CONTRIBUTION TO THE KNOWLEDGE OF MELLIFEROUS PLANTS: ETHNO-APICULTURAL SURVEY WITH BEEKEEPERS IN THE DISTRICT OF ZIGUINCHOR, KOLDA AND SEDHIOU (SENEGAL)

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ABSTRACT

An ethno-apicultural survey was carried out for the plant species pollinated by honey bees in the green district of Casamance (South Senegal). This survey followed a well-established questionnaire concerning beekeepers in these areas. The listed melliferous flora was made of 61 species either. It’s divided in 58 genus and 30 families though the most represented are in decreasing order Fabaceae with 12 species (19.67%) followed by Rutaceae and Malvaceae with 4 species (6.55% each), Arecales, Anacardiaceae, Combretaceae, Gramineae, Myrtaceae, with 3 species (4.91% each), then Chrysobalanaceae, Lamiaceae, Meliaceae and Rubiaceae with 2 species (3.27% each) and then Acanthaceae, Asteraceae, Canabaceae, Verbenaceae, Apocynaceae, Bignoniaceae, Amaranthaceae, Hymenocardia, Icacinaceae, Lauraceae, Moringaceae, Musaceae, Celastraceae, Rhizophoraceae, Sapindaceae, Sterculiaceae, Moraceae, Ochnaceae, with 1 species (1.63% each). Melliferous plants include 47.54% nectariferous plants followed by nectariferous polliniferous plants with 37.70% and finally polliniferous species with 14.75%. This study enabled us to identify eight (08) species with high melliferous value. To enhance the value of these plants, further studies on foraging activity and nectar production will be led to prove their real melliferous potential.

KEYWORDS: Melliferous flora, Ethno-apicultural survey, Casamance, South Senegal

INTRODUCTION

The melliferous plants are plant species on which the bee takes substances, including nectar, pollen and resin to feed and to develop its various products (honey, royal jelly...). It is well known that the products of the hive reflect in quantity and quality the nature of the pollinated plants (Lafleche, 1981). In addition, melliferous plants vary with climatic conditions (G de Layens, 1997). Indeed, Casamance includes three large districts with a very favorable climate for the development of plant species.

The area of classified forests is 607540 ha for 56 classified forests including 30 in Lower Casamance (116776 ha, Ziguinchor), 12 in Middle Casamance (84453 ha, Sedhiou) and 14 in Upper Casamance (396230 ha, Kolda). This potential allows the development of plant species, diversified and particularly honey. There are also mangroves that constitute specific plant formations. They enjoy the status of classified forests. This ecosystem is also home to many species of molluscs, fish, crustaceans, spiders, but especially bees (Geist, 2012). Yet, there is undoubtedly in these forests classified considerable beekeeping resource, which should be developed not only to provide local people a high quality food supplement, but also to promote the growth of bee colonies and to provide agriculture and all vegetation a sufficient number of pollinators. Similarly, it is also important to develop beekeeping in this district because it represents a diversification of cash income source for the beekeeper and often impoverished rural community and no other type of resources (Ahouandjinnou, 2016). The aim of this study is to determine the potentially honey plants to allow good conservation of these resources and a high quality beekeeping can solve the problem of malnutrition in indigenous peoples.

MATERIALS AND METHODS

Study Area

The survey was conducted in all three district. The Ziguinchor district has an area of 7339 km², lies at 12° 34′ 59” N Latitude...
and 16°16’18” W Longitude with a population of 549151 peoples. It has a sub-Guinean climate and a total annual rainfall of 1190.1 mm/year. Then the district of Kolda with an area of 13721 km², lies at 13°04’60” N Latitude and 14°49’60” W Longitude with a population of 847243 peoples. The climate is Guinean Sudano type with a total annual rainfall of 883 mm/year. Finally, the district of Sedhiou located at 12°42’29” N Latitude and 15°33’24” W Longitude has an area of 7330 km² and a population of 452994 peoples. Sedhiou has a Sudano Guinean climate and the average annual rainfall is about 1000 mm (National Agency of Statistics and Demography, 2013). Beekeepers were interviewed about the different types of melliferous plants in their areas. Below representative map of the survey area (Map 1).

**RESULTS AND DISCUSSION**

A total of 61 plant species from 58 genera and 30 families were identified as melliferous plants. The families, botanical names, local names, nectariferous plants, nectariferous-polliniferous plants, polliniferous plants, biological type, domestication type, beekeeping interest, flowering class, flowering period and quote percentage and uses are given in Table 1. The distribution of melliferous plants according to the biological type (Table 1) shows that the trees are the most represented 34/61 (55.74%) followed by shrubs 19/61 (31.15%) and herbs which is 7/61 (11.5%) and finally lianas which represent 1/61 (1.66%) are less than represented (Figure 1).

These results are according with those of Iritié et al., (2008) found 62.25% ligneous against 31.88% herbaceous and 6.88% liana, and with results from Dongock et al., (2004) who showed a higher rate of ligneous (trees, shrubs and herbs) of 63.5% against 36.5% of herbaceous plants and with those of Nombré I., (2003) 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 86.88% of species (see Table 1). Indeed, African species represent more than half of the species (57.38%) while pantropical species have more than 1/3 of the species. It has African species (57.38%) pantropical species (29.51%), Afro-Indian species (6.56%), species from Africa and tropical America (3.28%), an Afro-Asian species (1.64%) and an Asian American species (1.64%) (Figure 2).

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., (2004). Several species are visited by bees according to beekeepers, of the herbaceous strata to the ligneous strata with fruit plant, cereal or agroforestry plants.
Table 1: Summary of plants to data cited as melliferous

| Families/botanical name | LN | BT | DT | BGT | AI  | FP | FC | QP |
|------------------------|----|----|----|-----|-----|----|----|----|
| Adansonia digitata L. (MALVACEAE) | buy (W) | tree | spontaneous | Af | N | July- September | III | 13.7% |
| Aftzelia africana Sm. & Pers (FABACEAE) | Buqaw (d) | tree | spontaneous | Af | N | April | I | 94.10% |
| Anacardium occidentale L. (ANACARDIACEAE) | bu kayu (d) | tree | cultivated | Pan | N | January - March | III | 100% |
| Arachis hypogea L. Sp. (FABACEAE) | é tihé (d) | herb | cultivated | Pan | N | August- September | II | 29.4% |
| Avicennia germirians Jacq. (ACANTHACEAE) | bu bèg (d) | shrub | spontaneous | Pan | N | May -July | III | 94.1% |
| Bombax costatum Pellegr. et Vuill. (MALVACEAE) | bu dimb (d) | tree | spontaneous | Af | NP | November- December | II | 62.7% |
| Borassus akeass | si gumboudj (d) | tree | spontaneous | Af | P | April | I | 64.7% |
| Carapa procera DC. (MELIACEAE) | buhounoum | tree | cultivated | Pan | N | March-May | III | 17.6% |
| Cassia sieberiana DC. (FABACEAE) | bu saët (d) | shrubs | spontaneous | Af | P | February- May | III | 76.5% |
| Ceiba pentandra L. Gaertn. (MALVACEAE) | bu sana (d) | tree | spontaneous | Pan | NP | December- January | II | 100% |
| Celtis integrifolia Lam. (CANNABACEAE) | busingil (d) | tree | spontaneous | Af | NP | April-June | III | 7.80% |
| Citrus aurantium L. (RUTACEAE) | bu sorande (d) | shrubs | cultivated | Pan | N | August-September | II | 76.5% |
| Citrus grandis L. (RUTACEAE) | pamplemousse (f) | shrubs | cultivated | Pan | N | February-March | II | 78.4% |
| Citrus limon L. (RUTACEAE) | lemouna (d) | shrubs | cultivated | Pan | N | August-October | III | 70.6% |
| Cocos nucifera L. (ARECACEAE) | coco (w), tree | cultivated | Pan | P | October-November | II | 66.6% |
| Cola cordifolia (Cav.) R. Br. (STERCULIACEAE) | bu bëg (d) | tree | spontaneous | Af | N | February | I | 33.3% |
| Combretum micranthum G. Don (COMBRETACEAE) | butik (d), shrubs | cultivated | Af | NP | June-August | II | 21.6% |
| Daniellia oliveri (R.) Hutch. et Dalz. (FABACEAE) | bu sentigndao (d) | tree | spontaneous | Af | N | January- March | III | 100% |
| Delonix regia Boj. Raf. (FABACEAE) | flamboyant (f) | tree | cultivated | Pan | N | May-June | II | 31.4% |
| Detarium senegalense J. Gmelin. (MALVACEAE) | bu bunkud (d) | tree | spontaneous | Af | N | July-September | III | 43.1% |
| Dialium guineensis Willd. (FABACEAE) | bu faïah (d) | tree | spontaneous | Af | N | October-January | III | 100% |
| Elaëis guineensis Jacq. (ARJENACEAE) | slit (d) | tree | cultivated | Pan | P | All the year | III | 100% |
| Eucalyptus sp. (MYRTACEAE) | hot bitel (w) | tree | cultivated | Pan | NP | July-August | II | 60.8% |
| Faidherbia albida Del. Chev. (FABACEAE) | Boutafoul (d) | tree | spontaneous | Af | NP | January | I | 59.9% |
| Ficus senegalensis Miq. (MORACEAE) | bu gango sotto (d) | tree | spontaneous | Af | NP | February | I | 5.9% |
| Grewia bicolor Juss. (MALVACEAE) | Kel (w) | shrubs | cultivated | Af | NP | June-July | II | 9.8% |
| Guiera senegalensis j.f.qmel. (COMBRETACEAE) | bu funuk (d) | shrubs | cultivated | Af | NP | April-June | II | 7.8% |
| Hymenocardia acida Tul. (HYMENOCARDIACEAE) | bo sont (d) | tree | spontaneous | Af | NP | April-June | III | 41.2% |
| Hypitis suaveolens Poit. (LAMIACEAE) | baïla sanké (d) | herb | spontaneous | Af | NP | August-October | III | 62.7% |
| Icacina senegalensis A. Jussieu (ICACINACEAE) | furabang (d) | shrub | spontaneous | Af | NP | January-May | III | 58.8% |
| Khaya senegalensis A. Jussieu (MELIACEAE) | bu kay (d) | tree | cultivated | Af | N | April-May | II | 90.1% |
| Lantana camara L. (VERBENACEAE) | faux thé de | shrubs | spontaneous | Af | NP | February- April | III | 17.6% |
| Lepisanthes senegalensis (Juss. ex Poir.) Leenh (SAPINDACEAE) | gambie (f) | tree | spontaneous | Af | N | April-may | II | 13.70% |
| Lophira lanceolata Van Tiegh. ex Keay (UCHNACEAE) | é noun (d) | shrubs | spontaneous | Af | N | October-November | II | 19.6% |
| Mangifera indica L. (ANACARDIACEAE) | bu mágou (d) | tree | cultivated | Pan | N | January-March | III | 23.5% |
| Moringa oleifera Lam. (MORINGACEAE) | nebeday (w) | shrubs | cultivated | Af | N | January- May | III | 45.1% |
| Musa sapientum L. (MUSACEAE) | gu nanar (d) | herb | cultivated | Pan | N | August- October | III | 25.5% |
| Parinari excelsa Sabine (CHRYSOBALANACEAE) | nini (d) | tree | spontaneous | Af | N | March-April | II | 39.20% |
| Parinari macrophylla Sabine (CHRYSOBALANACEAE) | bïlé (d) | tree | spontaneous | Af | N | March-May | III | 45.1% |
| Newbouldia laevis (BIGNONIACEAE) | fugompó (d) | shrubs | spontaneous | Af | N | June | I | 31.4% |
| Oriza sativa L. (GRAMINEAE) | Mano (d) | herb | cultivated | Af | A | P | September | II | 43.1% |
| Parkia biglobosa Jacq.Benth (FABACEAE) | bu dilay (d); oul (w) | tree | spontaneous | Af | NP | February-may | III | 94.1% |
| Persea americana Mill. (LAURACEAE) | avocatier (f) | shrubs | spontaneous | Af | AAT | September-October | II | 3.9% |
| Psidium guajava L. (MYRTACEAE) | bi gbiar (d), goyavier (f) | shrubs | cultivated | Pan | N | All the year | III | 13.7% |
| Pterocarpus erinaceus Poir. (FABACEAE) | bu kon (d) | tree | spontaneous | Af | N | January-September | III | 96% |
| Rhizophora racemosa G.F.W Mey. (RHizophORACEAE) | boum ah (d) | tree | cultivated | Pan | N | All the year | III | 76.5% |
| Saba senegalensis DC. (APOCYNACEAE) | sidibasu (d) | Liana | spontaneous | Af | NP | All the year | III | 3.90% |
| Salacia senegalensis (Lam.) DC. (CELASTRACEAE) | bu fumb (d) | tree | cultivated | Af | NP | March-April | II | 11.70% |
| Sarcophus latifolius (Sm.) E.A.Bruce (RUBIACEAE) | Birilo (d) | tree | spontaneous | Af | NP | February-March | II | 27.40% |
| Senna alata L. (FABACEAE) | fu gagabou (d) | shrubs | cultivated | Af | NP | July-August | II | 23.5% |
| Sorghum bicolor L. | baroute (d) | herb | cultivated | Af | P | October | I | 25.50% |
| Spermatoce verticillata L. (RUBIACEAE) | é ribum (d) | herb | cultivated | Af | NP | October-November | II | 43.14% |

(Contd..)
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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 (70.5%) of melliferous plants cited by beekeepers are spontaneous plants. These results are according to those found by Dongock et al., (2011) who found 57.9% spontaneous plants versus 42.1% cultivated, but did not according to those of Iritie et al. (2014) who found that cultivated plants were larger with 58% of the species recorded, and Dongock et al., (2004) and Pinta et al., (2001) showed respectively that 67.5% and 64% of the species identified in the field were cultivated.

Among the cultivated fruits, the most important are 38.9% corroborated by the results of Dongock et al., (2004) who found 28.5% of fruit on the 32.5% of cultivated species. Mangifera indica, Eucalyptus sp, Arachis hypogaea that were cited by beekeepers for over 90% of these species and 5 are cited according to the citation percentage 16.39% of species are most important. The distribution of species according to the type of domestication, the results found by Sawadogo et al., (2001) the other periods of the year which many other species grow correspond to honeydew of secondary importance. The evolution of the number of herbaceous species in flower over the months is similar to the results of Ramirez (2000) and Yodomonhan et al., (2009) for which the herbaceous plants begin their flowering as soon as the rains begin.

According to the flowering classes, species that have more than 2 months of flowering are more numerous with 30 species (49.18%). By mixing the duration of flowering and beekeeping interest 30 species are intensely pollinated by bees and available for them for at least 2 months in course. Of these, 16 (53.33%) are nectariferous, 11 (36.67%) are nectariferous and polliniferous and 3 (10%) are polliniferous. Taking into account the duration of flowering, three classes of melliferous species are obtained. Class I species with a flowering time of one month, class II of 2 months and class III of taxa with a flowering period of more than two months, come first with 30 species of flowering class III, (49.18%), then class II flowering species with 22 species, (30.06%) of the flora mentioned, and finally, class I which comprises 9 species, (14.75%). Class III species are superior to those found by Yodomonhan et al., (2009) which is 34.5%, but these Class II and I species are higher than the species found 34.5% and 31% against 30.06% and 14.75% respectively. The flowering of these plants, which is as well in the rainy season as in the dry season and therefore throughout the year, offers a good opportunity for the promotion of beekeeping activities in this area.

According to the citation percentage 16.39% of species are most cited by beekeepers for over 90% of these species and 5 are cited by all beekeepers as melliferous, these are: Elaeis guineensis, Ceiba pentandra, Anacardium occidentale, Daniellia oliveri, Dialium guineensis.
In this species list cited as melliferous 6 were been already identified by Yodomonhan et al., (2009): Daniellia oliveri, Vernonia colorata, Hymenocardia acida, Syzygium guineensis, Grewia sp and Tamarindus indica. Sawadogo et al., (2001) had listed 4: Eucalyptus sp, Sorghum bicolor, Ceiba pentandra, Parkia biglobosa.

CONCLUSION

A total of 61 species were registered as melliferous plants. The information collected from this survey indicates that they are aware about of the presence of melliferous plants in their areas. This knowledge was inherited from their ancestors, but gradually disappears with the new generations who have abandoned the preservations of these forest resources. Most of the plant were wild and herbs, so their conservation is necessary for utilization of generations to come. This can be done by encouraging local people for the cultivation of these plants. Furthermore, this preliminary study may be act as a baseline for the discovery of new plant-based medicines but also for the implantation of apiaries for the production of honey. These melliferous species can be studied to know the compounds and these various activities.

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