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# 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), Arecaceae, 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, Annonaceae, Hymenocardiaceae, 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

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## 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 these district because it represents a diversification of cash income source for the beekeeper and often impoverished rural community and no other type of resources (Ahouandjinou, 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 km<sup>2</sup>, lies at 12 ° 34'59 " N Latitude

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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 km<sup>2</sup>, 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 km<sup>2</sup> 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, biogeographic 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 Iritie 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 shrubs) of 63.5% against 36.5% of herbaceous plants and with those of Nombé 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 I). 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.

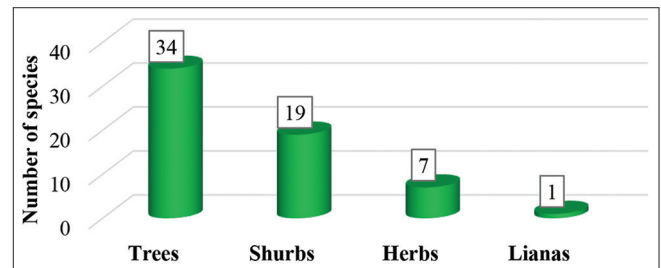


Figure 1: Distribution of plants according to their biological type

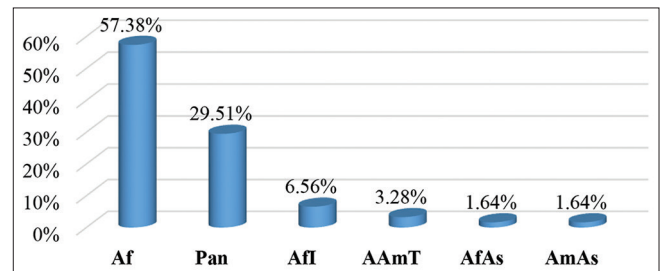
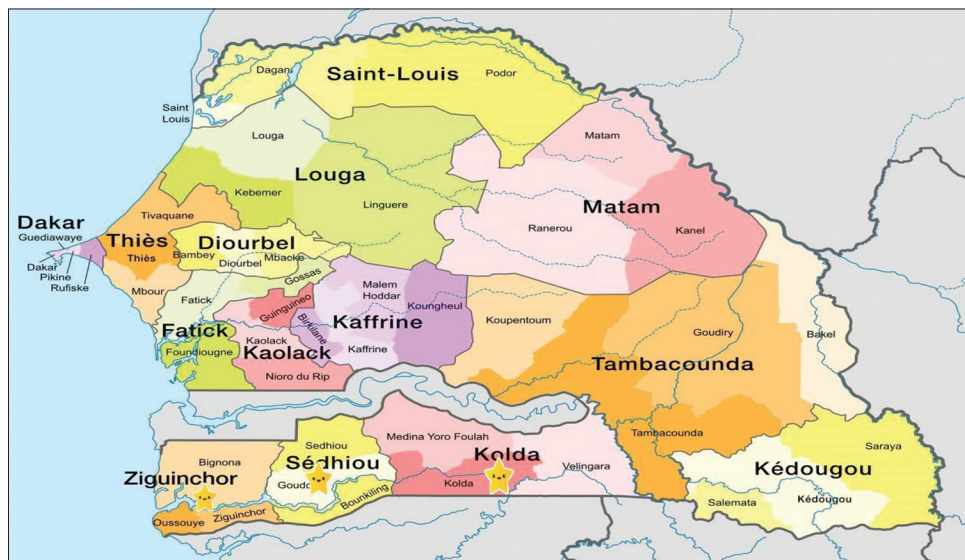


Figure 2: Distribution of plants according to their biogeographic type



Map 1: Map of the survey area (Ziguinchor, Sedhiou et Kolda)

Table 1: Summary of plants to data cited as melliferous

Families/botanical name of plants	LN	BT	DT	BGT	AI	FP	FC	QP
<i>Adansonia digitata</i> L. (MALVACEAE)	buy (W)	tree	spontaneous	Af	N	July- September	III	13.7%
<i>Azelia africana</i> Sm. & Pers (FABACEAE)	Bupaw (d)	tree	spontaneous	Af	N	April	I	94.10%
<i>Anacardium occidentale</i> L. (ANACARDIACEAE)	bu kayu (d)	tree	cultivated	Pan	N	January -March	III	100%
<i>Arachis hypogea</i> L. Sp. (FABACEAE)	é tihé (d)	herb	cultivated	Pan	N	August- September	II	29.4%
<i>Avicennia germinans</i> Jacq. (ACANTHACEAE)	bu bèg (d)	shurb	spontaneous	Pan	N	May -July	III	94.1%
<i>Bombax costatum</i> Pellegr. et Vuill. (MALVACEAE)	bu dimb (d)	tree	spontaneous	Af	NP	November- December	II	62.7%
<i>Borassus akeassi</i> Mart. (ARECACEAE)	si gumboudj (d)	tree	spontaneous	Af	P	April	I	64.7%
<i>Carapa procera</i> DC. (MELIACEAE)	buhounoum	tree	cultivated	Pan	N	March-May	III	17.6%
<i>Cassia sieberiana</i> DC. (FABACEAE)	bu saét (d)	shurbs	spontaneous	Af	P	February- May	III	76.5%
<i>Ceiba pentandra</i> L. Gaertn. (MALVACEAE)	bu sana (d)	tree	spontaneous	Pan	NP	December- January	II	100%
<i>Celtis integrifolia</i> Lam. (CANNABACEAE)	busingilit (d)	tree	spontaneous	Afi	NP	April-June	III	7.80%
<i>Citrus aurantium</i> L. (RUTACEAE)	bu sorance (d)	shurbs	cultivated	Pan	N	August-September	II	76.5%
<i>Citrus grandis</i> L. (RUTACEAE)	pamplémousse (f)	shurbs	cultivated	Pan	N	February-March	II	78.4%
<i>Citrus limon</i> L. (RUTACEAE)	lemouna (d)	shurbs	cultivated	Pan	N	August-October	III	70.6%
<i>Cocos nucifera</i> L. (ARECACEAE)	coco (w),	tree	cultivated	Pan	P	October- November	II	68.6%
<i>Cola cordifolia</i> (Cav.) R. Br. (STERCULIACEAE)	boubeum (d)	tree	spontaneous	Af	N	February	I	33.3%
<i>Combretum micranthum</i> G. Don (COMBRETACEAE)	butik (d),	shurbs	spontaneous	Af	NP	June-August	II	21.6%
<i>Daniellia oliveri</i> (R.) Hutch. et Dalz. (FABACEAE)	bu sentignadio (d)	tree	spontaneous	Af	N	January- March	III	100%
<i>Delonix regia</i> Boj. Raf. (FABACEAE)	flamboyant (f)	tree	cultivated	Pan	N	May-June	II	31.4%
<i>Detarium senegalense</i> J. Gmelin. (FABACEAE)	bu bunkut (d)	tree	spontaneous	Af	N	July-September	III	43.1%
<i>Dialium guineensis</i> Willd. (FABACEAE)	bu falah (d)	tree	spontaneous	Af	N	October- January	III	100%
<i>Elaeis guineensis</i> Jacq. (ARECACEAE)	siit (d)	tree	cultivated	Pan	P	All the year	III	100%
<i>Eucalyptus</i> sp. (MYRTACEAE)	hot bitél (w)	tree	cultivated	Pan	NP	July- August	II	60.8%
<i>Faidherbia albida</i> Del.Chev. (FABACEAE)	Boutafoul (d)	tree	spontaneous	Af	NP	January	I	54.9%
<i>Ficus senegalensis</i> Miq. (MORACEAE)	bu gang soto (d)	tree	spontaneous	Af	NP	February	I	5.9%
<i>Grewia bicolor</i> Juss. (MALVACEAE)	Kel (w)	shurbs	cultivated	Afi	NP	June-July	II	9.8%
<i>Guiera senegalensis</i> j.f.gmel. (COMBRETACEAE)	bu funuk (d)	shurbs	spontaneous	Af	NP	April-June	III	7.8%
<i>Hymenocardia acida</i> Tul. HYMENOCARDIACEAE	bo sönt (d)	tree	spontaneous	Af	NP	April-June	III	41.2%
<i>Hypsis suaveolens</i> Poit. (LAMIACEAE)	baïla sanké (d)	herb	spontaneous	AmAs	NP	August-October	III	62.7%
<i>Icacina senegalensis</i> A. Jussieu (ICACINACEAE)	furabang (d)	shurb	spontaneous	Af	NP	January-May	III	58.8%
<i>Khaya senegalensis</i> A. Jussieu (MELIACEAE)	bu kay (d)	tree	cultivated	Af	N	April- May	II	90.1%
<i>Lantana camara</i> L. (VERBENACEAE)	faux thé de gambie (f)	shurbs	spontaneous	Pan	NP	February- April	III	17.6%
<i>Lepisanthes senegalensis</i> (Juss. ex Poir.) Leenh (SAPINDACEAE)	biéche (d)	tree	spontaneous	Af	N	April- may	II	13.70%
<i>Lophira lanceolata</i> Van Tiegh. ex Keay (OCHNACEAE)	é noun (d)	shurbs	spontaneous	Af	N	October- November	II	19.6%
<i>Mangifera indica</i> L. (ANACARDIACEAE)	bu māgu (d)	tree	cultivated	Pan	N	January-March	III	23.5%
<i>Moringa oleifera</i> Lam. (MORINGACEAE)	nebeday (w)	shurbs	cultivated	Afi	N	January- May	III	45.1%
<i>Musa sapientum</i> L. (MUSACEAE)	gu nanar (d)	herb	cultivated	Pan	N	August- October	III	25.5%
<i>Parinari excelsa</i> Sabine (CHRYSOBALANACEAE)	nini (d)	tree	spontaneous	Af	N	March- April	II	39.20%
<i>Parinari macrophylla</i> Sabine (CHRYSOBALANACEAE)	biél (d)	tree	spontaneous	Af	N	March- May	III	45.1%
<i>Newbouldia laevis</i> (BIGNONIACEAE)	fugompö (d)	shurbs	spontaneous	Af	N	June	I	31.4%
<i>Oriza sativa</i> L. (GRAMINEAE)	Mano (d)	herb	cultivated	Af A	P	September	II	43.1%
<i>Parkia biglobosa</i> Jacq.Benth (FABACEAE)	bu dilay (d); oul (w)	tree	spontaneous	Af	NP	February –may	III	94.1%
<i>Persea americana</i> Mill. (LAURACEAE)	avocatier (f)	shurbs	spontaneous	AAT	P	September-October	II	3.9%
<i>Psidium guajava</i> L. (MYRTACEAE)	bi giab (d), goyavier (f)	shurbs	cultivated	Pan	N	All the year	III	13.7%
<i>Pterocarpus erinaceus</i> Poir. (FABACEAE)	bu kon (d)	tree	spontaneous	Af	N	january-March	III	96%
<i>Rhizophora racemosa</i> G.F.W Mey. (RHIZOPHORACEAE)	boum ah (d)	tree	cultivated	Pan	N	All the year	III	76.5%
<i>Saba senegalensis</i> DC. (APOCYNACEAE)	sidibusu (d)	Liana	spontaneous	Af	NP	All the year	III	3.90%
<i>Salacia senegalensis</i> (Lam.) DC. (CELASTRACEAE)	bu fumb (d)	tree	spontaneous	Af	NP	March- April	II	11.70%
<i>Sarcocephalus latifolius</i> (Sm.) E.A.Bruce (RUBIACEAE)	Birilo (d)	tree	spontaneous	Af	NP	February- March	II	27.40%
<i>Senna alata</i> L. (FABACEAE)	fu gagabu (d)	shurbs	cultivated	Af	NP	July- August	II	23.5%
<i>Sorghum bicolor</i> L.	baroute (d)	herb	cultivated	Af	P	October	I	25.50%
<i>Spermocoe verticillata</i> L. (RUBIACEAE)	é ribum (d)	herb	cultivated	Af	NP	October November	II	43.14%

(Contd...)

Table 1: (Continued)

Families/botanical name of plants	LN	BT	DT	BGT	AI	FP	FC	QP
<i>Spondias monbin</i> L. (ANACARDIACEAE)	bu mobaye (d)	tree	spontaneous	AAT	N	April-may	II	45 %
<i>Syzygium guineense</i> (Wild.) DC. (MYRTACEAE)	nanéli (d)	tree	cultivated	Af	NP	February-March	II	21.6%
<i>Tamarindus indica</i> L. (FABACEAE)	bu dahar (d)	tree	cultivated	AfI	NP	June- July	II	72.5%
<i>Terminalia macroptera</i> Guill. Pers (COMBRETACEAE)	bu ānga (d)	tree	spontaneous	Af	NP	April-June	III	24.5%
<i>Uvaria chamae</i> P. Beauv. (ANNONACEAE)	bu ñañaru (d)	shurbs	spontaneous	Af	NP	June- August	III	37.2%
<i>Vernonia colorata</i> (Willd.) Drake (ASTERACEAE)	bu simbiya (d)	shurbs	spontaneous	Af	P	January-March	III	19.60%
<i>Vitex doniana</i> Sweet. (LAMIACEAE)	buđink (d)	tree	spontaneous	Af	N	February-April	III	72.5%
<i>Zanthoxylum zanthoxyloides</i> Lam. (RUTACEAE)	ka sand (d)	tree	spontaneous	Af	N	September	I	33.30%
<i>Zea mays</i> L. (GRAMINEAE)	Etoubabounio (d)	herb	cultivated	Pan	P	June-September	III	17.65%

AAT: Africa and tropical America, AmAs: American and asiatic, BT: biological type, FP: flowering period, Af: African species, N: nectariferous, BGT: biogeographic type, QP: quote percentage, AfI: Indian afro species, NP: nectariferous polliniferous, DT : domestication type, d: diola, Pan: pantropical species, P: polliniferous, AI: apicol interest, f: french, AfA: asiatic afro species, LN: locals names, FC: flowering class, w: wolof

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 were listed by **Dongock et al., (2004)**.

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 29/61 (47.54%), followed by taxa which were at the same time pollinated for their nectar and their pollen (36.07%) and those visited only for their pollens (14.75%). These results are in according to those of **Nombré I, (2003)** which showed a predominance of nectariferous taxa of 62.89% against 27.47% of nectariferous and polliniferous taxa and 9.89% of polliniferous taxa at Nazinga in Burkina Faso. These results correspond to those obtained by **Bakenga et al., (2000)**, 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., (2015)** 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., (2009)** who found substantially equal rates of 31% nectariferous taxa, 35.6% nectariferous taxa and 33.3% polliniferous taxa.

The distribution of species according to the floral calendar: according to the time of flowering, the season from November

to June consists exclusively of ligneous plants 47/61 (67.21%), the rainy season from July to October all plants Herbs (*Arachis hypogaea*, *Musa sapientum*, *Oriza sativa*, *Sorghum bicolor*, *Zea mays*, *Hyptis suaveolens*) and some ligneous species (*Detarium senegalensis*, *Eucalyptus*, *Uvaria chamae*, *Zanthoxylum zanthoxyloides*, *Citrus*). The essential nectariferous flowers in the dry season with a month of March which corresponds to the first period of honeydew. According to **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 Yedomonhan 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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