



## Inventory of mushrooms eaten by the inhabitants of Brazzaville and data regarding their food value

### Inventaire des champignons consommés par les habitants de Brazzaville et données concernant leur valeur alimentaire

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**Résumé :** L'objectif général de cette étude consiste à dresser un inventaire des champignons consommés par les habitants de la ville de Brazzaville ainsi que d'obtenir des informations concernant leur valeur alimentaire. A cette fin deux enquêtes transversales à l'aide de questionnaires préétablis et de missions de terrain ont été réalisées. Une première enquête a porté sur l'inventaire des différentes espèces de champignons vendues par 50 vendeuses dans cinq marchés de Brazzaville et au Péage de Kintélé. Une deuxième enquête a porté sur la consommation de champignons de 300 ménages de Brazzaville et de Kintélé. Plusieurs missions de terrain ont été réalisées dans les zones de production de Mati et de Kitengué pour des études écologiques. Les tests statistiques ont été utilisés pour l'analyse des résultats. Les résultats ont montré que 11 espèces de champignons, avec la prédominance du genre *Termitomyces* sont consommées et génèrent des revenus contribuant ainsi à la réduction substantielle de la pauvreté dans les ménages des récolteurs pendant la période de récolte. Leur taux de consommation est de 79,3%, avec en général une fréquence de consommation hebdomadaire de deux à trois fois par semaine (45,5%). Tous les groupes ethnolinguistiques en consomment avec des taux et fréquences de consommation très variables; mais trois groupes sont fort friands des champignons qui constituent des substituts de viande et de poisson pendant leur période de récolte, à savoir les Kongo (35,1%), les Mbosi (20,7%) et les Téké (11,2%). Les caractéristiques nutritionnelles des champignons font d'eux des aliments de haute valeur nutritionnelle constituant les substituts potentiels des aliments riches en protéines de haute valeur biologique et en micronutriments, capables de pallier à certaines carences nutritionnelles et d'assurer la sécurité alimentaire des ménages.

Mots-clés : Champignons comestibles, République du Congo, Brazzaville.

**Abstract :** The general aim of this study is to make the inventory of mushrooms eaten by inhabitants of Brazzaville, as well as to gather data regarding their food value. For this purpose two lateral inquiries were carried out, using pre-established questionnaires and field missions. The first inquiry focused on mushrooms sold by 50 saleswomen at five markets of Brazzaville and at the toll ('Péage') at Kintélé. The second inquiry focused on mushrooms consumed by 3000 families of Brazzaville and Kintélé. For ecological studies several field missions were carried out in the production zones of Mati and Kitengué. Data were statistically treated whenever necessary. The results show that 11 mushroom species, predominantly of the genus *Termitomyces*, are consumed. The latter generate a substantial income during the collecting period, thus contributing to poverty alleviation. The rate of consumption is of 79.3 %, generally with a very variable frequency of consumption;

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however, three ethnic groups, namely the Kongo (35.1 %), The Mbosi (20.7 %) and the Téké (11.2 %), are very fond of mushrooms and consider them substitutes for meat and fish. The nutritional property of mushrooms places them among foodstuffs of high nutritional value, i.e. good suppliers of micronutrients or substitutes for classic protein-rich food. These wild edible mushrooms represent food security for families and their consumption helps to overcome eventual nutritional deficiencies.

Keywords: Edible mushrooms, Republic of Congo, Brazzaville.

## INTRODUCTION

A substantial amount of studies broach the importance of NWFP (Non-Wood Forest Products) for a better diet of local people. In Africa wild edible mushrooms are commonly mentioned in this context. Indeed, for nearly all tropical African countries at least one paper deals with the importance of mushrooms for the people's diet. Among many others we mention the following books: BUYCK (1994), MALAISSE (1997), LOWORE & BOA (2001), DE KESEL et al. (2002), BOA (2006) and papers: HÄRKÖNEN et al. (2003), BLOECH & MBAGO (2008), BUYCK (2008), GUISSOU et al. (2008), DEGREEF et al. (2016), YOROU et al. (2017) and ONGUENE AWANA et al. (2019), all treating the subject in a comprehensive way.

Contributions treating wild edible fungi of the Republic of the Congo, and in particular those of Brazzaville and surroundings, are not numerous. This paper tries to fill this blind spot using inquiries and field work. Aspect related to cultivated mushrooms in the studied area fall outside the scope of this paper, but we mention that the Bio-Tech Congo Company, founded in 2015 by the Ir. TSENGUÉ-TSENGUÉ, manufactures and markets kits of pre-incubated cultures yielding up to three kilos of fresh mushrooms in three months.

## MATERIALS AND METHODS

### Study place

The study was carried out in nine districts of the town of Brazzaville and in the urban municipality of Kintélé (Pool Department, Republic of the Congo). Field observations were carried out from 9 October 2020 till 20 March 2021. Brazzaville was chosen because it's a capital with a cosmopolite character and a population that still consumes wild mushrooms. The latter holds also for the municipality of Kintélé, but due to its position it is a more peri-urban area.

### Inquiries and field observations

The field inquiries are meant to assess aspects related to the supply and the consumption of wild edible mushrooms. They were carried out in town at (1) Milalou market, (2) Texaco Tsiémé market, (3) Dragage market, (4) Yoro market, (5) Total market of Bacongo and at (6) Kintélé tollbooth. Mushroom forays were carried out at the sites of Kitengué and Mati.

### Studied variables

The following demographic variables were addressed: age, sex, profession, educational level, marital status. The variables related to supply and consumption of mushrooms are the following:

- supplying modalities of edible mushrooms,
- supply sites,
- amounts purchased,
- frequency of weekly consumption of edible mushrooms,
- personal preference of edible mushrooms available on the markets,
- foodstuffs necessary to accompany edible mushrooms in dishes,
- ways of preparing edible mushrooms,
- factors limiting the consumption of the edible mushrooms.

In each couple, the person in charge of preparing meals (regardless of sex) was interviewed. The interviews were carried out in French, in Lingala or in Kituba.

## Study methods

In our study, the literature revised has allowed to determinate the nutritive values of the edible mushrooms consumed in the Republic of the Congo.

Identification of mushrooms was done by the second author using a set of identification tools (keys and descriptions) available on the continuously updated website of Edible Fungi of Tropical Africa (EFTA, DEGREEF & DE KESEL, 2017).

This prospective study is based on two transverse investigations, i.e. focused on the consumption of wild edible mushrooms and their supply and marketing. The technique used was by direct interview. Two methods were used: the recall of 24 hours and the alimentary story. The interviewees were attributed an individual code and were at least 18 years. People asked for an interview, but refusing to participate, were not counted in the statistics.

## Sampling

Sampling was done by random selection. A poll step of five plots was used during the selection. A sample of 300 households, belonging to the nine districts of Brazzaville and the urban municipality of Kintélé, was taken and interviewed. That is to say ten times 30 households. Moreover, 50 mushroom sale assistants, all chosen randomly, were retained from four sale points.

## Processing and statistical analysis of the data

The processing of the obtained data has been carried out using SPSS version 20 and Excel 2013. Quantitative variables are presented as an average ( $\bar{x}$ )  $\pm$  standard deviation (s), including extreme values (minimum and maximum measured), their differences were tested using t-student or Anova tests (k-1 degrees of freedom; 5% significance level). The qualitative values are expressed as percentages, and differences were tested using  $\chi^2$  tests.

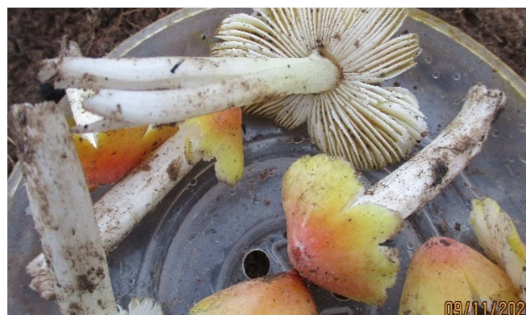
## RESULTS

### Diversity of edible mushrooms in Brazzaville (photographies © Germain MABOSSY-MOBOUNA)

Illustrations 1-9 show the diversity of edible mushrooms obtained from field missions and mushroom stalls on markets in Brazzaville. The most frequently observed species all belong to the genus *Termitomyces*.



(1) *Auricularia cornea* Ehrenb.



(2) *Hygrocybe* sp.



(3) *Lentinus squarrosulus* Mont.



(4) *Marasmius buzungolo* Singer



(5) *Termitomyces aurantiacus* (R.Heim) R.Heim



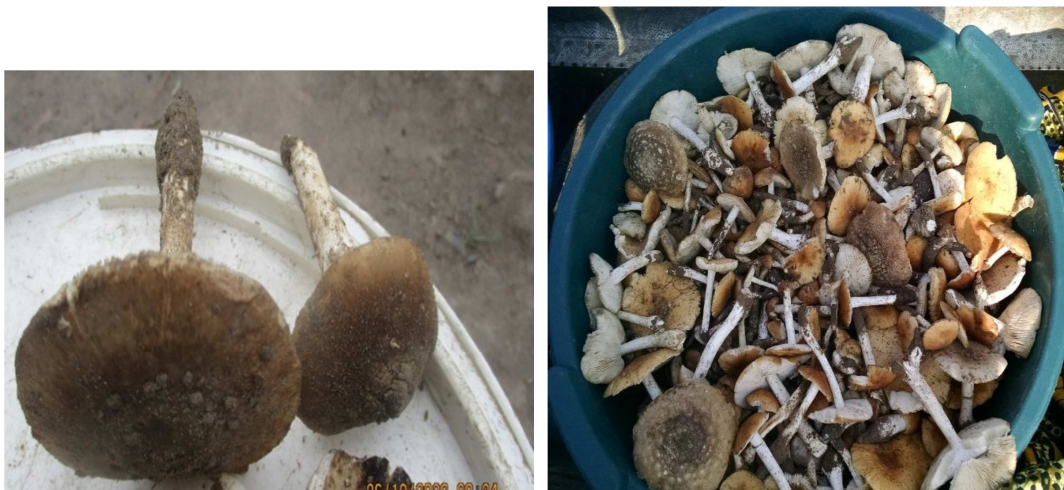
(6) *Termitomyces globulus* R.Heim & Gooss.-Font



(7) *Termitomyces letestui* (Pat.) R.Heim



(8) *Termitomyces mammiformis* R.Heim



(9) *Termitomyces singidensis* Saarim. & Härkönen

Extensive information regarding the morphology, ecology and distribution of the above mentioned taxa, except *Hygrocybe* sp., can be found on the website EFTA (DEGREEF & DE KESEL 2017).

#### **Phenology and growth sites of edible taxa**

There are two periods for collecting edible mushrooms in Brazzaville and they mainly coincide with the rainy periods. The rainfall is bimodal in the studied area. The first period begins mid-February and ends mid-April, with March being the main period for harvesting. During this period, only species growing on termite hills

in the dense wet forests, and also in the *Lantana camara* fallows are collected. From March till April *Termitomyces globulus* is the most abundant and most collected species. Specimens found on the markets of Brazzaville usually come from the forested areas of Mbamou island.

The second period stretches from mid-September till early December, with greatest productivity observed in November. In contrast with the first rainy period, the second is characterised by the abundance of species like *Termitomyces aurantiacus* and *Termitomyces singidensis*. These taxa are not collected from forested areas but savannahs and open fields on Mbamou island or elsewhere in the Pool department. In these savannahs *Termitomyces aurantiacus* is the most productive species.

*Marasmius buzungolo*, a common and typical forest-litter decomposing saprotrophic species, is collected during the two periods.

Table I.- Harvesting periods of edible mushrooms

| Species                         | Ecosystems                        | Harvesting period |
|---------------------------------|-----------------------------------|-------------------|
| <i>Auricularia cornea</i>       | Dense wet forest (on dead wood)   | III-IV            |
| <i>Hygrocybe</i> sp.            | Savannah- field (on soil)         | X-XII             |
| <i>Lentinus squarrosulus</i>    | Forest (on dead wood)             | XI-XII and III    |
| <i>Marasmius buzungolo</i>      | Dense wet forest, wooded savannah | III and XI        |
| <i>Termitomyces aurantiacus</i> | Savannah - field                  | X-XI-XII          |
| <i>Termitomyces globulus</i>    | Dense wet forest, fallow          | III-IV            |
| <i>Termitomyces letestui</i>    | Savannah - field                  | X-XI-XII          |
| <i>Termitomyces mammiformis</i> | Savannah - field                  | X-XI-XII          |
| <i>Termitomyces microcarpus</i> | Dense wet forest, savannah, field | IX-X-XI           |
| <i>Termitomyces singidensis</i> | Savannah - field                  | X-XI-XII          |
| <i>Termitomyces striatus</i>    | Savannah - field                  | X-XI-XII          |

### Knowledge of edible mushrooms by local populations

Table II presents the level of knowledge achieved by local populations concerning locally found edible mushrooms.

Table II.- Modalities of edible mushrooms knowledge in the Brazzaville area (Republic of the Congo)

| Variables                     | Modalities      | Staffs | %     | Significance |
|-------------------------------|-----------------|--------|-------|--------------|
| Mushroom knowledge (300)      | Yes             | 289    | 96.4  | $p < 0.001$  |
|                               | No              | 1      | 0.3   |              |
|                               | No response     | 10     | 3.3   |              |
| Number of known species (289) | One             | 111    | 38.41 | $p < 0.001$  |
|                               | Two             | 38     | 13.15 |              |
|                               | Three           | 54     | 18.68 |              |
|                               | More than three | 68     | 23.53 |              |
|                               | Does not known  | 13     | 4.50  |              |
|                               | No response     | 5      | 1.73  |              |
| Vernacular names (289)        | Yes             | 281    | 97.23 | $p < 0.001$  |
|                               | No              | 3      | 1.04  |              |
|                               | No response     | 5      | 1.73  |              |

Many people of Brazzaville (96.4 %) are acquainted with wild edible mushrooms. The difference between those who know them and those who don't is highly significant ( $P < 0.001$ ). Many citizens of Brazzaville know at least two edible mushroom species (42.21 %), shortly followed by those declaring to know only one species (38.11 %). While only 4.50 % of Brazzaville's inhabitants state having not any knowledge about edible mushrooms from the markets of Brazzaville, the bulk of the interviewed (97.23 %) have at least some knowledge and use local names for edible mushrooms. The difference is statistically significant ( $p < 0.001$ ). The knowledge or absence of knowledge seems independent from the educational level of the interviewees ( $p = 0.8150$ ). However, it is significantly affected by the ethnolinguistic group to which someone belongs ( $p < 0.001$ ). The people belonging to the Lari possess a significantly greater knowledge than any of the other ethnic groups studied ( $p = 0.002$ ).

### Local denominations of edible mushrooms in the Republic of the Congo

Table III : Local appellations of the diverse species of edible mushrooms by Congo citizens.

| Narrow Bantu                          | Linguistic groups   | % of subjects inquired | Local names                    |
|---------------------------------------|---|------------------------|--------------------------------|
| <b>Bantu A</b>                        |   |                        |                                |
| Makaa-Nyem A80-90                     | <i>Bekwel=Bakouélé</i> A85b                               | 0.7                    | Igoo, igon                     |
| <b>Bantu B</b>                        |   |                        |                                |
| Mbete languages B60                   | <i>Mbete=Mbere</i> B61                                    | 4.2                    | Akombo, ambuomo, pakayouama    |
| Teke languages B70                    | <i>Teke-boma</i> (central Téké) B74b                      | 8.9                    | Abuô ambuô, amvuô              |
|                                       | <i>Teke-fuumu</i> (téké du centre-Sud, teke du Pool) B77b |                        |                                |
|                                       | <i>Teke-wuumu</i>   |                        |                                |
|                                       | <i>Teke-kukuya</i> (South Téké) B77a                      |                        |                                |
|                                       | <i>Teke-nziku</i> B74a                                    | 2.8                    | Ambuo, amvuo                   |
|                                       | <i>Ngungwel=Ngangoulou</i> (North-East Téké) B72a         | 2.1                    | Budongulu                      |
|                                       | <i>Teke-laali</i> (South-West Téké) B73b                  | 0.4                    | Akumbu                         |
|                                       | <i>Teke-tege=teke-alima</i> (North Téké) B71              |                        |                                |
| <b>Bantu C</b>                        |   |                        |                                |
| Ndondi-Ngiri Ig C10                   | <i>Bomitaba</i> Ig C14                                    | 5.4                    | Makombo, mabaka-baka, tokomolo |
|                                       | <i>Enyele=Enyellé</i> C141                                | 0.4                    | Tokomolo                       |
| Mboshi Ig C20                         | <i>Akwa</i> C22   | 2.1                    | Akombo, toloko, abaka-lembo    |
|                                       | <i>Koyo</i> C24   | 5.2                    | Akombo, abongo                 |
|                                       | <i>Mbosi=Mboshi</i> C25                                   | 21.4                   | Akombo                         |
|                                       | <i>Likwala</i> C26  | 1.1                    | Akombo, makombo                |
|                                       | <i>Likuba =Likouba</i> C27                                | 2.1                    | Makombo                        |
| Bangi-Ntomba Ig (Lingala et al.) C 30 | <i>Bobangi=Bangi</i> C32                                  | 1.4                    | Babôkô                         |
|                                       | <i>Moi</i> C32  |                        |                                |
| <b>Bantu H</b>                        |   |                        |                                |
| Kongo Ig H 10                         | <i>Koongo</i> H16g  | 7.5                    | Mabuwa                         |
|                                       | <i>Koongo RDC</i>   | 2.5                    | Bubôkô                         |
|                                       | <i>Laadi =Lari</i> H16f                                   | 31                     | Mabuwa , buwa                  |
|                                       | <i>Beembe</i> H11   | 1.4                    | Mbulumbungu, tsalagamulélé     |
|                                       | <i>Doondo</i> H112 b                                      | 1.4                    | Mabuwa                         |
|                                       | <i>Suundi</i> H131  | 0.4                    | Mabuwa                         |
|                                       | <i>Yombe RDC</i>  | 0.4                    | Mabuwa                         |
|                                       | <i>Vili</i> H12   | 4.6                    | Bu'k                           |

| Oubanguish languages |                           |     |             |
|----------------------|---------------------------|-----|-------------|
| Monzombo-Ngbaka      | <i>Monzombo=Mondjombo</i> | 0.7 | Suu , koluo |

The local names of wild edible mushrooms were compiled for 29 linguistic groups. For the majority of the linguistic groups, only the common names of mushrooms are known. The vernacular name « mabuwa » is most widespread (40.7 %), followed in descending order by « akombo » (34 %), « amvuô » (11.7 %) and « makombo » (7.5 %) ; the other appellations are much less widespread.

Table IV.- Local specific Congolese names for edible mushrooms.

| Species                         | Local name   | Ethnic groups  |
|---------------------------------|--|--|
| <i>Auricularia cornea</i>       | Matoyi ma mpo<br>Apipa   | <i>Bangi</i><br><i>Teke-alima</i>  |
| <i>Hygrocybe</i> sp.            | Itegi<br>Abuô enko<br>Ombadzi  | <i>Akwa</i><br><i>Teke-boma</i><br><i>Teke-laali</i>   |
| <i>Marasmius buzungolo</i>      | Kana<br>Abuô achélé<br>Tsalanga-mulélé<br>Besele<br>Adunga   | <i>Monzombo</i><br><i>Teke-boma</i><br><i>Beembe</i><br><i>Teke-laali</i><br><i>Mbosi, Teke-alima</i>                          |
| <i>Termitomyces aurantiacus</i> | Toloko-tolowo<br>Kolowo<br>Nsempila, nsempela<br>Abuô edzua<br>Ibala-mwésé<br>Ambuomo<br>Budongulu | <i>Akwa</i><br><i>Monzombo</i><br><i>Lari, Doondo</i><br><i>Teke-boma</i><br><i>Mbosi</i><br><i>Mbere</i><br><i>Teke-laali</i> |
| <i>Termitomyces globulus</i>    | Ondzo'ô  | <i>Teke-alima</i>  |
| <i>Termitomyces letestui</i>    | Congo ya sika<br>Tumbula<br>Abuô ntsi<br>Mbulumbungu<br>Biyoyo                                     | <i>Monzombo</i><br><i>Lari</i><br><i>Teke-boma</i><br><i>Lari, Beembe</i><br><i>Teke-laali</i>                                 |
| <i>Termitomyces mammiformis</i> | Dede<br>Tsatsama, kinata ntôtô<br>Abuço meko edzua<br>Matumbula                                    | <i>Monzombo</i><br><i>Lari</i><br><i>Teke-boma</i><br><i>Lari</i>  |
| <i>Termitomyces microcarpus</i> | Asièkè<br>Asèlè<br>Bintsèti<br>Luwa lwa nzawu  | <i>Mbosi</i><br><i>Teke</i><br><i>Bangi, Moi</i><br><i>Lari</i>  |
| <i>Termitomyces singidensis</i> | Nsutomo<br>Binata<br>Abuô eko ntsabori   | <i>Monzombo</i><br><i>Lari</i><br><i>Teke-boma</i>   |
| <i>Termitomyces striatus</i>    | Abuô ntsè<br>Kata  | <i>Teke-boma</i><br><i>Monzombo</i>  |



For some ethnolinguistic groups, such as the Lari, the Monzombo, the Téké-Boma and the Téké-Laali, the people that have been inquired are able to identify at least three edible mushrooms species. Usually people give a name according to the habitat in which the species was collected, resulting in names like “mushroom of the savannah” or “mushroom of the forest”.

### **People dedicated to mushroom harvesting**

Harvesting edible mushrooms is as much an activity for women as it is for men. It is more practised by men than by women, by adults as by children. The differences are statistically significant ( $p < 0.001$ ). The differences are due to the fact that men frequently leave the village for mushroom hunting in the morning or around 18 hours, and then only coming back the next day. This activity is not seen with women or children. Most women leave the village for mushroom hunting around 4 a.m. Children often pick mushrooms early in the morning, before going to school, and then again in the afternoon, i.e. after class. Men seem to have a better knowledge of the different forest ecosystems and places where much appreciated mushrooms such as *Termitomyces globulus* can be found.

The number of collectors differs significantly from one locality to another ( $p < 0.001$ ). The highest numbers of mushroom collectors were observed on Mbamou island, namely at Nzete-Moko and Lissanga. This is due to high natural mushroom productions seen in the fields, savannahs and forests of these two localities.

Collectors who are the first to find a termite hill or site with edible mushrooms, usually monopolize the spot and prevent any-one else from collecting there. In the event the collector finds a second mushroom collecting spot nearby, he can already claim it by covering the mushrooms with some material.

### **Amount of edible mushrooms collected**

The amount of edible mushrooms collected depends from the productivity of the termite hill and/or the area. Large amounts are collected by both, men or women, and it occurs most often from March-April with for example *Termitomyces globulus*.

*Termitomyces aurantiacus* is the most productive of all edible species. During its fructification period all the markets of Brazzaville are inundated by this species.

### **Duration of the edible mushrooms harvesting**

The harvesting of edible mushrooms is bimodal and varies significantly from one rainy season to another ( $p < 0.001$ ). In general harvesting lasts one month in spring (around March) and two more months near the end of the year (around November).

### **Storage and long term conservation**

The freshly picked mushrooms are stored in bowls and then forwarded to the selling sites. However, they are rarely stored for long time as adequate structures for conservation, such as cooling, are not available. Due to this, a number of species quickly deteriorate, losing their organoleptic properties and becoming unusable within two or three days after collecting. This is notably the case with *Termitomyces aurantiacus*.

### **Cultural aspects linked to the collecting of edible mushrooms**

Many collectors told that after having discovered an area with plenty of edible mushrooms they should not scream or give a screech, for fear that some mushrooms would disappear. Field observations revealed that when the density of collectors is high, a cry of joy may attract attention of other people.

### **Marketing**

The investigation concerning marketing of edible mushrooms involved 50 saleswomen from the following sales points: Dragage market (32 %), Mikalou market (24 %), Port Yoro (32 %) and Texaco Tsiémé market (24 %). It should be mentioned that during this survey only *Termitomyces globulus*, obtained from Mbamou island, was available on these markets. Since it was only available in markets of the Northern zone, the survey covers only these places.

*Socio-economic characteristics of the traders (all saleswomen)*

Table V.- Social characteristic of the mushroom traders  
(Size consulted = 50)

| Variabes        | Cohorte/state                   | Total number | %   | Significance    |
|-----------------|---------------------------------|--------------|-----|-----------------|
| Sex             | Male                            | 0            | 0   |                 |
|                 | Female                          | 50           | 100 |                 |
| Age             | 18-25 years                     | 11           | 22  | <i>p</i> =0.547 |
|                 | 26-30 years                     | 6            | 12  |                 |
|                 | 31-35 years                     | 9            | 18  |                 |
|                 | 36-40 years                     | 9            | 18  |                 |
|                 | 41-45 years                     | 8            | 18  |                 |
|                 | 46-50 years                     | 6            | 12  |                 |
|                 | 51-55 years                     | 1            | 2   |                 |
| Occupation      | selling                         | 39           | 78  | <i>p</i> =0.428 |
|                 | harvesting/picking              | 11           | 22  |                 |
| Marital status  | Married                         | 0            | 0   | <i>p</i> =0.080 |
|                 | Free union                      | 43           | 86  |                 |
|                 | Single                          | 6            | 12  |                 |
|                 | Divorced                        | 0            | 0   |                 |
|                 | Widower                         | 4            | 2   |                 |
| Education level | Primary school                  | 3            | 6   | <i>p</i> =0.722 |
|                 | Secondary 1 <sup>er</sup> cycle | 6            | 12  |                 |
|                 | Secondary 2 <sup>c</sup> cycle  | 35           | 70  |                 |
|                 | University                      | 0            | 0   |                 |
|                 | Uneducated                      | 6            | 12  |                 |
| Family size     | 1 person                        | 0            | 0   | <i>p</i> =0.193 |
|                 | 2 persons                       | 0            | 0   |                 |
|                 | 3 persons                       | 2            | 4   |                 |
|                 | 4 persons                       | 9            | 18  |                 |
|                 | 5 persons or more               | 39           | 78  |                 |

Selling of edible mushrooms in Brazzaville is only carried by women (100 %) and all of the have the Congolese nationality (100 %). The average age of the sampled population is  $34.74 \pm 8.50$  year, with modus equal to 23 years and median 34.5 years. In spite of a high dispersion around the mean, the distribution of the age in the sample is close to normal; the mode is situated lower than the average. The most frequent age category of seller is between 18 to 25 years (22 %), followed by 31 to 35 years (18 %), 36 to 40 years (18 %), the less representative being 51 to 55 years (2 %). The average age of saleswomen is not significantly different from one market to another ( $p < 0.05$ ).

Marketing of edible mushrooms in the diverse markets of Brazzaville is an activity carried out by shopkeepers (78 %). The number of collectors selling their products themselves and directly on the markets is fairly high (22 %). Saleswomen are mostly not married but in free union (86 %) and possess an education level of the secondary 2<sup>d</sup> cycle (70 %); about 12% of the interviewed saleswomen have not got schooling. Saleswomen with a university level of education were not detected in our survey. The most frequent family composition of the saleswomen is the one with 5 persons or more (78 %). The marital status, the education level, the family composition and age category of saleswomen does not significantly differ from one selling point to another ( $p > 0.05$ ).

### *Sites and modes of supply*

Table VI- Modes of supply of edible mushrooms by the saleswomen (Size consulted = 50)

| Variables                    | Modes            | Size | %   | Significance |
|------------------------------|------------------|------|-----|--------------|
| Supplying site               | Selling sites    | 40   | 80  | $p = 0.626$  |
|                              | Production sites | 10   | 20  |              |
| Mode of purchase             | Wholesale        | 39   | 100 |              |
| Provenance villages (origin) | North Pool       | 16   | 32  | $p < 0.001$  |
|                              | South Pool       | 2    | 4   |              |
|                              | Mbamou island    | 32   | 64  |              |

Most of the inquired saleswomen buy the edible mushrooms at the selling sites (80 %). The mushrooms are usually brought by wholesalers coming from the production localities. Twenty percent (20 %) of the wholesalers take the mushrooms directly at the production sites. In this respect the difference between the market sites is not statistically significant ( $p > 0.05$ ). The offered mushrooms come essentially from Mbamou island (64 %) and North Pool (32 %). The origin of the supplied and offered mushrooms is significantly different from one market to another ( $p < 0.001$ ).

### *Marketing circuits*

In the marketing circuit of edible mushrooms, four people are involved. These are: the collectors, the wholesalers, the retailers and the consumers. In the production villages, two distinct commercial circuits can be observed, namely a direct circuit from collector to consumer and an indirect circuit from collector via a wholesaler-retailer to consumer. In the selling places the same circuits can be seen. The wholesalers are either the collectors (coming from the production sites), or the people that buy from their collectors clients. It is this second wholesaler category that is the most common.

### *Selling modalities of edible mushrooms*

All the investigated saleswomen have the habit of selling edible mushrooms (100 %). The majority of them are retailers (96 %) with a professional experience of 2 to 4 years (84 %) and selling only fresh mushrooms (100 %). For the majority of the retailers on the urban markets the standard selling unit for edible mushrooms is a heap or a pile worth 250 F CFA (88%). During the period of the present study, the average quantity (=amount) of mushroom sold weekly is  $147 \pm 135$  heaps, the mode being 120 heaps and the median 150 heaps. This amount is significantly different from one seller to another ( $p < 0.005$ ). The average weekly sold amount of mushrooms is statistically different from one market to another ( $p = 0.47$ ). The highest values have been observed on the Mikalou market ( $240 \pm 135$  heaps) and the lowest at Yoro ( $108 \pm 42$  heaps). The sale of edible mushrooms is profitable for 76 % of the sellers. The latter frequently make profits of 100 %, or even more during periods of scarcity. For saleswomen (100%), mushroom selling is not the main source of income as it covers only 8% of the household cost. For 90% of the sellers the sales of edible mushrooms is variable. The main cause is the scarcity (88%) of edible mushrooms on the market (88 %), which in turn is due to reduced productivity at the collecting sites. Moreover, due to the weakened financial and economic situation in the Republic of the Congo the purchasing power of the population has decreased.

The number of years saleswomen sell mushrooms, the condition under which edible mushroom are sold, the selling method and the annual frequency are not significantly different from one selling point to another ( $p > 0.05$ ). The causes of variation in the selling frequency, the price of the sold units, the generated income (eventually covering the cost of a household) and profitability are also not significantly different from one selling place (market) to another ( $p > 0.05$ ).

Table VII.- Selling modalities of edible mushrooms

| Variable                    | Modalities       | Size | %   | Significance |
|-----------------------------|------------------|------|-----|--------------|
| Selling form                | Wholesale        | 2    | 4   | $p = 0.086$  |
|                             | Retail-wholesale | 0    | 0   |              |
|                             | Retail           | 48   | 96  |              |
|                             | Variable         | 0    | 0   |              |
| State of the sold mushrooms | Fresh            | 100  | 100 |              |

|  |                        |    |     |           |
|--|------------------------|----|-----|-----------|
|  | Sun dried              | 0  | 0   |           |
|  | Smoked                 | 0  | 0   |           |
| Selling unit on urban market             | Pile or bunch of 250 F | 44 | 88  | p = 0.645 |
|  | Pile or bunch of 500 F | 2  | 12  |           |
| Selling constancy                        | Yes                    | 5  | 10  | p = 0.829 |
|  | No                     | 45 | 90  |           |
| Causes of variation in selling frequency | Scarcity               | 44 | 88  | p = 0.193 |
|  | Price increase         | 1  | 2   |           |
|  | No response            | 5  | 10  |           |
| Coverage of household cost               | Yes                    | 4  | 8   | p = 0.082 |
|  | No                     | 46 | 92  |           |
| Main source of income                    | Yes                    | 0  | 0   |           |
|  | No                     | 50 | 100 |           |
| Profitability                            | Yes                    | 38 | 76  | p = 0.478 |
|  | No                     | 12 | 24  |           |
| Habit of selling mushrooms               | Yes                    | 50 | 100 |           |
|  | No                     | 0  | 0   |           |
| Experience in selling edible mushrooms   | 1 year                 | 4  | 8   | p = 0.783 |
|  | 2 years                | 14 | 28  |           |
|  | 3 years                | 17 | 34  |           |
|  | 4 years                | 11 | 22  |           |
|  | 5 year and more        | 4  | 8   |           |

Table VIII.- Availability of edible mushrooms in the urban markets

| Variable       | periods                        | Size | %   | Significance |
|----------------|--------------------------------|------|-----|--------------|
| Selling period | November and December          | 2    | 4   | p = 0.291    |
|                | November, December and March   | 27   | 54  |              |
|                | November and March             | 10   | 20  |              |
|                | December and March             | 10   | 20  |              |
|                | November, December and January | 1    | 2   |              |
| Same species   | Yes                            | 0    | 0   |              |
|                | No                             | 50   | 100 |              |

There are two periods when edible mushrooms are available on the markets of Brazzaville, namely March and from November till December. The majority of the saleswomen (94 %) sell edible mushrooms during these two periods. Nevertheless, 6 % of them prefer to sell mushrooms only from November to December because in that period mushrooms are more abundant and easier to harvest.. Indeed, during this period the species of the savannahs and the fields show their highest productivity, especially *Termitomyces aurantiacus*. The main selling periods are not significantly different from one market to another ( $p = 0.291$ ). The species sold during these two periods are different.

### *Consumption of edible mushrooms*

Table IX.- Social characteristics of the consumers of edible mushrooms

| Variables | Categories  | Size | %    | Significance |
|-----------|-------------|------|------|--------------|
| Sex (300) | Male        | 58   | 19.3 | p<0.001      |
|           | Female      | 242  | 80.7 |              |
| Age (300) | 18-25 years | 54   | 18.0 | p<0.001      |
|           | 26-30 years | 69   | 23.0 |              |
|           | 31-35 years | 48   | 16.0 |              |
|           | 36-40 years | 55   | 18.3 |              |
|           | 41-45 years | 37   | 12.3 |              |
|           | 46-50 years | 21   | 7.0  |              |
|           |             | 9    | 3.0  |              |

|                          |                                 |     |      |             |
|--------------------------|---------------------------------|-----|------|-------------|
|                          | 51-55 years                     | 7   | 2.3  |             |
|                          | More than 55 years              |     |      |             |
| Profession<br>(300)      | State employee                  | 9   | 3.0  | $p < 0.001$ |
|                          | Informal sector                 | 53  | 17.7 |             |
|                          | Household                       | 81  | 27.0 |             |
|                          | Shopkeeper                      | 59  | 19.7 |             |
|                          | Private sector                  | 23  | 7.7  |             |
|                          | Unused                          | 26  | 8.7  |             |
|                          | No response                     | 49  | 16.2 |             |
| Marital status<br>(300)  | Married                         | 9   | 3.0  | $p < 0.001$ |
|                          | Free union                      | 171 | 57.0 |             |
|                          | Single                          | 97  | 32.3 |             |
|                          | Divorced                        | 7   | 2.3  |             |
|                          | Widower                         | 3   | 1.0  |             |
|                          | No response                     | 13  | 4.3  |             |
| Education level<br>(300) | Primary school                  | 28  | 9.3  | $p < 0.001$ |
|                          | Secondary 1 <sup>st</sup> cycle | 104 | 34.7 |             |
|                          | Secondary 2 <sup>d</sup> cycle  | 123 | 41.0 |             |
|                          | University                      | 29  | 9.7  |             |
|                          | Uneducated                      | 7   | 2.3  |             |
|                          | No response                     | 9   | 3.0  |             |
| Household size<br>(300)  | 1 person                        | 11  | 11.7 | $p < 0.001$ |
|                          | 2 persons                       | 17  | 9.7  |             |
|                          | 3 persons                       | 21  | 19.0 |             |
|                          | 4 persons                       | 54  | 28.7 |             |
|                          | 5 persons or more               | 176 | 31.0 |             |
|                          | No response                     | 21  | 7.0  |             |

In the present study the average age of people involved in household is  $34.22 \pm 9.31$  years, the mode equals 29 years and the median is 33 years. The dispersion around the average is high and superimposable to the median, which indicates that the distribution is close to normal. The mode sits in an age category inferior to the mean. The most frequent age category is from 26 to 30 years old (23 %), followed by 36 to 40 years (18.3 %) and from 18 to 25 years (18 %); which shows that the households in this study come mostly from the younger populations in Brazzaville.

The frequency of these age categories is not significantly different from one district to another ( $p=0.612$ ). The ages vary very significant from one couple to another ( $p < 0.001$ ). The mean ages are not significantly different from one sex to another ( $p=0.685$ ) and from one district to another ( $p=0.497$ ).

Women have participated more to this inquiry (80.7 %) than men (19.3%), but the sex ratio does differ significantly from one district to another ( $p < 0.001$ ).

Regarding the interviewees' occupation, housewives are the most frequent (27 %), followed by tradesmen (19.7 %) and the people working in the informal sector (17.7 %). People working in the public sector are less represented (3.0 %). The profession of interviewed people is statistically different ( $p < 0.001$ ) from one household to another, but not between districts ( $p=0.539$ ) or sexes ( $p=0.771$ ) respectively.

Most interviewees have reached a secondary education level (75.7 %), with predominance of the second cycle (41 % versus 4.7 %). The fraction of university level trained people is relatively important (9.7 %). People without any form of schooling represent 2.3 % of the investigated people. The level of education of mushroom consumers is statistically different from one district to the other ( $p < 0.001$ ), but is not different between the sexes ( $p=0.360$ ).

The majority of the interviewees have a family situation of the free union type (57.0 %), followed by singles (32 %), married (3.0 %), divorced (2.3 %) and widowers (1.0 %). The marital status of these people is statistically different from one district to another ( $p=0.004$ ).

Most of the households count less than five or four people (31 %, or 28.2 % respectively). The size of the households is significantly different from one district to another ( $p=0.001$ ).

### Rate and frequency of consumption of edible mushrooms

Table X.- Rate and frequency of consumption of edible mushrooms.

| Variables                             | Modalities                         | Size                       | %    | Signicativity |
|---------------------------------------|------------------------------------|----------------------------|------|---------------|
| Consumption of edible mushrooms (300) | Yes                                | 238                        | 79.3 | $p < 0.001$   |
|                                       | No                                 | 61                         | 20.4 |               |
|                                       | No response                        | 1                          | 0.3  |               |
| Causes of no consumption (61)         | Dietary habits                     | 23                         | 37.7 | $p < 0.001$   |
|                                       | Disgust                            | 20                         | 32.8 |               |
|                                       | No causes                          | 1                          | 1.6  |               |
|                                       | No response                        | 17                         | 27.9 |               |
| Frequency of consumption (238)        | Once a week                        | 46                         | 19.3 | $p < 0.001$   |
|                                       | Twice a week                       | 55                         | 23.1 |               |
|                                       | Three times per week               | 54                         | 22.7 |               |
|                                       | Four times per week                | 25                         | 10.5 |               |
|                                       | Five times per week                | 18                         | 7.6  |               |
|                                       | Six times per week                 | 13                         | 5.5  |               |
|                                       | Every day                          | 8                          | 3.4  |               |
|                                       | Once a month                       | 3                          | 1.3  |               |
|                                       | Twice a month                      | 2                          | 0.8  |               |
|                                       | Once a year                        | 8                          | 3.4  |               |
|                                       | No response                        | 6                          | 2.5  |               |
|                                       | Factors limiting consumption (238) | Availability on the market | 83   |               |
| Seasonality of the product            |                                    | 97                         | 40.7 |               |
| Dietary habit                         |                                    | 25                         | 10.5 |               |
| Picking processes                     |                                    | 3                          | 1.3  |               |
| Price                                 |                                    | 24                         | 10.1 |               |
| Preparation mode                      |                                    | 1                          | 0.4  |               |
| Dietary taboos                        |                                    | 0                          | 0    |               |
| Do not known                          |                                    | 2.1                        | 2.1  |               |

This table shows that the families' rate of consumption of edible mushrooms in Brazzaville is of 79.3 %. The rate varies very significantly from one district to another ( $p < 0.001$ ). People not consuming edible mushrooms, give their dietary habit (37.7 %) or disgust (32.8 %) as main reason. Families regularly consuming edible mushrooms are rare (3.4 %). During the week of investigation, most of the families declared a frequency of consumption of 2-3 times per week (45.8 %) followed by families with a frequency of 3-6 times per week (23.6 %). In general people eat edible mushrooms about three times per week (65.1 %). However, the frequency of weekly consumption of edible mushrooms is significantly different between families and also between districts of Brazzaville ( $p < 0.001$ ).

Families in Brazzaville consider the consumption of edible mushrooms is mostly limited by seasonality (40.7%), followed by scarcity on the market (34.9 %), their own feeding habits (10.5 %) and the price on the markets (10.1 %). Specific taboos related to mushroom consumption were not recorded. Factors limiting the consumption of edible mushrooms are statistically different from one family to another ( $p < 0.001$ ) but they are not from one district to another ( $p = 0.543$ ).

Table XI.- Edible mushroom consumption rate per district or municipality

| District or Municipality | Consumers |            | Non-consumers |            | Consumption rate (%) in the sample |
|--------------------------|-----------|------------|---------------|------------|------------------------------------|
|                          | Size      | Percentage | Size          | Percentage |                                    |
| Makélékélé               | 21        | 70.0       | 9             | 30.0       | 8.8                                |
| Bacongo                  | 23        | 76.7       | 7             | 23.3       | 9.7                                |
| Poto-Poto                | 25        | 83.3       | 5             | 16.7       | 10.5                               |
| Mongali                  | 25        | 83.3       | 5             | 16.7       | 10.5                               |
| Ounzé                    | 23        | 76.7       | 7             | 23.3       | 9.7                                |
| Talangai                 | 28        | 93.3       | 2             | 6.7        | 11.8                               |
| Mfilou                   | 15        | 50.0       | 15            | 50.0       | 6.7                                |
| Madibou                  | 23        | 76.7       | 7             | 23.3       | 9.7                                |
| Djiri                    | 24        | 80.0       | 6             | 20.0       | 10.3                               |
| Commune de               | 29        | 96.7       | 1             | 3.3        | 12.2                               |

|         |     |  |    |  |
|---------|-----|--|----|--|
| Kintélé |     |  |    |  |
| Total   | 238 |  | 61 |  |

The consumption rate of edible mushrooms varies from one district to another. The higher rates are respectively observed in the « Commune de Kintélé » (96.7 %) which belongs to the Département du Pool, in Talangai (93.3 %), Poto-Poto (83.3 %), Mongali (83.3 %) and Djiri (80.0 %). The lowest values are observed in Mfilou (50.0 %), Makélékélé (70.0 %), Ounzé (76.7 %), Madibou (76.7 %) and Bacongo (76.7 %). The rate of consumption is always higher or equal to 50 %, regardless of the district. However, the higher consumption frequencies (at least 4 times per week) are observed in families of Ounzé (46.7 %), followed by the ones of Bacongo (40.0 %), Madibou (40.0 %), Makélékélé (30.0 %) and Mfilou (26.7 %). The weekly frequency of consumption is significantly different between districts ( $p < 0.001$ ).

Table XII.- Edible mushrooms composition before the inquiries period.

| Variables                               | Modalities         | Size | %     | Significance |
|---|--------------------|------|-------|--------------|
| Consumption 24 hours before the inquiry | Yes                | 29   | 12.18 | $p = 0.001$  |
|   | No                 | 209  | 87.82 |              |
| Time since last consumption             | Less than one week | 45   | 18.91 | $p < 0.001$  |
|   | One week           | 17   | 7.14  |              |
|   | Two weeks          | 27   | 11.34 |              |
|   | Three weeks        | 20   | 8.40  |              |
|   | More than 3 weeks  | 11   | 4.62  |              |
|   | One year ago       | 73   | 30.67 |              |
|   | Do not known       | 45   | 18.91 |              |

At the time of investigation 18.91% of the households declared having consumed mushrooms less than a week ago, and 7.14% within the past week. More than half of the households (55.03%) had mushrooms more than one week before the investigation, an important fraction of which (30.67 %) from the previous year. The observed differences are highly significant from one district to another ( $p < 0.001$ ).

At the time of investigation very few families declared having consumed mushrooms the day before (12.18 %); this rate varies significantly from one district to another ( $p = 0.001$ ).

Table XIII.- Supplying modalities of edible mushrooms towards consumers.

| Variables   | Modalities          | Size | %     | Significativity |
|---|---------------------|------|-------|-----------------|
| Supplying sites (238)                               | Market              | 220  | 92.44 | $p < 0.001$     |
|   | The bush            | 1    | 0.42  |                 |
|   | Production locality | 1    | 0.42  |                 |
|   | Variable            | 16   | 6.73  |                 |
| Constancy of the supplying site (238)               | Yes                 | 73   | 30.68 | $p < 0.001$     |
|   | No                  | 147  | 61.76 |                 |
|   | No response         | 18   | 7.56  |                 |
| Mode of weekly purchase (238)                       | By pile or bunch    | 141  | 59.24 | $p < 0.001$     |
|   | Variable            | 1    | 0.42  |                 |
|   | No response         | 96   | 40.34 |                 |
| Amount of weekly purchased units (238)              | Constant            | 7    | 2.94  | $p < 0.001$     |
|   | Variable            | 186  | 78.15 |                 |
|   | No response         | 45   | 18.91 |                 |
| Weekly spending on edible mushrooms (in FCFA) (238) | 250 F               | 11   | 4.62  | $p < 0.001$     |
|   | 500 F               | 41   | 17.23 |                 |
|   | 1000 F              | 17   | 7.14  |                 |
|   | More than 1000 F    | 9    | 3.78  |                 |
|   | Variable            | 160  | 67.23 |                 |

The most common way to obtain edible mushrooms is by direct purchase on the market (92.44 %). Only one person (0.42 %) obtains them at the production localities and another person (0.42 %) obtains them in the bush. The most common way to purchase edible mushrooms (59.24%) is by buying piles (mushrooms with a

short stipe like *Termitomyces aurantiacus*) or bunches (usually 7 to 8 carpophores with a long stipe like *Termitomyces globulus*). The number of weekly purchased units of edible mushrooms varies significantly in 78.15 % of the consumers ( $p < 0.001$ ) and so do the weekly expenses ( $p < 0.001$ ) in 67.23 % of the consumers.

Table XIV.- Consumption of edible mushrooms.

| Variables  | Modalities                      | Size | %     | Significance |
|--|---------------------------------|------|-------|--------------|
| Preferred Species (238)                          | <i>Marasmius buzungolo</i>      | 12   | 5.04  | $p < 0.001$  |
|  | <i>Termitomyces aurantiacus</i> | 55   | 23.11 |              |
|  | <i>Termitomyces globulus</i>    | 46   | 19.33 |              |
|  | <i>Termitomyces letestui</i>    | 11   | 4.62  |              |
|  | <i>Termitomyces mammiformis</i> | 36   | 15.13 |              |
|  | <i>Termitomyces sindigensis</i> | 9    | 3.78  |              |
|  | No preference                   | 69   | 28.99 |              |
| Treatment of the mushrooms                       | Fresh (not treated)             | 238  | 100   |              |
|  | Sun-dried                       | 0    | 0     |              |
|  | Smoked                          | 0    | 0     |              |
| Food of animal origin going with in the cooking  | Smoked or fresh fish            | 189  | 79.41 | $p < 0.001$  |
|  | Bush meat                       | 31   | 13.03 |              |
|  | Salted fish                     | 10   | 4.2   |              |
|  | Variable                        | 4    | 1.68  |              |
|  | None                            | 4    | 1.68  |              |
| Food of vegetal origin going with in the cooking | Green vegetables                | 130  | 54.62 | $p < 0.001$  |
|  | Pulp juice of walnut palm       | 24   | 10.08 |              |
|  | Groundnut pasta                 | 40   | 16.81 |              |
|  | Cassava tuber                   | 10   | 4.21  |              |
|  | Cereals                         | 15   | 6.30  |              |
|  | Variable                        | 15   | 6.30  |              |
|  | None                            | 4    | 1.68  |              |
| Preparation method                               | Cooked with water               | 203  | 85.30 | $p < 0.001$  |
|  | Grilled                         | 14   | 5.88  |              |
|  | Cooked in papillottes           | 2    | 0.84  |              |
|  | Variable                        | 19   | 7.92  |              |
| Most used condiments in the cooking              | Clives                          | 12   | 5.03  | $p = 0.001$  |
|  | Onions                          | 18   | 7.57  |              |
|  | Aubergines                      | 1    | 0.42  |              |
|  | Variable                        | 207  | 86.98 |              |

The most preferred edible species is *Termitomyces aurantiacus* (23.11 %), followed by *Termitomyces globulus* (19.33 %) and *Termitomyces mammiformis* (15.13 %). Less favourite is *Termitomyces sindigensis* (3.78 %). This may be due to the fact that people simply know abundant and frequent species much better than infrequent ones. Some people (39.1 %) consume only one mushroom species, often the one that their ancestors used to consume.

Nevertheless, an important fraction (28.99 %) of consumers does not show a preference for a particular mushroom species. The preference given by the interviewees to the different edible mushrooms is significant ( $p < 0.001$ ).

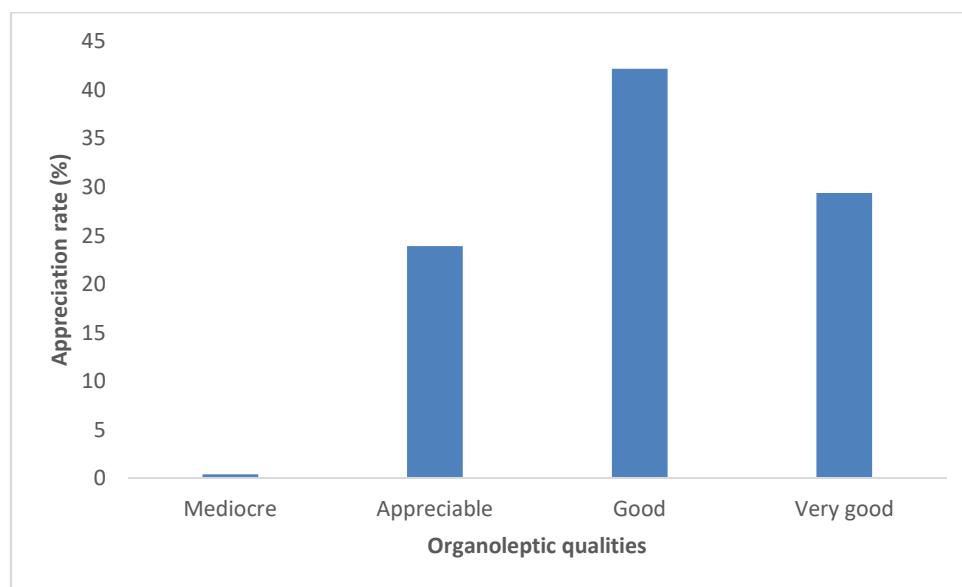
All consumers preferred fresh, non-transformed mushrooms over smoked or sun-dried ones (100%). The preference of people for different cooking methods is significantly different ( $p < 0.001$ ). The most preferred way of preparation is by cooking in water (85.30 %), followed by grilling (5.88 %). Cooking in papillotte is very rare (0.84 %). In only 1.68% of the consumers a dish can be composed of mushrooms with chikwangu. Most of the consumers eat mushrooms with fish (79.41 %) and/or with green vegetables (45.62 %). The most used condiments in cooking (86.98%) vary significantly from one family to another ( $p = 0.001$ ). Consumers using only one condiment per dish are rare: only onions (7.75 %), only chives (5.03 %) and only aubergines (0.42 %).

#### **Organoleptic qualities of edible mushrooms**

As indicated in Figure 1 (next page) the majority of the families (79.3 %) consider edible mushrooms at least as appreciable or better. However, almost a third (29.41 %) of the consumers attribute edible mushrooms



very good organoleptic qualities. Only, very few consumers (0.42 %) stated that organoleptic qualities of edible mushrooms are mediocre, especially their consistency is often not appreciated. In fact, some species like *Termitomyces aurantiacus* often rot within two days if not stored in a refrigerated place. As in most of the families, conservation of mushrooms is problematic, the weekly consumption is rather low.



**Figure I.-** Appreciation of organoleptic characteristics of mushrooms.

#### ***Rejections and illnesses linked to the consumption of edible mushrooms***

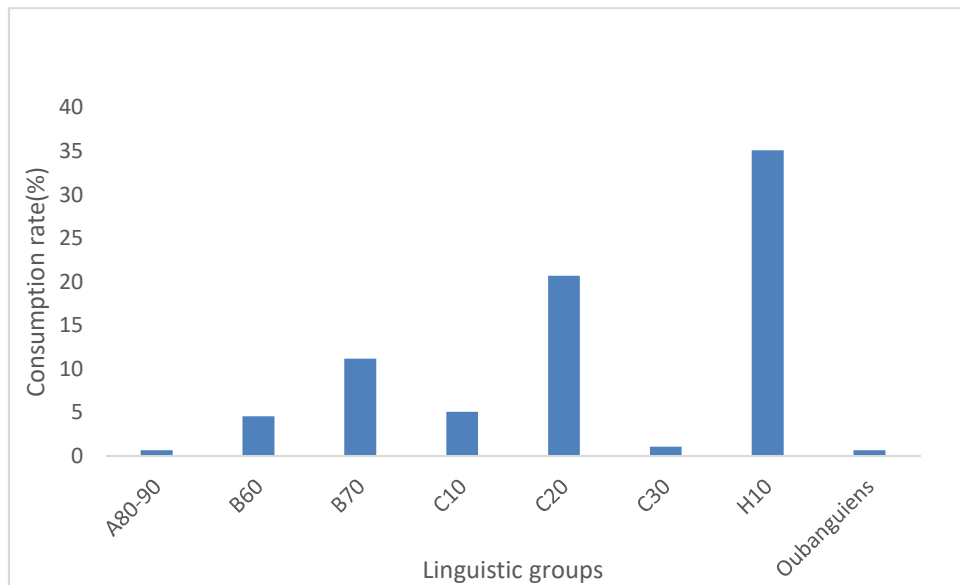
The survey has shown that none of the Congolese interviewees report rejection or taboos related to the consumption of edible mushrooms. Also illnesses or bad symptoms linked to the consumption of mushrooms were not reported. Some people (2.43 %) state that the consumption of mushrooms fits in the treatment of some pathologies, such as malnutrition and anemia.

Table XV.- Knowledge concerning rejection, illnesses or treatment of pathologies linked to mushrooms.

| Variables                    | Modalities   | Size (n) | %     | Significativity |
|------------------------------|--------------|----------|-------|-----------------|
| Knowledge on rejection (289) | Yes          | 0        | 0     |                 |
|                              | No           | 289      | 100   |                 |
| Treated illness (289)        | Malnutrition | 5        | 1.73  | p<0.001         |
|                              | Anaemia      | 2        | 0.70  |                 |
|                              | Do not known | 273      | 94.46 |                 |
| Provoked illness (289)       | Yes          | 0        | 0     | p<0.001         |
|                              | No           | 228      | 78.90 |                 |
|                              | Do not known | 61       | 21.1  |                 |

#### ***Consumption and linguistic/ethnic groups***

The number of edible species used for consumption varies significantly from one ethnic group to another ( $p=0.002$ ). The Lari, the Mbosi, the Kongo and the Téké know much more edible mushroom species than the other ethnic groups.



**Figure 2.-** Consumption rate of edible mushrooms per linguistic group.

## DISCUSSION

The folk names of the edible mushrooms used for food in the studied area vary from one ethnic group to another. The same observation has been made by GUISSOU et al. (2008) in a study regarding the edible mushrooms of Burkina Faso and by FADEYI et al. (2017) regarding edible taxa from the Monts Kouffé in central Benin. In our area, the ethno-linguistic groups consuming the most edible mushrooms, namely the Kongo, the Mbosi and the Téké, are also those who have the best knowledge of edible mushrooms. These ethnic groups are also fond of NTFP (non-timber forest products) of vegetal origin. For those ethnic groups, edible mushrooms frequently take the place of meat or fish.

If we consider the wild edible mushrooms of Bas-Congo, about the same list is available and supported by fine photos in LATHAM & KONDA KU MBUTA (2014). As not quoted species in our study appear four species, namely: *Lentinus* cf. *squarrosulus* Mont., *Polyporus arcularius* (Batsch.) Fr., *Psathyrella* cf. *tuberculata* (Pat.) A.H.Sm. and *Termitomyces microcarpus* (Berk. & Broome) R.Heim. In a same way, RAMMELOO & WALLEYN (1993) mention consumption of *Armillaria distans* (Pat.) Sacc. & P. Syd. *Chlorophyllum molybdites* (G. Mey.) Massee, *Collybia anombe* De Seynes (now *Xerula anombe* (De Seynes) R.H. Petersen)), *Collybia oronga* De Seynes (now *Xerula oronga* (De Seynes) R.H. Petersen)), *Leucocoprinus gandour* Har. & Pat. and *Phlebopus sudanicus* (Har. & Pat.) Heinem. in the Republic of the Congo.

The diversity of edible mushrooms in the area of study is lower than the diversity quoted by NDOLO EBIKA et al. (2018) in the Bomassa villages of the Sangha Department, Makao and Thanry-Congo of the Likouala Department, i.e. eleven species in our study against 51 in NDOLO EBIKA et al. (2018). The difference could be explained by edapho-climatic conditions. Indeed, our study has been carried out in a zone with a wet tropical climate presenting a long dry season whilst the study by NDOLO EBIKA et al. (2018) has been carried out in the equatorial zone where a dry season is nearly nonexistent. In our study, the most represented genus is *Termitomyces* whilst in the study of NDOLO EBIKA et al. (2018) it is the genus *Cantharellus*. In our study there are more symbiotic species (82 %) than saprotrophic species (18 %), whilst in NDOLO EBIKA et al. (2018) there are more saprotrophs (51.9 %) than symbionts (45.1 %). In the area of the present study the most marketed and income generating taxa belong to the genus *Termitomyces*. They alleviate poverty in families who are active in this sector. The same observation has been made by KONÉ et al. (2013), stating that rural populations of Ivory Coast can benefit from selling termitomyces. In Benin however, the drier climate does not support huge productions of *Termitomyces*, which makes this genus hardly marketed by local people (YOROU & DE KESEL, 2002).

Collecting edible mushrooms represents a non-negligible food supply for the people of Brazzaville. Indeed, the contributions of KHAN et al. (2008), HAMZA et al. (2012), FALANDYSZ & BOROVICKA (2013) and SUBRATA et al. (2013) have pointed out that edible mushrooms are good sources of protein, with nearly a tenth of essential amino-acids. Lysine and leucine are the most abundant. The sulfur amino-acids (methionine, cysteine) are generally in low quantity. The protein content of mushrooms is, however, lower than the one of raw

or dry meat products (10 times less, but more than the half is easily digested). Nevertheless, mushrooms have a higher protein content than milk (CHANG & BUSWELL, 2012). Studies presenting protein contents of 21 edible mushroom species from Zambia (MALAISSE, 2010) showed that the protein contents can range from 15 to 25 % of the dry weight. The highest protein contents have been observed in species of the genus *Termitomyces*, especially *Termitomyces clypeatus* (up to 32 %). Mushrooms provide a sufficient rich and low-cost alternative protein source, comparable - if not better and more complete in amino acid composition - than protein rich vegetables (Gonzalez et al 2020). They have a very low content in the fatty acids. Nevertheless, the linoleic acid and the alpha-linolenic acid represent 30 to 70 % of the total of the fatty acids. Moreover, the mushroom species have high contents in oligo-elements such as iron, copper, zinc and iodine and in macro-elements of which the potassium, but they have a low content in sodium (COLAK et al., 2009 ; NAKALEMBE et al., 2009 ; OLFATI et al., 2009 ; KALAC, 2012). Finally, edible mushrooms are rich in vitamins D and C.

## CONCLUSION

The objective of the present study was to make an inventory of the edible mushrooms available and marketed in the area of Brazzaville. Direct observations, inquiries and interviews carried out in communities of Brazzaville and Kintélé allowed us to collect valuable data regarding their diversity, their marketing and their consumption. The results obtained have revealed a fairly low diversity of edible mushrooms, with a consumption rate of 79.3 % and a feeble weekly consumption due to seasonality (phenology). The wild edible mushrooms represent a protein rich and low cost food source. The observed high interest and esteem local people show for this type of food is an excellent base for exploring ways to promote their cultivation which in turn would guarantee their constant supply to the local markets. The interrupted supply of wild edible species is an issue that most mushroom consumers and sellers from Brazzaville consider a problem in terms of diet, food supply and income generating activity.

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