

Study of Medicinal Plants Used in Bistros in the City of Abidjan

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Abstract

The medicinal plants have a heritage that can be considered invaluable especially in sub-Saharan Africa since the use of traditional medicine is very much rooted into the culture and health practices of the local population. In the urban social places, which are called “bistros” in Abidjan, the use of koutoukou, alcoholic drink made out of palm wine, is often combined with the use of medicinal plants having proven biological properties through empirical research carried out by the locals. The present study was conducted with the aim of inventorying and analysing the medicinal plants used in the bistros of the city of Abidjan. Four districts (Abobo, Cocody, Koumassi and Yopougon) were surveyed, encompassing a total of 347 bistros. Through semi-structured interviews conducted with the relevant stakeholders, twelve medicinal plant species were identified and ranked according to their cultural importance. Three species (*Garcinia kola*, *Zingiber officinale* and *Moringa oleifera*) stand out with an RFC of 100%, reflecting a strong consensus regarding their recognised biological properties: antimicrobial, anti-inflammatory and antioxidant. Additionally, two species, *Enantia polycarpa* and *Carapa procera*, with an RFC of 75%, are employed in the traditional treatment of malaria. This study confirms that the bistros of Abidjan constitute unsuspected ethnobotanical resources, the rigorous scientific exploration of which opens up promising prospects for the valorisation and promotion of traditional African medicine.

Keywords

Medicinal Plants, Traditional Ivorian Pharmacopoeia, Relative Citation Frequency (RCF), Koutoukou

1. Introduction

The growing use of medicinal plants is a cornerstone of healthcare for large sections of the population, particularly in sub-Saharan Africa. In urban areas, their sale has now spread to drinking establishments such as bistros [1] [2], which are venues designed for the sale and consumption of local beverages. Like other major African cities, Abidjan is the economic capital of Côte d'Ivoire and is home to a rich mix of ethnic and cultural groups. As a result, the city has numerous bistros. These are social venues where customers are offered local drinks prepared with medicinal plants. These medicinal plants may be served as decoctions or infusions, without any health supervision or rigorous scientific documentation [3] [4]. Given the prevailing situation, several questions arise: which medicinal plants are used in Abidjan's bistros? What is their cultural significance, and what consensus exists regarding their therapeutic uses? Given the scarcity and/or persistent gaps in scientific data on these informal ethnobotanical practices in urban areas of Côte d'Ivoire [5] [6], the overall objective of this study is to investigate the medicinal plants used in bistros in the city of Abidjan. Specifically, the study aims to: (i) catalogue the medicinal plant species used in Abidjan's bistros; (ii) determine the citation index for each plant; (iii) calculate the relative frequency of citation (RFC) for each plant in order to demonstrate their cultural significance.

2. Materials and Methods

Study area

The survey was conducted in the city of Abidjan, an urban area with a population of five (5) million and covering an area of 422 km². Abidjan comprises ten (10) municipalities, four (4) of which were included in our survey. These were the municipalities of ABOBO, YOPOUGON, KOUMASSI and COCODY (Figure 1). The survey conducted was a prospective study, and the criteria for selecting the municipalities were: geographical location (North, South, West and East); accessibility of the municipalities; a high number of bistros (*i.e.* 10 to 30 bistros per 100 m²); a high proportion of people on low incomes (Figure 1).

2.1. Materials

The survey materials consisted of a survey form (questionnaire), a pen, notepads, a voice recorder, a compass, a computer (Toshiba) and a camera (Canon).

2.2. Methods

Field data collection

This was a cross-sectional prospective study conducted from 10/01/2026 to 15/03/2026. A total of 347 bistros were identified as eligible across the four municipalities prior to sampling. A systematic random sampling method was applied to select bistros within each municipality. To be eligible for inclusion, a bistro had to serve koutoukou infused with at least one plant additive. Out of the bistros contacted, 73 either refused to participate or were unavailable at the time of the

survey, resulting in a final response rate of 82.61%.

Data were collected through individual, in-person interviews with bistro owners and/or managers (hereafter *respondents*), using a semi-structured interview based on a pre-designed questionnaire. Interviews were conducted in the language in which the respondent felt most comfortable. Socio-demographic data on respondents (sex, age) were collected, together with the medicinal plants and plant organs used as koutoukou additives. Species identification was carried out primarily in the field, with reference to the relevant botanical literature and confirmed against the taxonomic sources.

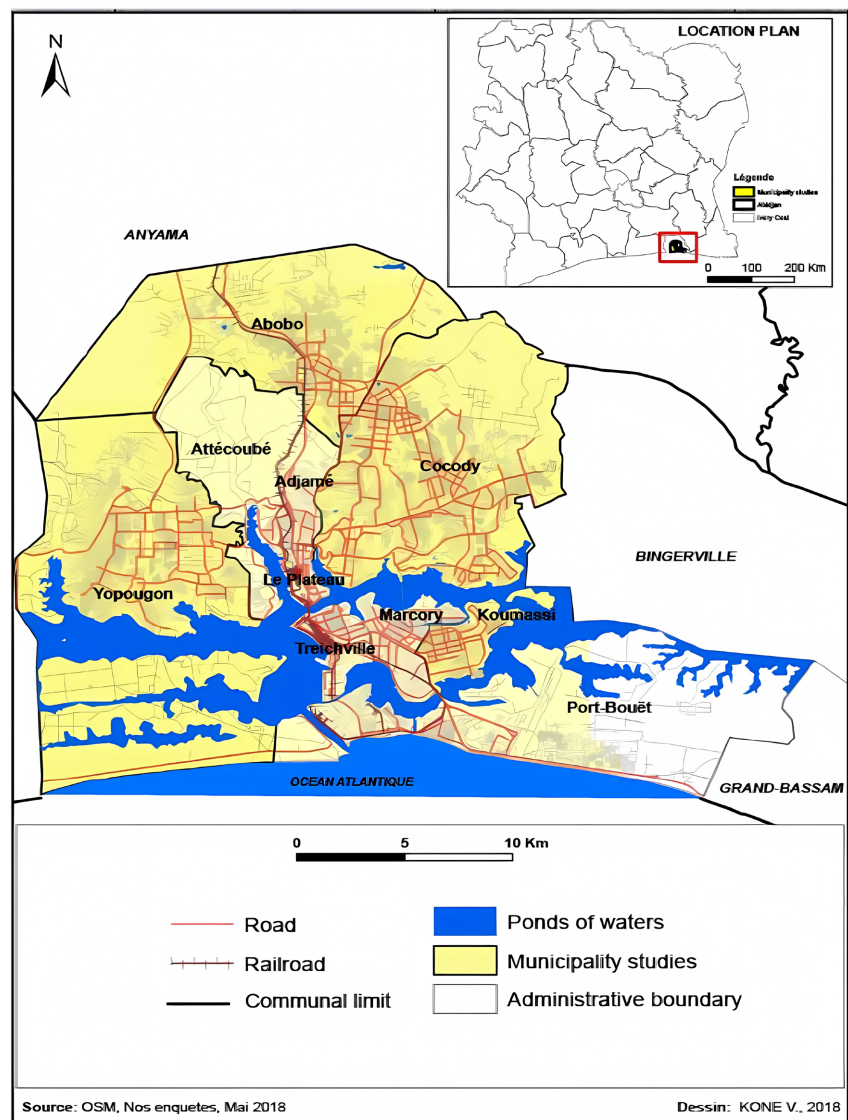


Figure 1. Map of the city of Abidjan.

Statistical analysis

The list of cited species was compiled in an Excel spreadsheet, and the proportion of plant organs used in koutoukou mixtures was calculated. Comparisons of

respondent/bistro counts across categories (municipality, sex, age class) were tested against a null hypothesis of an equal (uniform) distribution across categories, using Pearson's chi-square goodness-of-fit test (GraphPad Prism version 7.0, GraphPad Software Inc.). A threshold of $\alpha = 0.05$ was used to declare statistical significance. Because the chi-square goodness-of-fit test evaluates whether observed counts differ from an expected uniform distribution, and not a specific hypothesis about consumption behaviour, results are interpreted accordingly in §3.

Relative Citation Frequency (RCF) of plants

The Citation Index (CI) was defined, following [7], as the number of municipalities (out of the four surveyed) in which a given species was recorded as a koutoukou additive; CI therefore ranges from 1 to 4 and reflects the geographic spread of a species' use across the study area, not the number or proportion of individual respondents who cited it. The Relative Citation Frequency (RFC) was obtained, following [8], by dividing the CI of each plant by the total number of municipalities surveyed (four):

$$\text{RFC} = (\text{CI}/4) \times 100$$

A high RFC therefore indicates that a species was recorded in a large proportion of the surveyed municipalities, reflecting a broad geographic distribution of its use across the study area rather than unanimous endorsement by all 347 individual respondents.

3. Results and Discussion

• Bistros visited

Bistros are the main outlets for koutoukou. They are generally built of wood and are small in size. **Table 1** shows the total number (347) of bistros visited during the survey. Indeed, among the four (4) municipalities (Abobo, Cocody, Koumassi and Yopougon) surveyed. It appears that Yopougon has the highest number with 146 bistros, followed by 96 in the municipality of Koumassi. The municipalities of Abobo and Cocody have 71 and 34 bistros respectively. However, the difference in the number of bistros across the different municipalities is not statistically significant (**Table 1**).

Table 1. Number of bistros visited during the survey.

COMMUNE	NUMBER OF BISTROS
Abobo	71
Cocody	34
Koumassi	96
Yopougon	146
Total	347

Survey area: 4 out of 10 communes of Abidjan / Selection criteria: geographic location (N/S/E/W), accessibility, high bistro density (10 - 30 per 100 m²), high proportion of low-income residents.

The number of bistros differed markedly across municipalities: Yopougon accounted for the largest share (146), followed by Koumassi (96), Abobo (71) and Cocody (34). A chi-square goodness-of-fit test against a null hypothesis of an equal number of bistros across the four municipalities showed that this distribution differed significantly from uniform ($\chi^2(3, N = 347) = 76.40, p < 0.0001$). This result should be interpreted with caution: it does not, by itself, indicate a behavioural or cultural effect, since it is consistent with the substantial differences in surface area, population density and socio-economic profile among the four municipalities noted below, rather than necessarily reflecting differential propensity to run or patronise bistros. These findings are consistent with [9], who reported that Yopougon had the highest number of drinking establishments (tchapalodromes and bistros) among Abidjan's municipalities. Yopougon is the largest and most populous district of Abidjan (153.06 km²), characterised by a contrast between low-, middle- and high-income neighbourhoods [10]. Abobo, the second most populous municipality (nearly 100 km²), is composed mainly of working-class housing and numerous informal settlements, and has long served as a commuter area for residents with limited financial means [11]. Cocody, by contrast, is Abidjan's premier residential district (132 km²), home to the city's wealthiest social classes but also to informal settlements such as II Plateaux, Agban-zoo and Gobelet; bistros are therefore present in both affluent and low-income neighbourhoods of this municipality [9].

- **Gender distribution of survey**

Figure 2 (Pie chart) shows the distribution (percentage) of respondents by gender. Both genders were present in the bistros. Males accounted for 93% of the total, compared with 7% for females. This represents a ratio of 0.07.

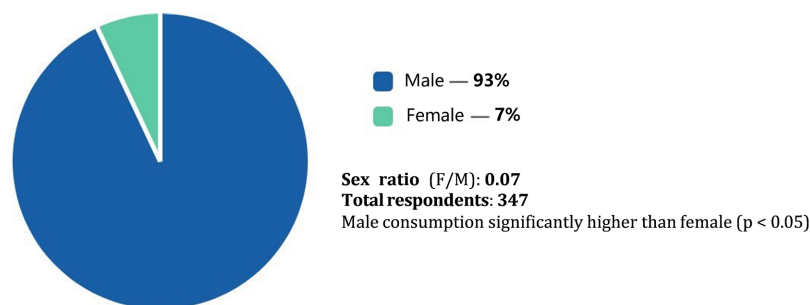


Figure 2. Gender distribution of survey of respondents.

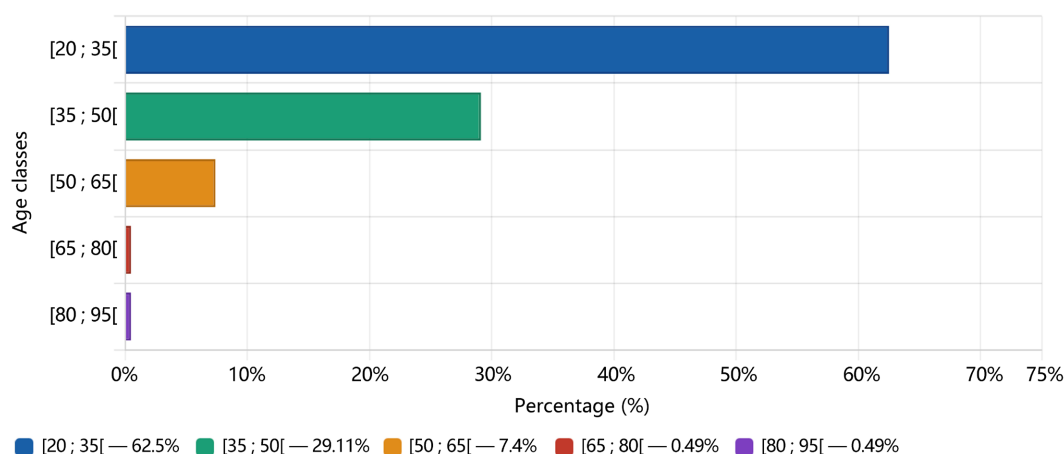
Both sexes were represented among the 347 respondents (bistro owners/managers). Males accounted for 93% ($n \approx 323$) of respondents, compared with 7% ($n \approx 24$) for females, corresponding to a sex ratio (F/M) of 0.07 (**Figure 2**). A chi-square goodness-of-fit test against a null hypothesis of an equal (50/50) sex distribution confirmed that this imbalance was statistically significant ($\chi^2(1, N = 347) = 257.64, p < 0.0001$). This finding concerns the sex of the bistro owners/managers interviewed, not directly the sex of koutoukou consumers, and should not be over-interpreted as a measure of drinking behaviour by sex; a dedicated survey of bistro

patrons would be required to characterise consumption patterns. With that caveat, the pronounced male predominance among bistro proprietors is broadly consistent with reports that bistro-type drinking establishments in Côte d'Ivoire are more commonly owned or managed by men [12], and with general patterns of higher male engagement in the informal alcohol trade in the sub-region.

- **Age distribution of respondents**

Respondents' ages ranged from 20 to 90 years and were grouped into five 15-year classes: [20; 35[, [35; 50[, [50; 65[, [65; 80[and [80; 95[(**Figure 3**).

The [20; 35[class accounted for 62.5% of respondents, followed by [35; 50[(29.11%), [50; 65[(7.4%), [65; 80[(0.49%) and [80; 95[(0.49%). A chi-square goodness-of-fit test against a null hypothesis of an equal distribution across the five age classes showed that the age distribution differed significantly from uniform ($\chi^2(4, N = 347) \approx 482, p < 0.0001$), with young and middle-aged adults markedly over-represented.



* $p < 0.05$ (significance threshold)—differences between age classes are *not* statistically significant | $n = 347$.

Figure 3. Percentage of age groups among respondents in pubs.

This youth-dominated profile contrasts with rural African ethnobotanical surveys, where medicinal-plant knowledge is typically concentrated among older informants and traditional healers; respondents aged 51 - 90 years accounted for close to half of all informants in a recent phytomedicine survey in West Gojjam, Ethiopia [13]. In the Abidjan bistro context, by contrast, the plant-additive practice appears to be embedded in a commercial rather than a purely medicinal transmission chain: bistro managers, who are predominantly young active adults, may learn which species to combine with koutoukou through apprenticeship at the point of sale rather than through generational inheritance, consistent with the informal, income-generating nature of urban ethnobotanical practices described for West African drinking establishments [2]. The very low representation of respondents over 65 years (under 1%) nonetheless underlines that documentation of this knowledge should not be delayed, given the generational erosion of traditional ecological knowledge repeatedly reported elsewhere [14] [15].

• Plants recorded and citation index

Twelve medicinal plant species (*Garcinia kola*, *Enantia polycarpa*, *Xylopia aethiopica*, *Zingiber officinale*, *Elymus repens*, *Moringa oleifera*, *Cocos nucifera*, *Tectona grandis*, *Citrus limon*, *Turraea heterophylla*, *Guiera senegalensis* (Siaguéhi), *Carapa procera*) were recorded across the four surveyed municipalities (**Table 2**).

Table 2. List of medicinal plants identified and their citation indice.

Name	Scientific Name	Family	Used	Abobo	Cocody	Koumassi	Yopougon	CI
Petit kola	<i>Garcinia kola</i> <i>Heckel</i>	Clusiaceae	Seeds	x	x	x	x	4
Gnamakou	<i>Zingiber officinale</i> <i>Roscoe</i>	Zingiberaceae	Rhizome	x	x	x	x	4
Moringa	<i>Moringa olifeira</i> Lam.	Moringaceae	Leaves	x	x	x	x	4
Jaune amer	<i>Enantia polycarpa</i> (DC.) Engl. & Diels	Annonaceae	Bark	x	x	x	-	3
Rouge Amer	<i>Carapa procera</i> DC.	Meliaceae	Bark	x	-	x	x	3
Poivre africain	<i>Xylopia aethiopica</i> (Dunal) A.Rich.	Annonaceae	Fruits	x	-	x	-	2
4H	<i>Turraea heterophylla</i> Sm.	Meliaceae	Stems	x	x	-	-	2
Citron	<i>Citrus limon</i> (L.) Osbeck	Rutaceae	Leaves	x	x	-	-	2
Siaguéhi	<i>Guiera senegalensis</i> J.F.Gmel.	Combretaceae	Roots	x	-	-	-	1
Coco	<i>Cocos nucifera</i> L.	Arecaceae	Roots	x	-	-	-	1
Tek	<i>Tectona grandis</i> L.	Arecaceae	Leaves	-	-	-	x	1
Chien dent	<i>Elymus repens</i> (L.) Gould	Poaceae	Leaves	x	-	-	-	1

Based on this index, *Garcinia kola* (Petit kola), *Zingiber officinale* (Gnamakou) and *Moringa oleifera* (Moringa) had the highest CI (4), indicating that their use as koutoukou additives was recorded across all four surveyed municipalities. *Enantia polycarpa* (Jaune amer) and *Carapa procera* (Rouge amer), with a CI of 3, were recorded in three of the four municipalities. *Xylopia aethiopica* (African pepper), *Turraea heterophylla* (4H) and *Citrus limon* (Lemon), with a CI of 2, were recorded in two municipalities, while *Guiera senegalensis* (Siaguéhi), *Cocos nucifera* (Coconut), *Tectona grandis* (Teak) and *Elymus repens* (Couch grass), with a CI of 1, were each recorded in only one municipality, suggesting either more localised use, availability constraints, or a specialisation of associated knowledge [16].

• Breakdown of plant parts used

Six plant parts mentioned by consumers were used (**Figure 4**). 40% of leaves and 20% of bark were used, compared with 10% of other parts (bark, fruit, stems and seeds).

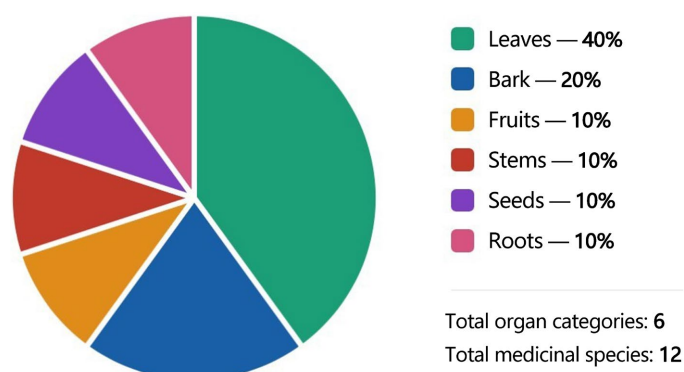


Figure 4. Glider components used.

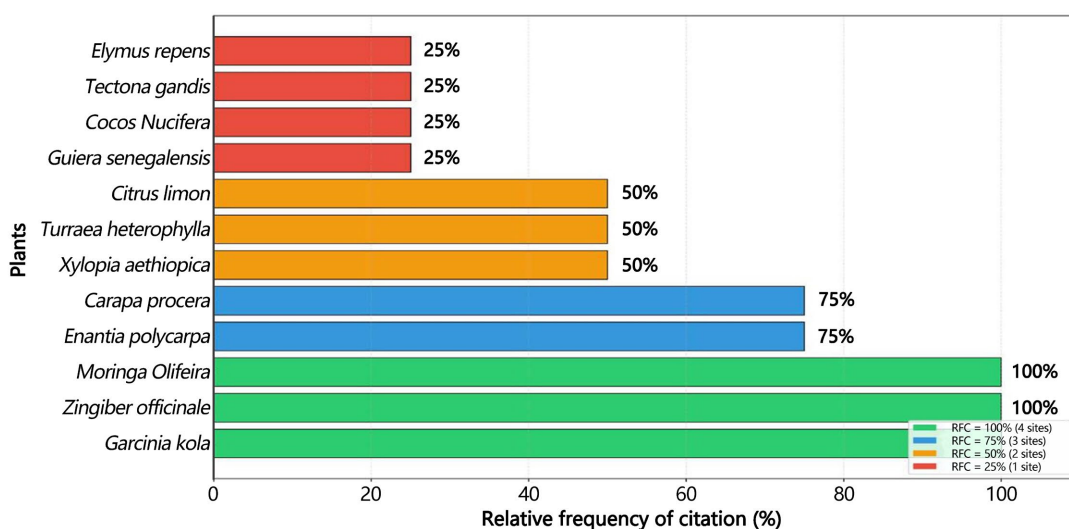
The predominance of leaves mirrors a broad pattern reported across recent African ethnobotanical surveys, where leaves are consistently the most harvested organ because their collection is non-destructive and does not compromise the survival of the parent plant, allowing low-cost, year-round restocking [13]. This is ecologically favourable, since leaf removal, unlike bark or root extraction, does not directly threaten the reproductive or structural integrity of the plant. The 20% share attributable to bark in this study nonetheless deserves attention, as it is harvested here from *Enantia polycarpa* and *Carapa procera*: market-driven bark and root harvesting has elsewhere brought high-demand species to the brink of local extinction, as illustrated by the near-disappearance of *Echinops kebericho* in southwestern Ethiopia following intensive root harvesting for market sale [17]. Given that Abidjan's bistros function as an informal, high-turnover retail channel for these plants, periodic monitoring of the two bark-yielding species identified here would help anticipate supply pressure before it affects the wider koutoukou trade.

• Relative Citation Frequency

The Relative Citation Frequency (RFC) of the surveyed plants, calculated as described in §2.4, is shown in **Figure 5** and ranges from 25% to 100%. Three species, *Garcinia kola* (Petit kola), *Zingiber officinale* (Gnamakou) and *Moringa oleifera* (Moringa) had an RFC of 100%, meaning they were recorded in all four surveyed municipalities. Two species, *Enantia polycarpa* (Jaune amer) and *Carapa procera* (Rouge amer), had an RFC of 75% (recorded in three municipalities). Three species *Xylopiya aethiopica* (African pepper), *Turraea heterophylla* (4H) and *Citrus limon* (Lemon) had an RFC of 50% (two municipalities). The remaining four species *Guiera senegalensis* (Siaguéhi), *Cocos nucifera* (Coconut), *Tectona grandis* (Teak) and *Elymus repens* (Couch grass) had an RFC of 25% (one municipality).

The RFC, calculated using the approach proposed by [18], classified the twelve surveyed species into four groups reflecting their geographic distribution across the study area. The first group (*Garcinia kola*, *Zingiber officinale* and *Moringa oleifera*), reached the maximum RFC (100%), indicating a broad, municipality-wide presence in koutoukou preparations. These three species are traditionally reported to have antimicrobial, anti-inflammatory, antioxidant and nutritional

properties [19] [20]; because a broad geographic distribution of traditional use can be a useful, though indirect, indicator for prioritising species in future pharmacological screening [21], they merit particular attention for follow-up phytochemical and toxicological investigation, provided such investigation directly tests the specific plant part and preparation used in the koutoukou mixtures documented here, rather than extrapolating from studies using different extracts or administration routes.



-Plants with RFC = 100%: 3 plants = *Small kola* (*Garcinia kola*), *Gnamakou* (*Zingiber officinale*), *Moringa* (*Moringa oleifera*);

-Plants with RFC = 75%: 2 plants = *Bitter yellow* (*Enantia polycarpa*), *Bitter red* (*Carapa procera*);

-Plants with RFC = 50%: 3 plants = *African pepper* (*Xylopia aethiopica*), *4H* (*Turraea heterophylla*), *Lemon* (*Citrus limon*);

-Plants with RFC = 25%: 4 plants = *Siaguéhi* (*Guiera senegalensis*), *Coconut* (*Cocos nucifera*), *Teak* (*Tectona grandis*), *Creeping bentgrass* (*Elymus repens*).

Figure 5. Relative frequency of citation for each plant surveyed.

The second group, *Enantia polycarpa* (RFC = 75%) and *Carapa procera* (RFC = 75%), is widely reported in the West African ethnobotanical literature as used in traditional medicine, including for malaria, skin conditions and parasitic infections [22]; these are traditionally reported uses, and the present study does not itself provide pharmacological evidence for efficacy. The third group (RFC = 50%: *Xylopia aethiopica*, *Turraea heterophylla*, *Citrus limon*) shows a more specialised or geographically uneven pattern of use [23] [24]. The fourth group (RFC = 25%: *Guiera senegalensis*, *Cocos nucifera*, *Tectona grandis*, *Elymus repens*) had the most localised occurrence, which may reflect limited local availability, specialisation of use among particular respondents, or early-stage erosion of the associated knowledge [25] [26].

These results confirm the usefulness of the RFC as a tool for prioritising medicinal plants for further study and for documenting local ethnobotanical heritage.

4. Conclusion

This ethnobotanical study, conducted in the bistros of Abidjan, documented twelve medicinal plants used as koutoukou additives, illustrating the vitality of traditional therapeutic knowledge in an urban Ivorian setting. Analysis of the citation index (CI) and relative citation frequency (RFC), both measured at municipality level, showed that three species, *Garcinia kola*, *Zingiber officinale* and *Moringa oleifera*, were recorded across all four surveyed municipalities, while *Guiera senegalensis*, *Cocos nucifera*, *Tectona grandis* and *Elymus repens* were each recorded in only one municipality, suggesting a more localised and potentially vulnerable body of associated knowledge. The number of bistros, and the age and sex composition of respondents, differed significantly across municipalities (chi-square goodness-of-fit tests, $p < 0.0001$), reflecting differences among the surveyed municipalities rather than a demonstrated behavioural effect. Overall, this study confirms that Abidjan's bistros constitute an under-documented ethnobotanical resource, whose further exploration, including dedicated toxicological assessment of the plant-alcohol combinations identified, could support the future valorisation of traditional Ivorian pharmacopoeia.

Ethics Approval Consent to Participate

Data were collected with respect to confidentiality, anonymity and consent. All respondents were informed about the aim of this study.

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Author Contributions

Ban Ouéméla Venance Allais: Conceived and designed the study, coordinated field data collection, performed statistical analyses, interpreted the results, and drafted the manuscript.

Dehe Bahou Roger: Contributed to the methodological framework, participated in field surveys, and contributed to the review of the manuscript.

Konate Mory Latif: Participated in data collection in the field, assisted in the compilation of plant inventories, assisted in the identification of plant species.

Djyh Bernard Nazaire: Contributed to the design of the questionnaire, participated in semi-structured interviews with bistro owners, and assisted in data entry and verification.

Bahi Calixte: Provided scientific guidance on ethnobotanical methodology, supported species identification in relation to existing botanical literature, and critically reviewed the manuscript.

Ouattara Karamoko: Participated in field surveys, assisted in data collection and analysis, and contributed to the final revision of the manuscript.

All authors have read and approved the final version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations and Acronyms

RFC/RCF, Relative Citation Frequency/Relative Frequency of Citation;
CI, Citation Index;
WHO, World Health Organization;
NIAAA, National Institute on Alcohol Abuse and Alcoholism.