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SEASONAL HONEY POLLEN COMPOSITION IN THE SOUDANO-GUINEAN HIGHLAND ZONE OF CAMEROON

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ABSTRACT

In order to assess the influence of seasons on the exploitation of mellliferous plants by *Apis mellifera adansonii*, seasonal pollen spectra of 104 honey samples collected between September 2010 and March 2011 in the Highlands area of west Cameroon (LN 5°21.459–5°35.449 and LE 10°04.729–10°26.249) were analysed using melissopalynology methods. The aim was to evaluate the influence of seasons on the exploitation of melliferous plants by *A. mellifera adansonii*. The spectrum of bee-plants exploited during the rainy season was large and diversified compared to the dry season. Asteraceae and Caesalpiniaceae were the most represented families for the dry and the rainy seasons, respectively. Asteraceae was also the most represented family in the two seasons. The spontaneous *Eucalyptus saligna* and *Terminalia mantaly* were much foraged during the two seasons. Flowers of herbs were highly exploited in both the seasons and white colour flowers were frequently foraged. Honey of rainy season was more diversified with four distinguished colours. Predominant and important minor was significantly higher in rainy season compared to the dry season. The frequency of pollen in honey varied considerably with seasons and availability of blooming vegetation exploited by honeybees. Irrespective of vegetation diversity with seasonal variation, honeybee visits were very specific to some plants species.

Keywords: melliferous plants, season, biological characteristic, honey colour, Cameroon

INTRODUCTION

The pollen grains in honey serve as indicators of its geographic origin and botanical sources (Anklam, 1998). Understanding the composition of honey is important from the point of view of human health (Fea´s et al., 2010) whose biological properties depend on the nectar source (Jain et al., 2013; Valentini et al., 2010). Honeybee-plant interaction is the best known model of plant-insect relationship. Bees are the most important and the most effective pollinators due to their foraging behaviour (Payette, 1996); having this advantage due to their size and physical constitution. They perform 20 to 30 visits each day during peak blooming seasons and can visit 20 to 30 million flowers each day. Börje (1991) thus indicates that under favourable conditions a tree can produce a great number of flowers and give as much as one kilogram nectar per day. Bees can forage about 250 flowers per hour (Laflèche, 1981). A colony of bee collects for their own food about 20 to 40 kg of pollen per year (Laflèche, 1981). Foraging activity of bees reflects the diversity of bee flora in time and in space.

Honeybee behaviour and the presence of drones depend on the seasonal variations (Mutsaers and Campion, 2010). Foraging activity of bees depend on the season, the biological type of the plants and the selective behaviour of bees (Lobreau-Callen and Damblon, 1994; Bastos et al., 2003). Akoegninou et al. (2010) in Benin and Abel and Banjo (2012) in Nigeria identified different species of melliferous plants. In Madagascar, Ralalaharisoa-Ramamonjisoa et al. (1996) noted that the flora bees varying with the bees ecotypes. Seasonal management of bee colonies can be based on pollen and nectar analysis from flowers which constitute practically the only food source for bees from larval through adult phases (Bastos et al., 2003). The pollen grains in honey serve as indicator of its geographic origin and main botanical sources. The present work is aimed at studying the impact of seasons on the pollen spectra of honeys in the highland area of west Cameroon.

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MATERIALS AND METHODS

Study area

Study area is located in the Sudano-Guinean western highlands of Cameroon (LN 5°21.459–5°35.449 and LE 10°04.729–10°26.249) (Figure 1). Altitude is 1500 m on average. Soils are argileous or lateritic, and volcanic types. Climate is characterized by two seasons, a rainy season from mid-March to mid-November with annual precipitation between 1500–2000 mm; and a dry season from mid-November to mid-March; average relative humidity is 75% (70 – 85%). Temperature varies from 18-22°C in dry and 25-28°C in rainy season with annual insolation of 1874 hours. Natural vegetation is herb savannah with shrubs which has been greatly modified by a dense human population whose main activity is agriculture (Dongock et al., 2004)

Collection and analysis of honey

A total of 104 honey samples were collected between September 2010 and March 2011 during the two seasons. In the rainy season, 61 honey samples were collected and 43 in the dry season. Honey was extracted by pressing. Qualitative and quantitative analyses of the honey samples were carried out according to melissopalynology methods as recommended by Louveaux et al. (1978). To quantify the pollens in the samples a total of 200 pollen grains were counted and regrouped according to the Zander classes as follows: predominant (≥45%), secondary (≥16% to <45%, important minor (≥3% to <16%) and minor (<3%)(Louveaux et al., 1978). Frequency of melliferous plants have been defined as the percentage of honey samples containing pollen of specific species of plants compared to the total number of honey samples analysed. Melliferous plants were grouped into three levels of frequency: frequent plants whose pollen identified in more than 60% of honey analysed, average frequent (≤60% to ≥30%) and less frequent plants (<30%).

Identification of honey colours

Honey colours were determined by spectrophotometry as proposed by Gonnet (1985), Clark (1995) and Biochrom (2003). Honey samples optic density was measured between 570 and 590mn wavelengths.

Statistical analysis

Descriptive statistics was used for frequencies distribution and Chi square test at 5% probability to separate means.

RESULTS

Influence of the season on the spectrum of melliferous plants

A sum total of 142 melliferous plants species were identified in honeys samples (Table 1) out of which 85% (120 plants in 65 families) foraged in the rainy season compared to only 42.6% (57 plants in 35 families) in the dry season. There was a significant difference ($P \leq 0.05$) (Chi square test) in the spectrum of families and species of bee-plants exploited between the rainy and the dry seasons.

The season also significantly influenced the diversity of pollen type in honey samples. About 85% pollen types were identified in the honey of rainy season, while in the dry season only 40% melliferous were foraged by bees. Asteraceae (*Ambrosia maritime, Ageratum hostonianum, Bidens pilosa, Cichorium intybus, Echinops giganteus, Gazania* sp., *Helichrysum cameroonense, Pacourina* sp., *Senecio burtonii, Synedrella nodiflora, Tithonia diversifolia, Vernonia amygdalina*) was the most represented during the both seasons, followed by Celastraceae (*Euonymus* sp., *Hippocratea guineensis, Celtis tessmannii, Trema guineensis*) in the dry season; Caesalpiniaceae (*Bauhinia acuminate, Brachystegia cynometroides, Cassia mimosoides, Caesalpinia bonduc, Caesalpinia pulcherima, Gleditschia africana, Julbernadia seretii, Parkinsonia aculeate, Senna alata*) and Euphorbiaceae (*Croton macrostachyus, Chrozophora plicata, Dalechampia* sp., *Julocroton* sp., *Jatropha kamerunica, Manihot esculenta, Ricinus communis*) in the rainy season.

Influence of the season on the biological types of melliferous plants

All the biological types were foraged during the two seasons by *A. mellifera adansonii* but in variable proportions (Fig. 2). Flowers of herbs were exploited during the two seasons; however they were mostly represented in dry season (48%) compared to the rainy season (38.7%). Herbs were followed by shrubs (30%)

in the rainy season and trees (27%) in the dry season. Small trees were always less represented during. The percentage of trees, herbs and small trees in the zone were comparable (P>0.05) (Chi square test). In contrary, shrubs exploited in rainy season were significant (P<0.05) (Chi square test) compared to the dry season. Research zone is highly degraded due to anthropic activities which greatly influence the foraging pattern of bees. Wild species represent in general a higher proportion of melliferous plants in the zone during the two seasons. However, there was insignificant difference (P>0.05) (Chi square test) between wild and cultivated plants during the two seasons. Flower colours of melliferous plants were diversified and varied with the season. White flowers were the most represented in dry season (43%) and the rainy season (45%), follow by the yellow colours with 23 and 22%, respectively.

Influence of the season on the type of flowers colours visited by bees

Different colours of flowers were visited by bees (Figure 3), but at different proportion depending on the season. Plants with white, blue, orange and red colour flowers were more foraged in the two seasons; whereas the proportions of yellow, green, crimson, mauve, beige and pink were exploited in high proportion in rainy season compared to the dry season. Irrespective of the seasons, white, yellow, and green colours flowers were the most exploited than others colours.

Influence of the season on the honey colours

Honey colours varied with the season. Honey from rainy season were more diversified with five colours (amber, black amber, black red, light brown and black) compared to those from dry season (three colours i.e., amber, black amber, dark brown). Amber and black amber coloured honey was found during the two seasons with a higher proportion in the rainy season with 30% and 45% of honey samples, respectively. Dark brown (50 %) is present only in the dry season and the light brown, black red and dark honey in the rainy season with 10.0% each. Irrespective of the season white, yellow, and green colours flowers were the most exploited than others colours

Seasonal intensity of exploitation of melliferous plants

Seasonal exploitation of melliferous plants (Table1) indicates that proportion of plants exploited as predominant (84.5%), and as important minor (85.3%) in rainy season was significantly higher compared to the dry season 36.7 and 25.5% respectively; as concern Minor melliferous plants their proportion exploited in dry season is significantly higher (68.1%) compared to the proportion of the rainy season (28.1%). The secondary melliferous plants were exploited at equal proportion (63.5%) in the both seasons.

Predominant melliferous plants

In the rainy season 17 species were identified as predominant in 41 honey samples of rainy season. The most frequent were *E. saligna*, *P. soyauxii* and *T. mantaly*, the pollen of each species present in 19.51% of honey samples containing predominant pollen. They were followed by *C. mimosoides* (14.63%) and *T. diversifolia* (09.09%). The predominant melliferous plant harvested during the rainy season is twice more than those of the dry season. Except *G. bambutana* and *C. arabica* which were foraged only in the dry season, all other species were exploited throughout the year. *E. saligna, T. mantaly, Elaeis guineensis* and *Weinmannia* sp. were found in honey sample of the two seasons. However, the percentages of honey samples that contained their pollen appeared higher in the rainy season compared to the dry season. In fact, in the rainy season, 14.9, 8.5 and 6.4% were represented by *T. mantaly*, *E. saligna* and *P. soyauxii*, respectively against 5.9, 8.8 and 3.0% in the dry season, respectively. In the rainy and dry season predominant bee-plants are represented by cultivated tree (46.5 and 50.0%, respectively) and shrubs (23.07 and 50.0%, respectively) with white corolla (45.45 and 66.7% respectively).

Secondary melliferous plants

Spectrum of secondary melliferous plants exploited by bees during the rainy season is wider and diverse compared to the dry season species. In fact 57% were identified in the rainy season compared to 46% for the dry season. Myrtaceae with 23.1% of honey samples was

the most represented family in the rainy season, while in the dry season it was Asteraceae (18.8%). Six secondary melliferous plants were visited during the two seasons: *B. pilosa, T. diversifolia, C. mimosoides, C. nigricans, E. saligna* and *F. heitzii.* However, *B. pilosa* and *C. mimosoides* are frequently visited in the dry season with 13.2 and 10.5%, respectively compared to the rainy season honey with 4.1 % each. *T. diversifolia* and *E. saligna* were rather foraged more in the rainy season with their pollen in 16.7 and 40.8% of honey against 07.9 and 10.5%, respectively during the dry season. *F. heitzii* was exploited by honeybees at the same level over the past two seasons. A quarter of secondary melliferous plants were visited only during the dry season against 35.7% in the rainy season. They were most represented by wild herbs in the dry season (50.0%), followed by cultivated trees (25.0%); while in the rainy season they were mostly cultivated trees (44.4%) and shrubs (38.8%). In both the seasons, white (44.4 and 31.3%, respectively for the rainy and dry season) and yellow (31.3% for each season) flowers colours were frequently foraged by honeybees.

Important minor melliferous plants

Spectrum of important minor melliferous plants in the rainy season was larger (with more than 95.0% of the plants) as compared to the dry season (with only 22.7% of the total important minor melliferous plants). In the dry season, frequently foraged plants were *E. saligna* (18.4%) and *C. arabica* (10.0%). In the rainy season, *B. pilosa* and *H. cameroonense* were presented with 16.3% each of honey samples, followed by *E. guineensis* (14.3%), *L. kerstingii* (14.3%). All important minor melliferous plants were identified both in the dry and rainy season but with higher intensity during the rainy season. Wild shrubs with 36.3% for each season were frequently exploited; followed by cultivated trees represented by 29.5 in the rainy season and 27.3% in the dry season. In the both season white was the most foraged with 37.5 and 50.5% for the rainy and dry seasons, respectively.

Minor melliferous plants

Spectrum of the dry season was less diversified compared to the rainy season. *E. guineensis* was the most frequently foraged specie during the two seasons with pollen identified in 42.1 and 75.5% of honey samples of the rainy and dry season, respectively followed by *B. pilosa, L. kerstingii* and *T. diversifolia* with 31.6, 62.3, 10.5 % and 42.9; 18.4, 32.7 % of their pollen in honey samples of the rainy and dry season, respectively. The most foraged species during the rainy season were *B. pilosa* (62.3%), *P. reclinata* (59.2%), *Z. mays* (57.1%), *T. mantaly* (51.0%), *C. arabica* (46.9%) and *L. kerstingii* (42.9%). Minor melliferous plants exploited by bees during the two season's represented 29.5% of total minor bee-plants, but their level of frequency was generally higher during the rainy season. Minor melliferous plants found in less than 40.0% of honey represented 94.5 and 99.3% of plants in the honey of rainy and dry season, respectively. For this group of melliferous plants, wild shrubs followed by cultivated trees were frequent in both the seasons; white flowers colour was also the most foraged one.

Melliferous plants specifically exploited in dry and rainy seasons

Proportion of melliferous plants specifically exploited in rainy season was higher for dominant (26.2%) and important minor plants (65.2%) compared to 10.5 and 02.2%, respectively for dry season. However the proportions of secondary (33.3%) and minor plants (68.1%) foraged in dry season was lower compared to those foraged in rainy season 29.9 and 27.2%, respectively.

Seasonal frequency of exploitation of melliferous plants

The frequency of melliferous plants depends highly on the season and the availability of blooming vegetation. The table 1 summarizes the main important melliferous plants identified. The frequent melliferous plants (11.6%) and averagely frequent plants (30.2%) were highly exploited by bees in dry season compared to the rainy season. The less frequent plants were most represented in the rainy season. There was no significant difference ($P>0.05$) (Chi square test) during the two seasons for the melliferous plants averagely exploited. The melliferous plants less frequent represented the large number of melliferous; it indicates the geographical origin of honey. The figure 4 represents melliferous plants whose pollen was frequently observed in honey of the study zone. Only ten species of plants were frequent in honey, with fourth species frequent

in honey of rainy season and six in the honey of dry season. *T. mantaly* and *L. kerstingii* were highly represented in the rainy season, *E. saligna* and *E. guineensis* in the dry season.

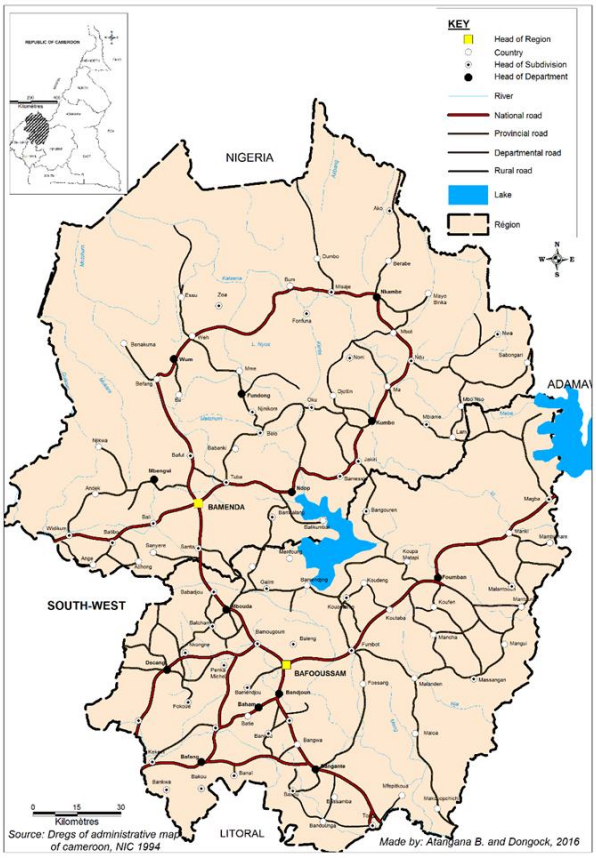

Figure 1: Map showing the study zone with the different divisions were the sample were collected

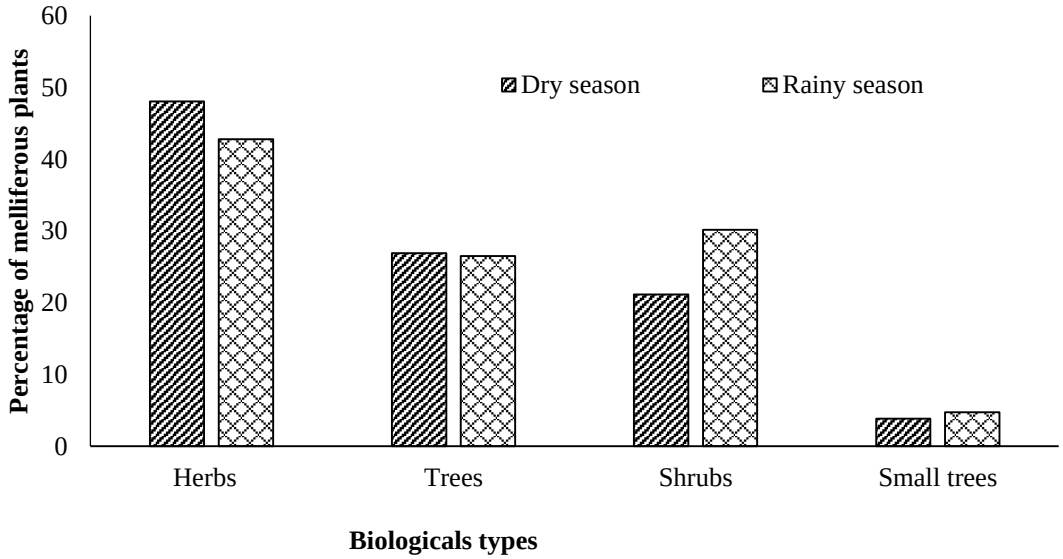

Figure 2: Repartition of melliferous plants identified in honey grouped in function of the biological type and the season of exploitation

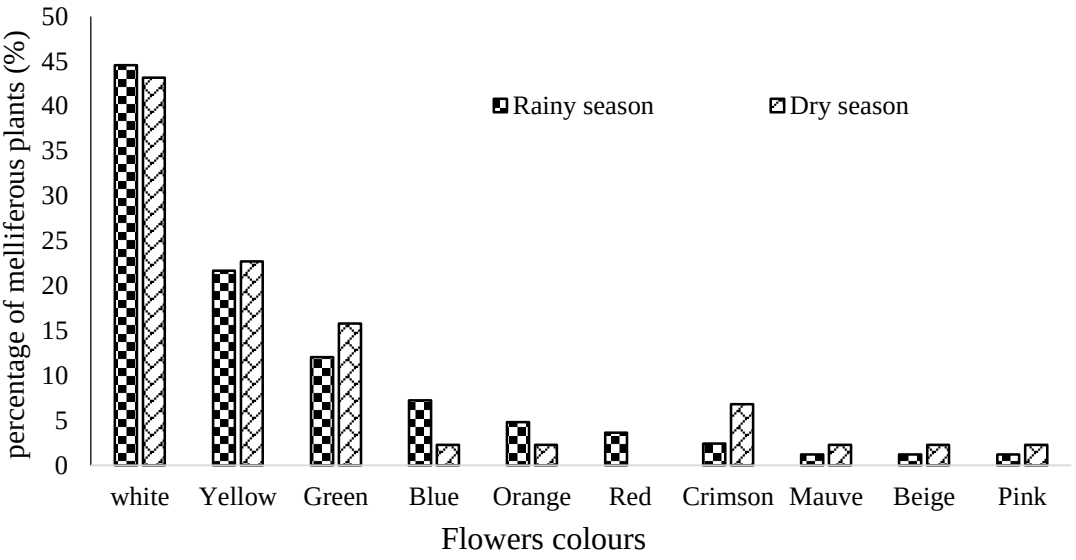

Figure 3: Repartition of melliferous plants identified in honey grouped in function of the flowers colours and the season of exploitation

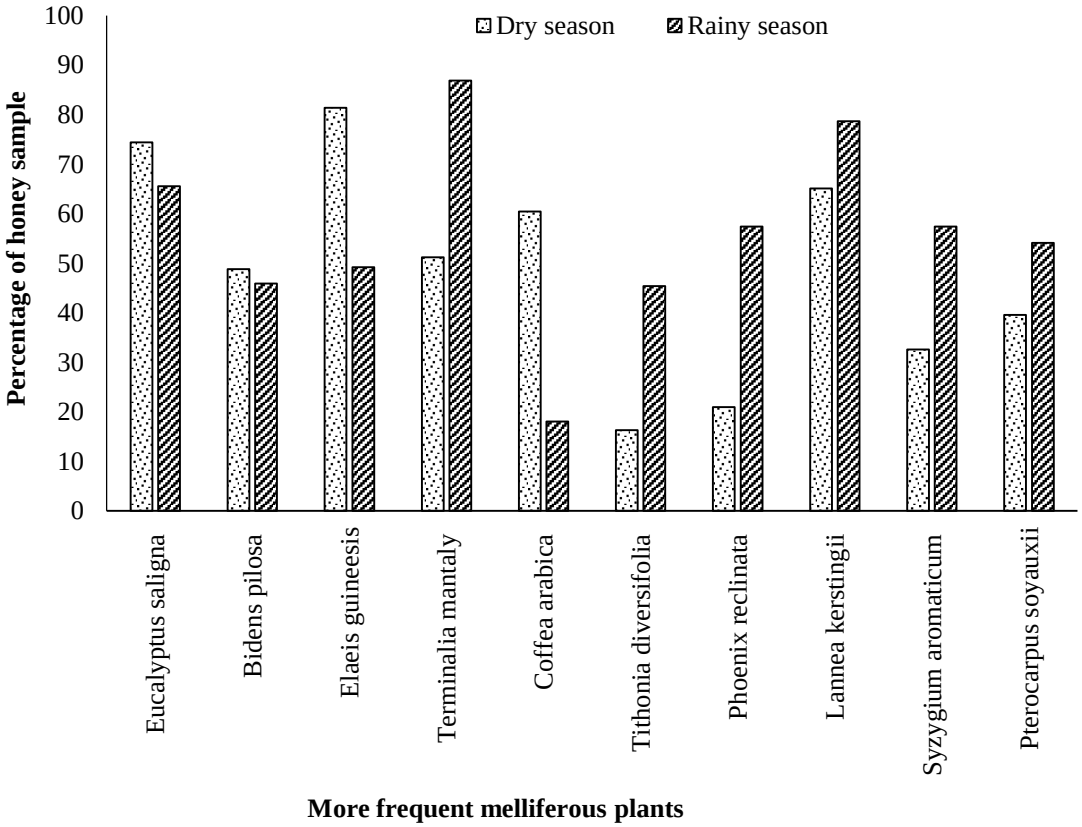

Figure 4: Important melliferous plants grouped in function of the seasons of exploitation and their frequency in honey of the study zone

Table 1: Most important melliferous plants whose pollen were identified in honey samples (Predominant (D), Secondary (S), Important minor (I) and Minor (M)) during the dry season (DS) and rainy Season (RS), value correspond to the number of honey samples)

Melliferous plants	PD		S		IM		M	
	DS	RS	DS	RS	DS	RS	DS	RS
Eucalyptus saligna Smith.	7	8	7	19	14	2	4	12
Tithonia diversifolia (Hemsl.) A. Gray.	3	4	4	8	4	2	10	14
Bidens pilosa Linn.	-	3	7	3	4	8	24	16
Cassia mimosoides Linn.	-	6	5	2	-	2	4	2
Terminalia mantaly H. Perrier.	4	8	-	14	6	11	12	20
Coffea arabica Linn.	2	-	3	-	6	2	15	9
Pterocarpus soyauxii Taub.	-	8	-	4	1	7	6	9
Syzygium aromaticum (L.) Merr. & L.M. Perry.	-	1	-	6	-	7	9	21
Weinmannia sp.	1	3	-	5	-	1	8	12
Elaeis guineesis Jacq.	1	2	-	3	-	8	27	35
Mimosa invisa Mart.	-	1	1	-	-	2	6	15
Buchholzia tholloniana Hua.	-	1	-	-	-	1	-	-
Ageratum conyzoïdes Linn	-	1	1	-	-	-	-	-
Ceasalpinia bonduc L. Roxb.	-	1	-	1	-	6	1	3
Phoenix reclinata Jacq.	-	1	-	1	-	3	14	30
Gnidia bambutana Gilg & Lederm. ex Engl.	1	-	-	-	-	-	-	-
Leucas oligocephala Hook.	-	1	-	-	-	-	-	-
Combretum nigricans var. *elliotica* (Engl. & Diel) Aubr.	-	1	1	2	-	4	1	9
Myrianthus arboreus P. Beauv.	-	1	2	4	-	2	6	15
Helichrysum cameroonense Hutch. & Dalz.	-	-	1	-	1	3	-	3
Lannea kerstingii Engl. & K. Krause	-	-	-	6	3	10	14	17
Carex sp.	-	-	2	-	-	-	-	1
Croton macrostachyus Hochst. ex. Del.	-	-	-	1	-	6	3	14
Cyperus distans L.f.	-	-	2	-	-	1	2	9
Fagara heitzii Aubrév. & Pellegr.	-	-	1	1	-	3	4	11
Vernonia amygdalina Delile	-	-	-	1	-	-	4	5
Crotalaria retusa Linn.	-	-	1	-	-	-	-	7
Podocarpus milanjianus Rendle.	-	-	1	-	-	-	2	13
Gnaphalium sp.	-	-	1	-	-	-	-	-
Capparis polymorpha A. Rich.	-	-	1	-	1	1	3	4
Coffea robusta Linden	-	-	-	-	-	2	-	3
Zea mays Linn.	-	-	-	-	-	-	3	9
Leucaena leucocephala (Lam.) de Wit.	-	-	-	-	-	3	-	8
Salix ledermannii Seemen	-	-	-	-	-	1	6	-
Celtis tessmannii Rendle	-	-	-	-	-	5	8	16
Euonymus sp.	-	-	-	-	-	1	1	4
Terminalia macroptera Guill. & Perr.	-	-	-	-		3	4	8
Julbernardia seretii (De Wild.) Troupin.	-	-	-	-	-	7	11	12
Ficus sycomorus Linn.	-	-	-	-	1	2	6	5
Citrus sinensis (L.) Osbeck.	-	-	-	-	-	-	-	1
Saccharum officinarum Linn.	-	-	-	-	2	-	4	5
Piper umbellatum Linn.	-	-	-	-	-	-	-	2
Commiphora Africana (A. Rich.) Engl	-	-	-	-	-	2	-	8
Casuarina equisetifolia Linn.	-	-	-	-	-	1	-	7
Persea americana Mill.	-	-	-	-	-	1	-	1
Parkinsonia aculeate Linn.	-	-	-	-	-	1	-	3
Dombeya ledermannii Engl.	-	-	-	-	-	1	-	2
Corchorus olitorius Linn.	-	-	-	-	-	1	-	2
Myrcia sp.	-	-	-	-	-	1	-	-
Hippocratea guineensis Hutch. & M.B. Moss.	-	-	-	-	-	1	-	3
Cichorium intybus Linn.	-	-	-	-	-	1	-	-
Albizia sp.	-	-	-	-	-	1	-	-

DISCUSSION

Spectrum of melliferous plants in the rainy season is generally large and diversified compared to the dry season. The diversity of melliferous plants in rainy season was also observed in the meridional part of Benin (Akoegninou et al., 2010) and in the South-western Nigeria (Abel and Banjo, 2012). However these results are contrary to those obtained by Bastos et al. (2003) in four sites in Brazil. In these sites the spectra of melliferous plants identified in honey of dry season were always more diversified compared to the rainy season. Asteraceae was the most represented family during the rainy and dry season. Similar results were found in the Cerrado areas of Minas Gerais state of Brazil (Bastos et al., 2003). In contrast the Leguminosae was the most exploited family of melliferous plants in rainy season in the Sudano-Guinean zone of Benin (Akoegninou et al., 2010; Yedomonhan et al., 2012).

In the rainy season, the most frequent predominant plants were *E. saligna*, *T. mantaly*, while the secondary plant was *E. saligna*. The important minor plants were *H. cameroonense* and minor was *B. pilosa*. In dry season, pollens of *E. saligna* and *T. mantaly* were predominant, *B. pilosa* and *C. mimosoïdes* were secondary, *E. saligna* was an important minor while *E. guineensis* and *C. Arabica* were found as Minor. In Cerrado areas of Minas Gerais state of Brazil, during the dry season, the species responsible for the botanical origin of the honey represented as accessory pollen are *Astronium* sp., *Serjanea* and *Eucalyptus* (Bastos et al., 2003). Pollen grains of *Eucalyptus* sp. were classified as dominant pollen. The isolated pollen which is the most important nectar source for the bees is represented by the genera Baccharis, Anadenanthera and Mimosa.

In that same area as confirmed by Bastos et al. (2003). During the rainy season, the pollen of *Mimosa* sp. was dominant and that of *Eucalyptus* which was not at the blooming peak period during this season, was classified as occasional isolated pollen. The accessory pollen was represented by *Eucalyptus* sp. The important isolated pollens in honey composition were represented by *Astronium* sp. *Baccharis* sp., *Schrankia* sp. and *Richardia.* The main isolated pollen in honey composition was represented by the genera: *Alternanthera*, *Mimosa*, *Antigonum* and *Tagetes*.

For the biological types, in the rainy season, trees were predominant; followed by shrubs and herbs respectively. In the dry season, only tree and shrubs were presents. These results corresponds to those of Lobreau-Callen and Damblon (1994) in Côte d'Ivoire, inside woody savannah at proximity of gallery forest and in Nigeria where the vegetation is varied, bees in this case foraged practically and abundantly flowers trees. This also confirmed the result of Paul et al. (2003) in north and south Soudanian phyto- geographical sector of Burkina Faso where trees were the most used followed in order by the grass, shrubs and the lianas. Amakpe et al. (2015) confirm that perennial plants are the main pollen and nectar sources for bees in the tropical areas where most of the annual flora are burned in dry seasons. Meanwhile in the floodable savannah region of Chad, subjected under anthropogenic action, especially close to the lake (Lobreau-Callen and Damblon, 1994). In the Mediterranean region and in the zone where herbal savannah occupies a vast surface, Lobreau-Callen and Damblon (1994) and Ricciardelli D'Albore (1998) noticed that herbaceous are completely exploited while woody strata are relatively neglected.

Lobreau-Callen and Damblon (1994) also noted like in our zone a predominance of the woody strata in savannah zone during the dry season meanwhile herbaceous are exploited during the rainy season. In the dry season, bees select flowering plants on the top of the canopy trees, few herbs are foraged (Bidens and many species of Cassia), in rainy season, they exploit preferably big trees and visits frequently some shrubs and herbs; however the number of trees and shrubs species foraged increase Lobreau-Callen and Damblon (1994).

In the semi-arid zones of Sudan savannah (Lobreau-Callen and Damblon, 1994), bees are less selective because they gather nectar and pollen of all strata. During the dry season, bees forage on trees and shrubs, herbs are not visited because flowers are not present. During the rainy season, bees are selective and exploit in priority flowers of trees and shrubs, few herbs are visited. The foraging behaviour as well as the biological type varied with the season.

However the absence or the presence of melliferous plants pollen does not mean that honey study don't come from the region where

the plants are found, but simply that the species were not present at the proximity of hives or that the flowering period took place a long time before the harvesting of the honey. In fact, honey collected in hive doesn't contain pollen or nectar foraged by bees after sixth month (Lobreau-Callen and Damblon, 1994).

Spontaneous plants represented in general the higher proportion of melliferous plants in the zone no matter the season compared to cultivated plants. These results are different from those of Abel and Banjo (2012) in south-western Nigeria where most of the melliferous plant species are cultivated plants. About the flowers colours of melliferous plants, our results shows that the white flower followed by yellow flowers are frequent. This confirms observations made by Tchuenguem et al. (2000) on plants visited by insects in the equatorial zone where the yellow colour is more exploited by insects in the Soudano-guinean Western Highlands of Cameroon (Dongock et al. 2004; 2011).

From our work, it was noted that honey colours vary with the season. The literature on honey colour in Central Africa is very poor. Few researches are from Mbofung et al. (2000) on Adamawa honey, where they present clear amber colour as predominant; and from Dongock et al. (2004) in the sudano-guinean of the West Cameroon which observed that honey colours are much diversified in the rainy season. Honey colour in general reflects the melliferous vegetation exploited by bees and the beekeeping practice. Floral diversity within the flight range of a honeybee colony is of utmost importance for the output from beekeeping. Börje (1991) noted that condition such as soil, climate, altitude, bee species and beekeeping practices are important; but comparing region where these factors are similar, bees will produce more honey under multifloral conditions and ecological balance.

CONCLUSION

Melliferous plants represent the source of food collected by the bees throughout the year. Due to colony preferences and blooming peaks of the botanical components, melliferous plants species bloomed at different times of the year and characterize different season's apicultural activities. Spectrums of melliferous plants in the rainy season are large and diversify compared to the dry season.

Asteraceae was the most represented family in the two seasons. The most frequent species as predominant in the rainy and dry season honey were *E. saligna* and *T. mantaly*. Honey analysed contained *E. saligna* and *T. mantaly* pollen in high proportion, they can be analysed as monoflora honey. This indicates that whatever the diversity of the vegetation, bees were very specific to some plants species for their needs. All the biological types are foraged by bees during the two seasons. Herbs were most exploited during the two seasons; small trees were always lowly represented during these seasons. Spontaneous plants represented in general the higher proportion of melliferous plants. White flowers were the most represented in dry season and yellow during the rainy season. Honeys of rainy season were more diversified compared to honey of dry season. The presence of the melliferous minor plants and less exploited melliferous plants were the great indicator of the geographical honey of the zone.

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