December correspond to the availability of fruits, which fall from the tree once they are mature (Table 14).

**Table 13. Some vernacular names known for the plant in the study area**

|  |  |
| --- | --- |
| **Ethnic group** | **Vernacular name** |
| **Indigenous** | "Gloyiriploh", "Gnougouboue", "Koblicanyiriplo", "popocici" |
| **Ivorian allochthons** | "Allakpadjoma", "Djanganayiride", "Finzade", "Gbninni Gbenon", "Kangolikanma", "Kidjanbroude", "Sourafinzande", "Yorokougbahi" |
| **Non-Ivorian allochthons** | "Vando", "Vrissikpa", "Weda" |

**Fig. 3. Methods of obtaining fruits in the different localities visited**

**Table 14. Periods of availability of the plant in the study area**

|  |  |
| --- | --- |
| **Localities** | **Periods** |
| **Bahoulifla** | February-May, November-December |
| **Bonoufla** | February-May |
| **Gatifla** | February-April |
| **Gnamienkro** | February-June, November-December |
| **Seïtifla** | February-May |

## ****3.6**** Fruit consumption

### ****3.6.1**** Consumption level of fruits according to the locality

The consumption level of *Garcinia afzelii* fruits varies according to the locality (Table 15). The highest level of consumption is found in the locality of Gnamienkro (30.43%), while the lowest is recorded in Bonoufla (5.88%). Furthermore, the Chi-square independence test revealed that the theoretical Chi-square value (χ2theo=9.48) is greater than the observed Chi-square value (χ2obs=8.76). Therefore, there is no dependence between the consumption level and the locality. Additionally, the Chi-square homogeneity test showed no significant difference (p > 0.05) between the consumption levels in different localities.

**Table 15. Consumption level of fruits according to the department**

|  |  |  |
| --- | --- | --- |
|  | **Consumption level (%\*\*)** | **Chi-square parameter** |
| **Localities** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **p** | **χ2theo** | **Marascuilo** |
| **Bahoulifla** | 27.65 | 72.34 | 4 | 8.76 | 0.06 | 9.48 | a\* |
| **Bonoufla** | 5.88 | 94.11 |  |  |  |  | a |
| **Gatifla** | 12.96 | 87.03 |  |  |  |  | a |
| **Gnamienkro** | 30.43 | 69.56 |  |  |  |  | a |
| **Seïtifla** | 25.71 | 74.28 |  |  |  |  | a |

\*[Common letters on each line indicate no significant differences (p > 0.05) according to the Marascuilo procedure]

\*\* Percentage

\*\*\* Degrees of freedom

### ****3.6.2**** Consumption level according to education level

The consumption level of *Garcinia afzelii* fruits differs according to the education level (Table 16). People with primary education consume the most *Garcinia afzelii* fruits (26.47%). Furthermore, the Chi-square independence test revealed that the theoretical Chi-square value (χ2theo=7.81) is greater than the observed Chi-square value (χ2obs=0.99). Therefore, there is no correlation between the consumption level and the education level. Additionally, the Chi-square homogeneity test showed no significant difference (p > 0.05) between the consumption levels across different education levels.

**Table 16. Consumption level according to education level**

|  |  |  |
| --- | --- | --- |
|  | **Consumption level (%\*\*)** | **Chi-square parameter** |
| **Education level** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **p** | **χ2theo** | **Marascuilo** |
| **Illiterate** | 23.21 | 76.78 | 3 | 0.99 | 0.80 | 7.81 | a\* |
| **Primary** | 26.47 | 73.52 |  |  |  |  | a |
| **Secondary** | 19.76 | 80.23 |  |  |  |  | a |
| **Higher** | 25.00 | 75.00 |  |  |  |  | a |

\*[Common letters on each line indicate no significant differences (p > 0.05) according to the Marascuilo procedure]

\*\* Percentage

\*\*\* Degrees of freedom

### ****3.6.3**** Consumption level according to age

The consumption level of *Garcinia afzelii* fruits varies according to age (Table 17). People aged 60 and above consume the most G*arcinia afzelii* fruits (43.24%). Moreover, the Chi-square independence test showed that the observed Chi-square value (χ2obs=12.76) is greater than the theoretical Chi-square value (χ2theo=7.81). Therefore, there is a dependency between the fruit consumption level and age. Additionally, the Chi-square homogeneity test revealed at least one significant difference (p ≤ 0.05) between the fruit consumption levels of different age groups. Indeed, the Marascuilo procedure indicated that the consumption levels of people aged 30 to 40 differ significantly (p ≤ 0.05) from those aged 60 and above.

**Table 17. Consumption level of fruits according to age group**

|  |  |  |
| --- | --- | --- |
|  | **Consumption level (%\*\*)** | **Chi-square parameter** |
| **Age group** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **P** | **χ2theo** | **Marascuilo** |
| **[18-30[**  | 25.53 | 74.46 | 3 | 12.76 | *<*0.05 | 7.81 | ab\* |
| **[30-41[**  | 12.90 | 87.09 |  |  |  |  | a |
| **[41-60[**  | 19.73 | 80.26 |  |  |  |  | ab |
| **≥60** | 43.24 | 56.75 |  |  |  |  | b |

\*[Different letters on each line indicate significant differences (p < 0.05) according to the Marascuilo procedure]

\*\*Percentage

\*\*\*Degrees of freedom

### ****3.6.4**** Consumption level according to ethnic group

The level of consumption of *Garcinia afzelii* fruits varies according to the ethnic group (Table 18). Ivorian allochthonous individuals consume the most *Garcinia afzelii* fruits (25.14%). Furthermore, the chi-square independence test revealed that the theoretical chi-square value (χ2theo=5.99) is higher than the observed chi-square value (χ2obs=4.94). Therefore, there is no relationship between consumption level and ethnic group. Additionally, the chi-square homogeneity test showed that there is no significant difference (p ˃ 0.05) between the consumption levels of different ethnic groups.

**Table 18. Consumption level of fruits according to ethnic group**

|  |  |  |
| --- | --- | --- |
|  | **Consumption level (%\*\*)** | **Chi-square parameter** |
| **Ethnic group** | **Yes** | **No** | **dl\*\*\*** | **χ2obs** | **p** | **χ2theo** | **Marascuilo** |
| **Ivorian allochthonous** | 25.14 | 74.85 | 2 | 4.94 | 0.08 | 5.99 | a\* |
| **Non-Ivorian allochthonous** | 0.00 | 100.00 |  |  |  |  | a |
| **Indigenous** | 22.22 | 77.77 |  |  |  |  | a |

\*[Common letters on each line indicate no significant differences (p > 0.05) according to the Marascuilo procedure]

\*\*Percentage

\*\*\*Degrees of freedom

### ****3.6.5**** Consumption level according to gender

The consumption level of *Garcinia afzelii* fruits varies according to gender (Table 19). Men consume slightly more G*arcinia afzelii* fruits (23.07%) compared to women (22.82%). Furthermore, the Chi-square independence test revealed that the theoretical Chi-square value (χ2theo=3.84) is greater than the observed Chi-square value (χ2obs=0.001). Therefore, there is no dependency between consumption level and gender. Additionally, the Chi-square homogeneity test showed no significant difference (p > 0.05) between the consumption levels of different genders.

**Table 19. Consumption level of fruits according to gender**

|  |  |  |
| --- | --- | --- |
|   | Consumption level (%\*) | Chi-square parameter |
| Gender | **Yes** | **No** | **dl\*\*** | **χ2 obs** | ***P*** | **χ2 theo** |
| Female | 22.82 | 77.17 | 1 | 0.001 | 0.96 | 3.84 |
| Male | 23.07 | 76.92 |  |  |  |  |

\*Percentage

\*\*Degrees of freedom

# ****4. DISCUSSION****

The ethnobotanical study revealed a dependence between variables such as locality, age group, education level, and ethnic group, and the dichotomous variable "level of knowledge." This observation shows that these characteristics influence the level of knowledge. Regarding locality, of the 600 people surveyed, 352 individuals, or 58.7%, are familiar with *Garcinia afzelii* fruit. The level of knowledge about these fruits is higher in the localities of Bahoulifla, Gatifla, and Gnamienkro. Additionally, significant differences (p ≤ 0.05) exist between the levels of knowledge across different localities. Similar observations were reported by Atakpama et al. (2012), who studied *Sterculia setigera* in Togo. According to these authors, the high level of knowledge about wild plants in a phytogeographical zone is linked not only to culture but also to the increased poverty level of the population and the low urbanization of the area. Indeed, rural populations are more dependent on natural resources, which they use for economic, medicinal, and food purposes (Tabuti & Damme, 2012; Kaoma & Shackleton, 2014). The study results showed that the level of knowledge about *Garcinia afzelii* fruits increases significantly (p ≤ 0.05) with age. Individuals aged 60 and older have the highest level of knowledge. This result may be because older individuals are more likely to provide reliable information, as they hold a substantial portion of ancestral knowledge that is transmitted orally. The transmission of this knowledge is currently at risk because it is not always guaranteed (Orch et al., 2015). Moreover, the experience accumulated with age is the main source of local information about plant use. The results obtained corroborate those reported by Monyn et al. (2016), who found that an individual's age could be a factor influencing the level of knowledge about plants. However, the use of these plants shrouded in mystery and superstition, would lead knowledge holders to often be reluctant to share their expertise (Muluwa & Bostoen, 2007). Regarding education level, the ethnobotanical study showed that illiterate respondents, making up 84.21% of the sample, have a better knowledge of *Garcinia afzelii* fruits. Furthermore, the levels of knowledge about *Garcinia afzelii* fruits among illiterates differ significantly (p ≤ 0.05) from those with secondary and higher education levels. This could be because individuals with lower education levels tend to be more attached to their cultural values, while those with higher education tend to adopt Western lifestyles (Tchiégang & Kitikil, 2004). Indeed, those with ancestral knowledge tend to have a higher illiteracy rate, and their main source of ethnobotanical information is family knowledge passed down by elderly people (Rachid et al., 2020). Moreover, the survey found that indigenous people have a better knowledge of *Garcinia afzelii* fruits. The observed differences between the knowledge levels of different ethnic groups may be due to cultural heritage, with knowledge being passed down from generation to generation within the same ethnic group. The results are in agreement with those of Monyn et al. (2016), who noted that cultural origin could be a determining factor in the knowledge of a wild edible species. Additionally, studies conducted by Ekué et al. (2010) and Assogbadjo et al. (2011) in Benin and those by Yao et al. (2015) in Côte d'Ivoire showed that the use of wild plants in the diet of sub-Saharan populations is linked to several factors, including the cultural group to which the individual belongs. The ethnobotanical survey on the use of *Garcinia afzelii* fruit showed that there is a relationship between the characteristics of locality and age group and the dichotomous variable "level of use." This result indicates that these characteristics influence the level of use. Regarding the department, of the 600 surveyed, 530 individuals, or 88.33%, use *Garcinia afzelii* fruits. The level of use of these fruits is high in the study area, particularly in the locality of Gnamienkro (93.68%), and significant differences (p ≤ 0.05) exist between the levels of use in some localities. The study showed that 91.15% of people aged 41 to 59 use *Garcinia afzelii* fruits more than those in other age groups. This result reflects the knowledge and frequency of use among this category of the population. Our results are similar to those from Uganda on wild edible species by Tugume et al. (2016), who reported that individuals aged over 50 use plants more because they have more knowledge about their usefulness compared to younger people. The results obtained regarding consumption revealed that there is only one significant difference (p ≤ 0.05) between the characteristic "age group" and the dichotomous variable "level of consumption." Thus, 43.24% of the oldest individuals (≥ 60 years) consume more *Garcinia afzelii* fruits compared to other age groups. Similar results published by Betti et al. (2016) revealed a high consumption of wild fruits in Côte d'Ivoire. Moreover, the importance of a wild edible plant varies depending on the dietary habits of the populations involved, according to Diarra et al. (2016). Furthermore, it was observed that the name of *Garcinia afzelii* fruit is specific to each ethnic group, which makes identification challenging. Indeed, according to Sow (2003) and Tchumou (2017), the naming of a species is linked to the region and sociocultural group. Additionally, the primary method of harvesting the fruit is gathering. The high use of this method could be due to the difficulty of accessing this species, as *Garcinia afzelii* is a species from the forested areas of Côte d'Ivoire, making it difficult to access (Zanh et al., 2016).

# ****5. CONCLUSION****

The ethnobotanical study conducted on *Garcinia afzelii* highlights the deep connections between traditional knowledge of this fruit and several social and cultural factors. Locality, age, education level, and ethnic group emerge as variables significantly influencing the level of knowledge and use of the fruit. In particular, rural populations, with lower literacy rates, tend to retain a deeper knowledge of this species, likely due to their attachment to ancestral knowledge and their economic and nutritional dependence on natural resources. Elders, carriers of traditional knowledge, are thus the most experienced and the primary transmitters of this knowledge, although this transmission is now under threat. The results also confirm that cultural specificities, such as naming practices specific to each ethnic group, sometimes complicate the identification of this species. Furthermore, the primary method of harvesting, which is gathering, reflects the difficulty of accessing *Garcinia afzelii*, often found in forested areas. Finally, this study underscores the importance of preserving and promoting the ethnobotanical knowledge of local populations regarding *Garcinia afzelii*. This could not only contribute to the conservation of this species but also the promotion of its use in traditional food and medicinal practices, thus supporting food self-sufficiency and the resilience of local communities.

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