



Ethno Apicultural Survey of Melliferous Plant Species in the Great Green Wall Widou and Koyli Alpha, Senegal

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Authors' contributions

This work was carried out in collaboration among all authors. Author KD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors WD and ADF managed the analyses of the study. Authors SIMD, AIM and RL performed the statistical analysis. Author ADF managed the literature searches and approved the final corrections. All authors read and approved the final manuscript.

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ABSTRACT

This study has surveyed honey plants used by *Apis mellifera* in the Great Green Wall of Senegal by involving 38 people (21 in Widou, 17 in Koyli Alpha). The study revealed seventeen species divided into fourteen genera and nine families. Fabaceae was the most represented family with 5 species followed by Combretaceae (3 species), Malvaceae and Rutaceae each with 2 species, and Anacardiaceae, Balanitaceae, Rhamnaceae, Sterculiaceae, Meliaceae each with one species. The most frequent melliferous plant species were : *Combretum glutinosum*, *Guiera senegalensis*, *Balanites aegyptiaca*, *Acacia radiana*, *Lannea acida*, *Terminalia avicennoides*, *Sclerocarya birrea*, *Sterculia setigera* and *Maytenus senegalensis*. The trees were more large with 58.82% followed by shrubs (35.29%) and herbs (5.88%). Spontaneous plants represent 76.47% and cultivated plants represent 23.53%. The melliferous flora was largely dominated by African and Afro-Indian species, which together accounted for 70.58% of the species. According to their apicultural value, the nectariferous species represented 58.82% and the remaining were polleniferous (41.18%). The

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species that bloom in the rainy season were more numerous with 52.94% of the species. This study enabled us to identify nine (09) species with high melliferous value. Further studies on foraging activity and nectar production would be highly useful to test real melliferous potential of these plants and their value further.

Keywords: Apiculture; nectariferous species; Senegal; melliferous potential.

1. INTRODUCTION

For several decades, the countries of the Sahel-Saharan District of the Circum Sahara were confronted, except for a few years with anormal rainfall, with a rainfall deficit which had the effect of a strong disruption of the major ecological balances, a drop of isohyets to the South and an almost inexorable process of desertification. Desertification, an almost global phenomenon, is taking on a specific face of calamity and poverty in Africa and especially in the southern part of the Sahara, which is gradually creating a feeling of desolation and inevitability. Currently, more than 2/3 of the surface of the African continent is covered by desert or highly degraded areas [1].

Through its pernicious and recurrent effects, desertification has led to a severe degradation of natural resources, a drop in agricultural production, a situation of food insecurity and a heavy socio-economic balance that have a very negative impact on the economic development efforts of most of the country of Saharo-Sahelian space. Faced with this recurring situation of multiple environmental challenges and the condition of severe degradation of ecosystems largely related to climate change and desertification, Africa, condemned to face the crisis, proposes as response the implementation of a new approach called "Great Green Wall Initiative». It emanates from the strong conviction and willingness of Africans to break with fate to face these two major environmental challenges [2].

The Great Green Wall must be a strip of vegetation consisting of natural, artificial, residential, cultivation and breeding units whose primary role is to constitute the first line of resistance and defense against desertification of which suffers our continent. It is a strip of vegetation, multi-species, about 7 000 km long from Dakar to Djibouti and 15 km wide.

It is located in a geographical area characterized by annual rainfall averages between 100 and 400 mm [3]. It crosses the transition zone between the steppe formations and the Sudano-Sahelian

Savannah areas where the population density is low and the activities essentially pastoral and agricultural and is characterized by typical native vegetation and flora.

In this context, the choice must be made taking into account species with socio-economic value, species of ecological importance and species resilient to climatic and ecological conditions.

On this basis, melliferous plants are thus of unprecedented interest.

Melliferous plants, plant species whose substances, especially nectar, pollen and resin, are harvested by the bee for food and which results in humans various natural productions, including honey [4]. They play an important role in ecosystem dynamics through pollinating insects. The Great Green Wall is chosen because it is a reforestation zone to curb the advance of the desert, from which several studies have been carried out including environmental impact studies that show the diversity of insects [5], on the characteristics of herbaceous vegetation and woody vegetation etc. [6]. It would be important to know the part of these melliferous plants in this zone hence the interest of this study. A survey will be carried out in connection with the beekeeping situation and the plants bitumized by the bees. This study will make it possible to know the melliferous plants which could be chosen during reforestation in the Sahelian zones which will participate in the development of beekeeping, reduce poverty, fight against green house gases and finally produce a reference palynotheucus, essential tool for the pollen analysis of honey and thus contribute to the making of the Atlas of pollen from SENEGAL.

2. MATERIALS AND METHODS

2.1 Study Area

The survey was conducted in two villages in the District Louga. The Louga District has an area of 24847 km², lies at 15°16' N Latitude and 15°31' W Longitude with a population of 950095 inhabitants. Its climate is characterized by the

alternation of two seasons: a dry season of 9 months and a rainy season of 3 months. The average temperature hovers around 27.73°C and fluctuates between a maximum average of 30.19°C in October and a minimum of 24.4 8°C in January, [5] and a total annual rainfall of 422,6 mm / year [3].

Below representative map of the survey area (Map 1).

2.2 Vegetation Description, Socio-Economic Conditions and Study Design

The vegetation consists of a Savannah tree, is strongly marked by the degradation of climatic conditions. The area of the Great Green Wall, specifically Widou Thiengoli and Koyli alfa, belongs to the sandy Ferlo and is characterized by a succession of dunes and shallow little rugged. Flora and vegetation structure remains woody throughout the Great Green Wall in the Ferlo. These areas are characterized by an alarming socio-economic situation because of the absence of rains and manufacturies to stop the galloping unemployment rate. The main activity of this zone lies in the practice of the traditional breeding often source of exodus in search of pasture. This study was conducted using a pre-established questionnaire. It covered the period from August 2015 to December 2016. The majority ethnicities encountered were Peulh.

2.3 Collection, Identification and Classification

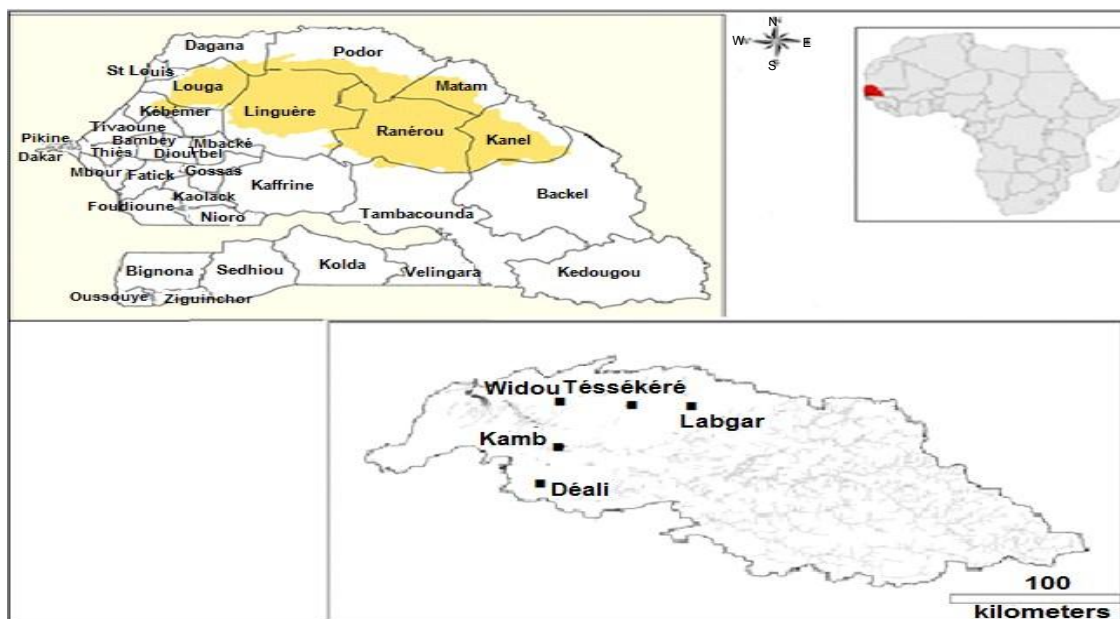
The unknown species of our interviews had been collected and identified in the laboratory of Botany by Pr Diatta. The classification was made using the books of Kerharho, [7], Eklou-Natey [8] and the new classification APG III (2014).

2.4 Statitiscal Analysis

The database software, SPSS was used for data linkage and processing. Regular statistics (percentage) were displayed for the frequency of plants quoted.

3. RESULTS AND DISCUSSION

A total of 17 plant species from 14 genera and 9 families were identified as melliferous plant species. The families, botanical names, local names, nectariferous plants, nectariferous-polliniferous plants, biological type, biogeographic type, domestication type, beekeeping interest, flowering period and quote percentage were given in Table 1. The information enabled us to complete this table to share field information come from work Yodomonhan et al. [2], Bassène et al. [9], Adjakpa et al. [10], of Arbonnier et al. [11], Nombéré [12], Tossou [1].



Map 1. Map of the survey area (Widou and Koyli alpha)

The most represented being the Fabaceae with 5 species followed by Combretaceae with 3 species then Malvaceae and Rutaceae with 2 species each, and finally the Anacardiaceae, Balanitaceae, Rhamnaceae, Sterculiaceae, Meliaceae with one species each (Fig. 1).

These results are according with those of Diatta [13] who found that the families Fabaceae was

the most represented. Hamel [14] has found the families Fabaceae species was the most represented. The distribution of melliferous plants according to the biological type (Table 1) shows that the trees are the most represented 10/17 (58.82%) followed by shrubs 6/38 (35.29%) then herbs are less than represented 1/38 (5.89%) (Fig. 2).

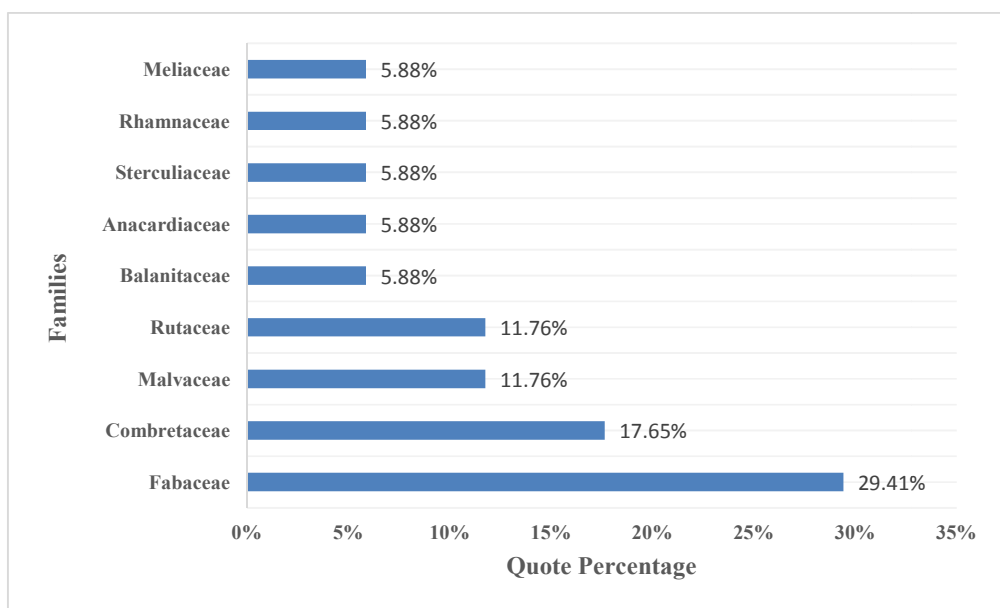


Fig. 1. Families plants species

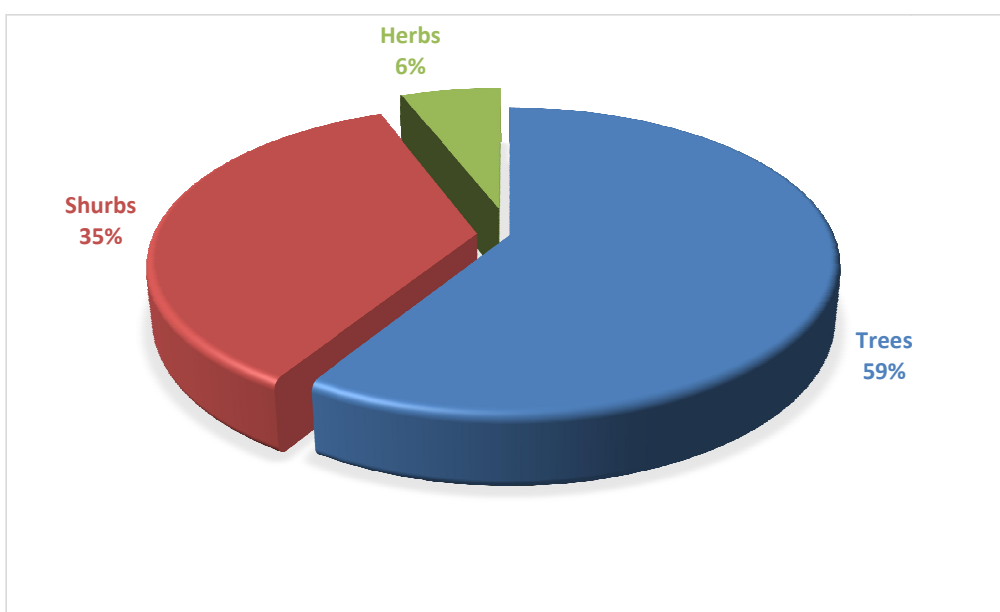


Fig. 2. Distribution of plants according to their biological type

Table 1. Summary of plants to data cited as melliferous

| Families/botanical name of plants | LN | BT | DT | BGT | AI | FP |
|--|------------------|-------|-------------|-----|----|----------------------|
| <i>Vigna unguiculata</i> (L.) Walp (Fabaceae) | niébé belli (P) | Herb | Cultivated | Pan | N | Rainy season |
| <i>Acacia nilotica</i> (L.) Delile (Fabaceae) | neb neb (P) | Tree | Spontaneous | Afl | NP | Rainy season |
| <i>Acacia senegal</i> (L.) Willd. (Fabaceae) | Patodé (P) | Tree | Spontaneous | Afl | NP | Dry season |
| <i>Acacia tortilis var raddiana</i> (Forssk.) Hayne (Fabaceae) | Alluki (P) | Tree | Spontaneous | Afl | NP | Rainy season |
| <i>Adansonia digitata</i> L. (Malvaceae) | Boki (P) | Tree | Spontaneous | Af | N | Rainy season |
| <i>Balanites aegyptiaca</i> L. Delile (Balanitaceae) | Golétéki (P) | Tree | Spontaneous | Afl | N | Dry season |
| <i>Citrus limon</i> (L.) Burm. (Rutaceae) | Limon (P) | Shurb | Cultivated | Pan | N | Rainy season |
| <i>Citrus maxima</i> (Burm.) Merr. (Rutaceae) | Pamplemousse (P) | Shurb | Cultivated | Pan | N | Rainy season |
| <i>Combretum glutinosum</i> Perr. ex DC. (Combretaceae) | Doko (P) | Shurb | Spontaneous | Af | NP | Dry season |
| <i>Grewia bicolor</i> Juss. (Malvaceae) | Kéli (P) | Shurb | Spontaneous | Afl | NP | Rainy and dry season |
| <i>Guiera senegalensis</i> J.F.Gmel. (Combretaceae) | Eloko (P) | Shurb | Spontaneous | Af | NP | Rainy season |
| <i>Sclerocarya birrea</i> (A.Rich.) Hochst. (Anacardiaceae) | Eri (P) | Tree | Spontaneous | Af | N | Dry season |
| <i>Sterculia setigera</i> Delile (Sterculiaceae) | Bobéri (P) | Tree | Spontaneous | Af | N | Dry season |
| <i>Tamarindus indica</i> L. (Fabaceae) | Dadmi (P) | Tree | Cultivated | Afl | NP | Dry season |
| <i>Ziziphus mauritiana</i> auct. (Rhamnaceae) | Dabé (P) | Shurb | Spontaneous | Afl | N | Rainy season |
| <i>Anogéissus leiocarpus</i> (DC.) Guill. & Perr. (Combretaceae) | Godoli (P) | Tree | Spontaneous | Af | N | Rainy season |
| <i>Azadirachta indica</i> A. Juss. (Meliaceae) | Nim (P) | Tree | Spontaneous | Pan | N | Rainy and dry season |

LN : Local name ; BT : Biological type ; DT : Domestication type ; BGT : Biogeographic type ; AI : Apicol interest ; FP : flowering period
Pan : Pantropical species ; Afl : Indian afro species ; Af : African species ; N : nectariferous ; NP : nectariferous polliniferous ; P : Peulh

Note also the therapeutic interest of ligneous trees such as *Acacia nilotica* species that has shown antioxidant and antiinflammatory activity [15]. The *Tamarindus indica* species has shown antioxidant activity [16]. *Guiera senegalensis* (Combretaceae) has shown acaricidal properties against *Hyalomma anatolicum* (Acari: Ixodidae) [17]. *Anogeissus leiocarpus* has shown antiplasmodial and antileishmanial activities [18].

These results are not according with those of Diatta [13] found 86.89% ligneous against 13.11% herbaceous and 6.88% liana, and with results not confirm from Dongock et al. [19] who showed a higher rate of ligneous (trees, shrubs and shrubs) of 63.5% against 36.5% of herbaceous plants and with those of Nombéré [12] who found 52.8% of ligneous against 47.92% in Garanga and 57.37% of ligneous against

42.27% of herbaceous plants in Nazinga, Burkina Faso.

The melliferous flora is dominated by African and pan-tropical species which together account for nearly 70.58% of species (see Table 1). Indeed, They each represent 35.29%. It has African species (35.29%) pantropical species (23.53%), Afro-Indian species (35.29%), and cosmopolitan species (5.88%) (Fig. 3).

The dominance of the African species can be explained by the fact that African species are more adapted to the bioclimatic conditions of the environment than other species Noba et al. [20]. Several species are visited by bees according to the herbaceous strata to the ligneous strata with fruit plant, cereal or agroforestry plants.

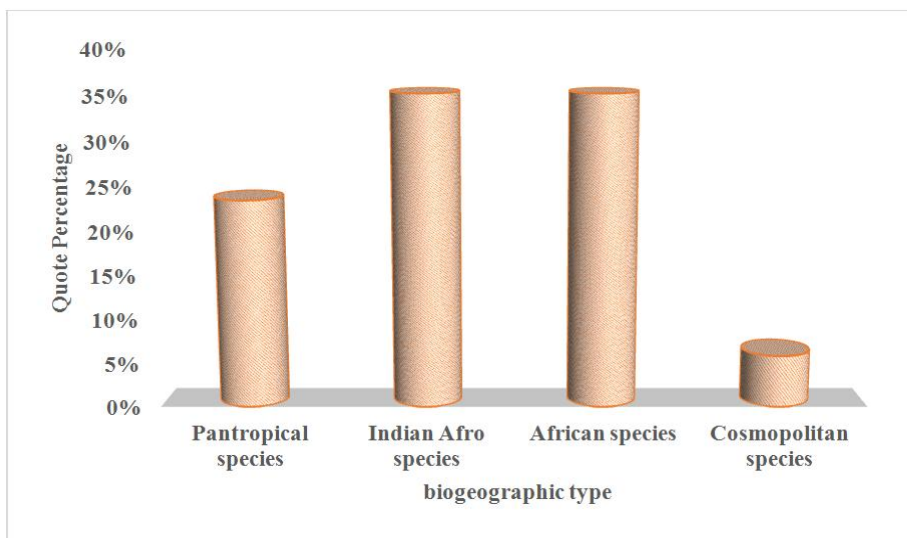


Fig. 3. Distribution of plants according to their biogeographic type

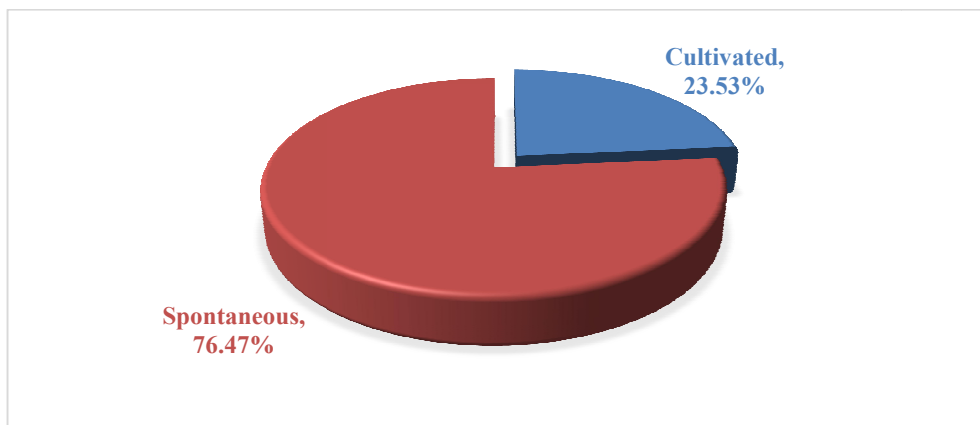


Fig. 4. Distribution of plants according to their domestication type

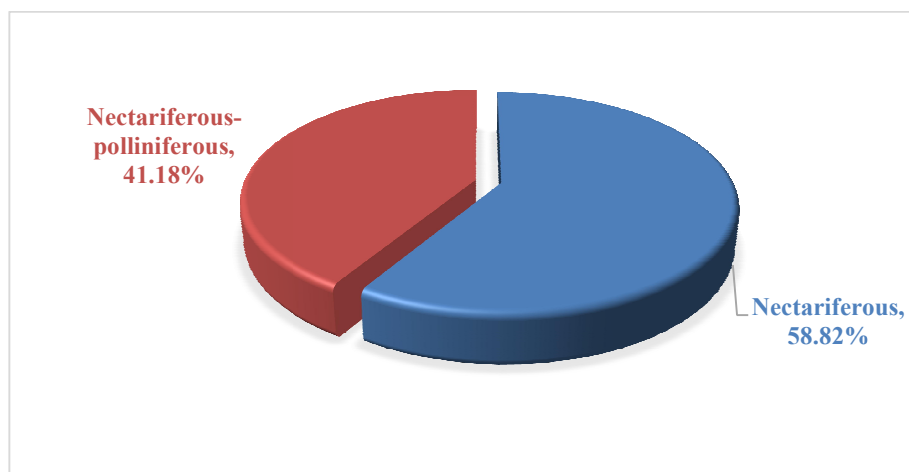


Fig. 5. Distribution of plants according to their apicol interest

The distribution of species according to the type of domestication showed the importance of spontaneous plants as melliferous plants in the study area. In fact, the large majority (76.47%) of melliferous plants cited by beekeepers are spontaneous plants (Fig. 4) above.

These results are according to those found by Diatta [13] who found 70.5% spontaneous plants versus 29.5% cultivated, Dongock et al. [12] who found 57.9% spontaneous plants versus 42.1% cultivated, but did not according to those of Iritie et al. [21] who found that cultivated plants were larger with 58% of the species recorded, and Dongock et al. [18] and Pinta et al. [22] showed respectively that 67.5% and 64% of the species identified in the field were cultivated.

Natural or spontaneous plants are more represented because they have a better spatial distribution.

Regarding the distribution according to beekeeping interest, the results showed that the nectariferous taxa are more important with 10/17 (58.82%), followed by taxa nectariferous Polliniferous represent 41.18%. We were unable to identify polliniferous species in this survey (Fig. 5).

These results are in according to those of Diatta [13] which showed a predominance of nectariferous taxa of 47.54% against 36.07% of nectariferous and polliniferous taxa and 14.75% of polliniferous taxa at Casamance in Sénégal. These results correspond to those obtained by Bakenga et al. [23], in Bukavu, the author shows that more than 2/3 species are foraging for their

nectar, they were not in agreement with those of Amakpé et al. [24] found almost equal rates of nectariferous and polliniferous nectariferous taxa, which are 40.6% and 41.5%, respectively, and its polliniferous taxon rate of 14.5% remains equal to that of our results was 14.75%. They do not according to those of Yodomonhan et al. [1] who found substantially equal rates of 31% nectariferous taxa, 35.6% nectariferous taxa and 33.3% polliniferous taxa.

The species that bloom in the rainy season are more numerous with 52.94% of the species. The species that bloom during the two seasons represent 35.29% and the dry season species represent 11.76% (Fig. 5) above. These results are in according to those of Diatta [2] which showed a predominance of more species in the rainy season.

4. CONCLUSION

A total of 17 species were registered as melliferous plants. The information collected from this survey indicates that respondents were aware about the presence of melliferous plants of their area. Such information was inherited from their ancestors which is gradually disappearing with the new generations in the lack of interest in preserving their forest resources. Most of the plants were wild herbs so their conservation is necessary for utilization for the future generations for the production quality honey. This can be possible by encouraging local population for cultivation of these plants in agriculture fields. This preliminary study can also provide baseline information for the exploration

of new plant-based medicines. These melliferous species can be analysed for further identification of novel compounds and their activities.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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